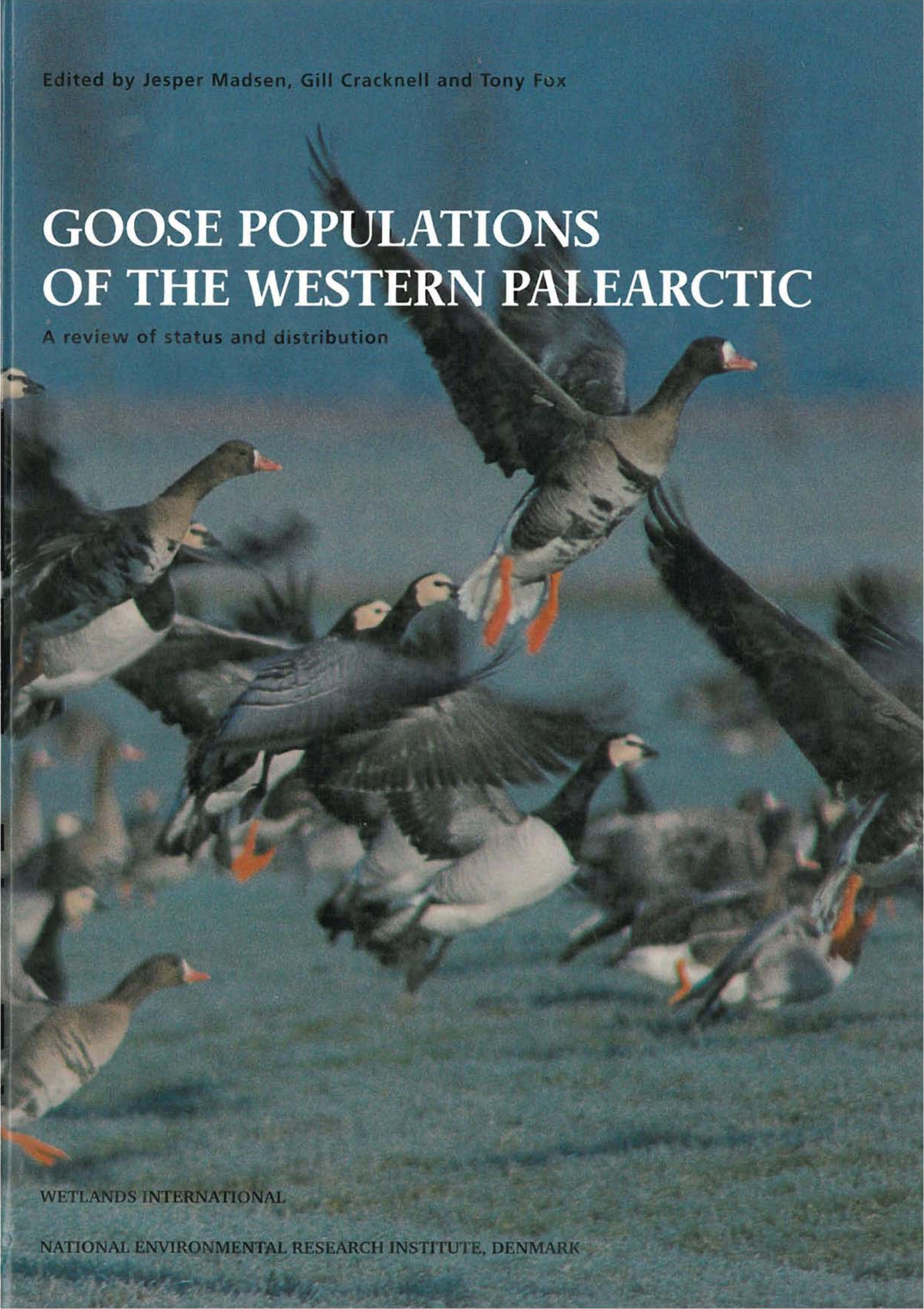

Edited by Jesper Madsen, Gill Cracknell and Tony Fox

GOOSE POPULATIONS OF THE WESTERN PALEARCTIC

A review of status and distribution

WETLANDS INTERNATIONAL

NATIONAL ENVIRONMENTAL RESEARCH INSTITUTE, DENMARK

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Edited by
Jesper Madsen, Gill Cracknell and Tony Fox

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Photo:
I. J. Øien

Foreword

In a world where most news about bird populations is bad, geese have long stood out as exceptions. Fifty years ago, most geese, in both Eurasia and North America, had become scarce. Now most species, though not quite all, are flourishing and some are probably more numerous than they have ever been, at least in historical times.

The principal credit for this happy state of affairs must go to the geese themselves, adept as they are at discovering new places and exploiting new opportunities. Many of the new opportunities that they have found helpful were provided, quite incidentally, by modern agriculture. Advances in farming technology - big machinery needing larger fields, higher-yielding grasses and grains, heavy use of artificial fertilisers - which have done so much harm to many breeding birds in the temperate regions, have provided geese with far more winter food, much of it of better quality than they could find when they were dependent on salt- and fresh-water marshes and pasturelands for food and on estuaries and natural lakes for safe roosts. Another incidental boost from modern techonology has been the construction of large reservoirs to provide cities with drinking water and power stations with cooling water. Many of these artificial lakes have been adopted as roosts, offering economical access to feeding areas that would previously have been too distant to be worth using.

Geese have also benefited from greater protection and preservation of coastal and inland wetlands by the creation of refuges or reserves, involving restrictions on hunting and other kinds of human disturbance. In many countries, changes in regulations that shortened the open season for goose hunting, or prohibited it altogether, may also have helped. These changes have been made possible by changes in human needs and attitudes. In most countries subsistence hunting is no longer necessary, while recreational wildfowl shooting is less popular than it was, now that most people live in towns and cities, not in the countryside.

Those of us who study geese, professionally and privately, cannot claim direct responsibility for most of the

Photo: Claus Eriksen

changes that have been good for geese. We can, and should, claim credit for collecting the kinds of information summarised in this report. We have been able to track the changes in numbers and distribution of geese in the Western Palearctic in far greater detail and with greater precision than was possible for our predecessors. This again is due to technological changes: motor vehicles and good roads have enabled us to be far more mobile than the ornithologists of previous generations. We also have much better optical equipment and cameras to detect and record what we find. Even more recently, we have been able to begin using radiotelemetry to tell us in detail how, where and when birds travel, and satellite imagery to learn about habitat conditions in even the most remote areas. These new ways of observing are enlarging our understanding of geese and the places where they live. We, like the geese, are no cleverer than our forebears, just more fortunate.

This report summarises much of the work of today's goose watchers in all parts of Europe. It will be very useful to us, and to regional administrators, reserve managers and others, over the next decade or so, until the ever-changing distribution of geese demands major revisions. Yet it may prove at least as valuable to our successors in 2099, for they will then have, as we do not, a reliable and detailed picture of the status and distribution of geese in the Western Palearctic a hundred years earlier. If our efforts can be sustained through several more generations, 21st century goose-watchers will have the benefit of a full record of changes in the intervening years. Then they should really know something about geese.

Our sincere thanks should go to the authors and editors of this report, and to the many other observers who contributed most of the records from which it has been compiled. Lucky us, and lucky them, having been able to enjoy the spectacular sights and evocative sounds that 'our' geese provide.

Hugh Boyd
Scientist Emeritus
Canadian Wildlife Service

Foreword by the editors

When we first announced the proposal to draft a review of the status and distribution of geese in the Western Palearctic, we little understood what we were taking on. The idea was received with considerable enthusiasm at the first ever meeting of the Wetlands International Goose Specialist Group held in the Odra Valley of Poland in November 1995 - an exciting and enjoyable meeting which marked the tenth anniversary of the Goose Specialist Group. Ten years did seem a good time span for review and contemplation! Our approach to waterfowl management and the "politics of geese" have changed considerably over this time. Geese, as so many observers have pointed out, are no respecters of human political boundaries, and this continues to necessitate international consultation and co-ordination of common approaches. Hence, there has been increasing emphasis placed upon the need for management and co-ordination on a flyway-wide level, yet, we have seen increasing goose damage conflict associated with several of the expanding populations. At the same time, we have experienced a huge upsurge in scientific interest in geese, manifest in the increasing number of projects and publications arising from the community.

As deadlines came and went, the pace of putting the review together has been frenetic, with scripts in all manner of states flying back and forth across the post services and electronic media of the world. The editorial team originally conceived of this publication as a series of texts, written by a team of experts on each species/population, in almost identical format, each author following a closely defined "recipe". In the event, as the material started to appear, it became obvious that different populations necessitated very different treatments and that different authors had employed very different approaches and styles. For this reason, it was decided to try and retain the major headings for each population, but to leave the style and narrative to the authors concerned. The result is, perhaps, a mix of styles adopted according to population, but we hope this diversity will add rather than detract from the accounts. It certainly made the process of editing a lot more entertaining than might have been the case!

The process has also been overly long, for which we must apologise. The sheer scale of the task of standardising maps, figures and tables as well as editing the text proved far more expensive in time and money than we ever expected. The variable response time of contributors regretably means that some of the early acconts are little out of date, compared to those received more recently. We are extremely grateful to our sponsors for enabling us to compile the work and to the authors and contributors for their patience and forebearance as deadlines for publication passed.

This volume represents an enormous amount of work carried out not only by 19 expert principal authors, 56 co-authors and additional 23 contributors, but many more counters and enthusiasts throughout the Western Palearctic. It is humbling to think of the contribution by so many to this process and we hope the review will represent a "thank you" to every single person involved. It is a highly relevant document, as well, since the Agreement on the Conservation of African Eurasian Waterbirds (under the Convention on the Conservation of Migratory Species of Wild Animals, the Bonn Convention) specifically makes a series of recommendations for conservation and management action. These include assessment of flyway harvests, management of agricultural conflict, definition of the status and distributions of populations, population sizes and trends, migration routes, productivity and mortality processes and general research programmes. Precisely these subjects are tackled here in the current review for all populations of geese occurring in the Western Palearctic. As well as summarising the present knowledge, the review also offers pointers for the future as to how this remarkable information-gathering network might be extended and improved. We merely hope that this document will serve as a useful reference work for some years to come.

Photo:
J. B. Kristensen

Acknowledgements

We must start by thanking the principal authors of the population accounts who have done a simply magnificent job in pulling these texts together. All were already very busy individuals, with little time for penning major reviews, even if the subject was one close to their hearts. That they have all completed more or less on time is a great credit to them all. It has quite simply been a huge pleasure to be associated with such a great team of experts with such enthusiasm for the task. We also very sincerely thank all the co-authors and the supporting contributors, who have contributed their knowledge and understanding at regional, national and local levels. These parts of the jigsaw have proved vital in providing overviews of whole populations, presented here for the first time, and their contributions have been essential to this process. A good deal of the material is not just gathered together for the first time, but much has never been published anywhere before, and we are again most honoured and pleased that the authors have felt able to make such a special contribution to this important overview.

Without Wetlands International, there would be no Goose Specialist Group. We extend our sincere thanks to Mike Moser and Janine van Vessem for their support of this project, and to Paul Rose and Val Taylor for their considerable support with the maintenance of the Goose Database over the years. The production of this book would not have been possible without financial and departmental support from the Danish National Environmental Research Institute at Kalø and we thank Karsten Laursen and latterly Henning Noer for their support of the process throughout. Stefan Pihl organised and maintained the Goose Specialist Group Database for many years from Kalø, and he collated data and sent these out to authors in support of the writing process, as well as bringing his special wisdom to the whole process.

We thank the photographers who allowed us to use their pictures for the illustration of the book: Anders Bylin, Hans Dekkers, Claus Eriksen, Ian Francis, Jan Bolding Kristensen, Oscar Merne, Myrfyn Owen, Jan Petersen, Erik Thomsen and Ingar Øien. A special thanks to Hans Dekkers for his magnificent goose pictures.

We thank the Dutch Jachtfonds and the UK Joint Nature Conservation Committee (and David Stroud in particular for his help and encouragement throughout), for generous grants which supported Gill Cracknell for the period when she was employed to collate and edit the scripts and Peter Mikkelsen for drawing and editing figures. The production of the final product would not have been possible without generous funding from the Scottish Natural Heritage, Aage V. Jensen Charity Foundations and the Institute of Nature Conservation in Belgium.

Introduction

Authors:
A.D. Fox,
J. Madsen

Photo:
H. Dekkers

There can be few people unmoved by the sight of several hundred wild geese lifting into the air in a clamour of cries and thrashing of wings. A wildfowler may be moved by the spectacle and the thrill of the hunt. A birdwatcher may be moved with awe, aware that these birds have bred in far distant arctic regions and travelled many thousands of kilometres to winter quarters. A farmer may be moved by anger, conscious that these geese are devouring part of his livelihood. But as we witness such a sight in the late 20th century, it is hard to remember that, some 50 years ago and after wartime ravages of the European continent, there were far fewer geese than today. Concern at that time was for the very survival of the goose populations which had seemed so abundant at the beginning of this century.

Amongst the first priorities of the pioneers of goose research, therefore, was simply to determine the origin, distribution and abundance of wintering geese. Amongst the first in the field was Hugh Boyd, the first research biologist with Peter Scott's fledgling Severn Wildfowl Trust (now The Wildfowl & Wetlands Trust), although there followed similar contributions from characters such as Hudec, Kuijken, Lebret, Markgren, Mörzer-Bruyns, Phillipona, Rooth, Rutschke, Sterbetz and Uspenski on the European continent. In Britain, Hugh Boyd used ringing recoveries to separate populations within species and networks of volunteer counters to determine population size. These early count networks were the starting point for the invaluable time series to which contemporary counts add, right up to the present time. Count information from some populations now exist for 45 years, and data gathering continues, providing unique perspectives on vertebrate populations over a considerable time span.

In winter, we now know that the Western Palearctic currently supports some 3.8 million geese from 23 different populations of nine different species. In contrast to post-war trends, all but a very few of these populations now show increasing trends. Most, if not all, have benefited from their ability to exploit their traditional plant foodstuffs (generally grasses, and nutritious storage organs such as seeds and rhizomes) which are now

provided in artificial super-abundance in the late 20th century farming environment. Despite the considerable loss of wetland habitat in recent years, given the rich table of food provided by the agricultural landscape of the continent, there is some justification in believing that there are more geese here now than ever before. Indeed, it is very likely that the conversion of natural habitats to agricultural land has been the dominant factor in this change of fortunes over the last 50 years.

The exploitation of farmland, coupled with the recent increases in goose population size, has therefore brought additional focus upon the status and trends in goose numbers. Huge flocks of geese descending on crops are of considerable concern to farmers, whether damage actually occurs or not. Since the 1970s in particular, the farming community, with its goal of maximising yields under increasing economic pressure, has shown increasing intolerance towards increasing numbers of geese. In spite of this, relatively small numbers of individual farmers suffer damage which, on a continental scale, is insignificant in cost terms compared to agricultural over-production and incentives. An increasingly urbanised general public in Europe, by contrast, place different economical and recreational values on wild geese, generating income for local communities and through government subsidies to agriculture, birdwatching and hunting for example.

Whether we like it or not, therefore, geese rank highly on the conservation and agricultural agendas of Europe, and because they are invariably long-distance migrants, they represent a shared natural resource which requires international co-operation in order to resolve conflict. Mechanisms to alleviate agricultural conflict and to manage goose populations and their habitats all require solutions at local, regional and international levels.

Fundamental to providing such mechanisms is a sound information base concerning the extent, number and status of discrete goose populations, and it is this information which Wetlands International set out to collate with the formation of the Goose Specialist Group in 1987. One of the major declared aims of the group was to centralise and improve the existing goose count network throughout the Western Palearctic and establish and maintain a formal database of these counts.

Why the review?

This Goose Specialist Group count network and database has now been functioning for more than 10 years, and it is timely that the information gathered is reviewed and presented in a single publication. The idea was first mooted at the Group meeting in the Lower Odra Valley in Poland, 1995, when it was decided that there was an overwhelming need for a collation (for the first time ever) of the numbers, trends, distribution, ecology, recent history and conservation status of all goose populations occurring in the Western Palearctic. It was clear that the level of knowledge and information would vary considerably from population to population and from region to region, but it was felt that a gathering of available information and a summary of data and material would in itself identify gaps and flag up future direction and priorities at all levels down to that of individual range states. It was also felt that no single author could possibly do justice to the available information, and besides, the Goose Specialist Group is a fertile community of talented and committed people who are well able to make expert contributions at all levels. With some trepidation, therefore, the editors asked the gathered participants in Poland if they would be willing to draft population or countrywide sections. The enthusiasm for the project was enormous, and the results of these not inconsiderable labours follow.

So who is this review written for? Our intention is that the audience will be a broad one, although first and foremost, it is written for the international goose research and nature conservation and management community as a source of reference. In a very real sense, the review stands as a very tangible testament to the enormous efforts of all the counters and other supporters who have contributed data or information to the database and the Group over the years. The contributions of volunteers across this huge landmass should never be underestimated in a process of this kind. To stand at a remote goose roost in appalling weather conditions only to find very few geese flying in represents a very special kind of commitment, and our collective thanks must go out to every single contributor who has made sacrifices in order to provide the data which are presented here. However, the review is very much intended to be a working document on a number of levels. We trust that it will be a common source document for goose population status and trends, although inevitably with rapid changes in population size of the current magnitude, we are well aware that the actual numbers may well be out of date before this review is even printed! What we hope will age rather more gracefully are the country profiles which review national perspectives, including the scale and form of topics such as agricultural conflict and hunting. These have then been synthesised into population perspectives which we hope will be useful to managers, who can set their experiences in a wider perspective and see other situations and potential models, and hopefully offer some solutions to local and national problems. However, in collating these accounts, we hope that others will use this gathered material to take forward further analyses. We felt that this publication should be a review of numbers, trends and distribution of specific goose populations, so the readers will look in vain for grander syntheses of the effects of hunting or agricultural changes on populations. Such analyses must await much further work. Finally, throughout the review, we have tried to draw together the shared experience to determine common standards and we offer some modest research and management recommendations for the future for all populations.

Inevitably, we shall disappoint many readers because this does not offer a new synthesis, nor a magical global solution to all the goose problems and conflicts which are manifest at the present. The reason is simple - there is no such solution. Our understanding of factors affecting goose population dynamics remains lamentably poor, and in particular, our ability to predict population development into the future rests upon a historical record of spectacular failure. Nevertheless, simply to have identified discrete populations and collated data relating to each represents a template for further development. We hope that in gathering together this impressive work of so many contributors we lay the path for more ambitious future work.

Recently, Wetlands International has produced a flyway atlas of Anatidae populations in Africa and Western Eurasia, primarily based on data from the International Waterfowl Census (Scott & Rose 1996). We refer to this publication for the identification of key sites for each of the goose populations dealt with.

MONITORING OF GEESE IN THE WESTERN PALEARCTIC

Organisation of monitoring

Systematically organised surveys of goose populations were first organised in Great Britain in the late 1940s, when the Wildfowl Trust started to count nationally the populations of wintering geese. In 1947, the International Wildfowl Research Institute (latterly IWRB, and now, Wetlands International) was created and started mid winter (January) censuses of waterfowl in the late 1950s. Progressively through the 1960s and 1970s, national and international coordination of counts improved due to the creation of national and international networks and coordination centres. However, even at the time of writing this report, there is not sufficient coverage to allow an annual assessment of the size and trend of all populations.

Until 1987, there was an international coordinator for each goose species, organising and collating the internationally agreed count information. Because of an increasing need for standardisation and central storage of data, the species coordination approach was then disbanded, and since then, there has been one central coordination unit organising and storing the count information in a computerised database (during 1989-

Table 1. Monitoring and banding of goose populations wintering in the Western Palearctic, including month of population counts, assessment of precision of population estimates, frequency of censuses and whether field observations of productivity and studies using banding are carried out. The precision of each population estimate is crudely divided into good (annual precision of population estimate thought better than 10% of real total), fair (precision 10-30% around the true total) and poor (more than 30% around the true total). Brackets around count intervals indicate that counts are performed regularly in some countries, but irregularly in others, hence good overall annual population totals are not available. Years given in brackets in Productivity estimate and Ongoing banding columns show the decades when the activity was started.

Population	Breeding range	Winter range	Month of count	Precision of estimate	Count interval	Productivity estimates	Ongoing banding studies
Bean Goose							
Anser fabalis fabalis	Scand./Russia	Baltic region	11	fair (in Sweden/ Denmark good)	(1y)	yes (1990s)	yes (1970s)
Anser fabalis rossicus	Russia	C/W Europa	11	poor (in Germany/ Netherlands good)	(1y)	yes	no (closed)
Pink-footed Goose							
Anser brachyrhynchus	Iceland/	Great Britain Greenland	10/11	good	1y	yes(1960s)	yes(1980s)
Anser brachyrhynchus	Svalbard	NW Europe	11/1	good	1y	yes (1970s)	yes (1980s)
White-fronted Goose							
Anser a. albifrons	Russia	Europe	1	fair (improving)	1y	yes (1960s)	yes (1990s)
Anser a. flavirostris	W Greenland	British Isles	3/4	good	1y	yes (1960s)	yes (1970s)
Lesser White-fronted Goose *Anser erythropus*	Scand./Russia	C/SE Europe	1 (11)	poor (in Hungary good)	(1y)	no (in Scandinavia)	satellite tagging
Greylag Goose							
Anser a. anser	Iceland	Scotland	10/11	good	1y	yes (1960s)	yes (1990s)
Anser a. anser	Scotland	Scotland	9/4	good	1y	yes (1980s)	yes (1980s)
Anser a. anser	Great Britain feral	Great Britain	9	fair (annual index)	1y	no	yes (local)
Anser a. anser	NW Europe	NW/SW Europe	9/1	fair	1y	no	yes (1970s)
Anser a. anser	C Europe	N Africa	1	fair	1y	no	yes (1970s)
Anser a. rubirostris	Black Sea	Black Sea	1	poor (improving)	(1y)	no	no
Anser a. rubirostris	Caspian Sea	Caspian Sea (?)	1	poor	(1y)	no	no
Canada Goose							
Branta canadensis	Great Britain	Great Britain	1	fair (annual index)	1y	no	yes (1980s)
Branta canadensis	Scandinavia	NW Europe	1	fair	1y	no	yes (1980s)
Barnacle Goose							
Branta leucopsis	E Greenland	British Isles	3	good	3-5y	yes (1970s)	yes (1960s)
Branta leucopsis	Svalbard	Scotland	11	good	1y	yes (1970s)	yes (1970s)
Branta leucopsis	Russia/Baltic	NW Europe	1/3	good	1y	yes (1970s)	yes (1970s)
Brent Goose							
Branta b. bernicla	Russia	W Europe	1/5	good	1y	yes (1960s)	yes (1970s)
Branta b. hrota	NE Canada	Ireland	10	good	1y	yes (1980s)	yes (1980s)
Branta b. hrota	Svalbard	NW Europe	11/1/5	good	1y	yes (1980s)	yes (1980s)
Red-breasted Goose							
Branta ruficollis	Russia	Black Sea	1	fair (improving)	1y	yes (1990s)	yes (1990s)

1996 at the National Environmental Research Institute, Kalø, Denmark and from 1997 onwards at IBN/DLO in Wageningen, the Netherlands).

In the mid 1990s, mid winter counts are performed in almost all Western Palearctic countries where wintering geese occur (24-28 countries participating annually). Encouragingly, networks are now effective in most countries, even the new states in the former Soviet Union as well as in former Yugoslavia. There remain gaps in coverage, especially the southeastern part of the region which is unfortunate because this is the wintering area of the globally threatened Lesser White-fronted Goose. In most countries, counts are made from the ground but in certain remote or large areas, these are supplemented by counts from light aircraft (e.g. offshore areas in Denmark, Marismas del Guadalquivir in Spain, west coast of Scotland and Ireland) or helicopters (the Ukrainian Black Sea coast). Counts are usually made within few days to avoid mass movements of geese and hence duplicate counts. In some regions, geese roost on one side of a border between two countries and fly to feed on the other side (e.g. the Dollart in Germany/The Netherlands), and the same geese may be counted on both sides of the border. The national count coordinators together with the international coordination unit have to make sure that only one of the counts is used in the calculation of the overall population estimate.

Table 2. Conservation status of the goose populations wintering in the Western Palearctic, shown by recent population estimates (1994-1997 where available), trends (in the 1990s) and listings according to the African/Eurasian Waterbird Agreement (AEWA) under the Bonn Convention (at population level), the Bern Convention (at species level) and the EU Wild Birds Directive (at species/sub-species level).

Population	Breeding range	Winter range	Population estimate	Trend	Bonn Convention (AEWA)	Bern Convention	EU Birds Directive
Bean Goose						III	II/1
Anser f. fabalis	Scand./Russia	Baltic region	100,000	sta	B1		
Anser f. rossicus	Russia	C/W Europe	600,000	?	C1		
Pink-footed Goose						III	II/2
Anser brachyrhynchus	Iceland/Greenland	Great Britain	250,000	inc	B2a		
Anser brachyrhynchus	Svalbard	NW Europe	37,000	inc	B1		
White-fronted Goose[1]						III	
Anser a. albifrons	Russia	NW Europe			C1		II/2
Anser a. albifrons	Russia	C Europe			B2c		II/2
Anser a. albifrons	Russia	Black Sea	1,400,000	sta?	C1		II/2
Anser a. albifrons	Russia	Caspian Sea			A2		II/2
Anser a. flavirostris	W Greenland	British Isles	33,000	inc	A3a		
Lesser White-fronted Goose *Anser erythropus*	Scand./Russia	C/SE Europe	15,000	dec	A1b	II	I
Greylag Goose						III	II/1
Anser a. anser	Iceland	Scotland	80,000	dec	B1		
Anser a. anser	Scotland	Scotland	9,000	inc	-		
Anser a. anser	Great Britain feral	Great Britain	22,000	inc	-		
Anser a. anser	NW Europe	NW/SW Europe	200,000	inc	C1		
Anser a. anser	C Europe	N Africa	25,000	inc	A2		
Anser a. rubirostris	Black Sea	Black Sea	85,000	?	B1		
Anser a. rubirostris	Caspian Sea	Caspian Sea (?)	100,000+	?	B1		
Canada Goose						-	II/1
Branta canadensis	Great Britain	Great Britain	64,000	inc	-		
Branta canadensis	Scandinavia	NW Europe	60,000	inc	-		
Barnacle Goose						II	I
Branta leucopsis	E Greenland	British Isles	40,000	inc	B1		
Branta leucopsis	Svalbard	Scotland	23,000	inc	A2		
Branta leucopsis	Russia/Baltic	NW Europe	267,000	inc	C1		
Brent Goose						III	II/1
Branta b. bernicla	Russia	W Europe	300,000	inc/sta	B2b		
Branta b. hrota	NE Canada	Ireland	20,000	sta	A2		
Branta b. hrota	Svalbard	NW Europe	5,000	sta	A1c	III	II/2
Red-breasted Goose *Branta ruficollis*	Russia	Black Sea	70,000	sta/inc	A1b	II	I

Note: [1]the populations of *A. a. albifrons* have, in accordance with previous accounts, been divided into geographical wintering populations, but see Mooij et al. (this volume) who dispute that these are closed populations.

AEWA categories:

A1: (a) species included in Appendix I to the Convention (species in need of strict protection), (b) species listed as threatened in the 1994 IUCN Red List of Threatened Animals, (c) populations numbering less than 10,000 individuals. A2: populations numbering 10,000 - 25,000 individuals. A3: populations numbering 25,000 - 100,000 individuals and considered at risk as a result of (a) concentration onto a small number of sites at any stage of their annual cycle, (b) dependence on a habitat type which is under severe threat, (c) showing significant long-term decline, or (d) showing extreme fluctuations in population size or trend.

B1: populations numbering 25,000 - 100,000 individuals and which do not fulfil the conditions in respect of A (above). B2: populations numbering more than 100,000 individuals and considered to be in need of special attention as a result of: (a), (b), (c) or (d) above.

C1: populations numbering more than 100,000 individuals which could significantly benefit from international cooperation and which do not fulfil the conditions in respect of either A or B (above).

Bern Convention categories:

Annex II: Each Contracting Party shall take appropriate and necessary legislative and administrative measures to ensure the special protection of the wild fauna species.

Annex III: Each Contracting Party shall take appropriate and necessary legislative and administrative measures to ensure the protection of the wild fauna species.

EU Wild Birds Directive categories:

Annex I: Vulnerable, rare or endangered species which are to be the subject of of special conservation measures concerning their habitat.

Annex II: Species which may be hunted under national legislation (part 1: species may be hunted anywhere in EC territory; part 2: species may be hunted only in certain Member States).

In many countries, monthly goose counts are arranged (Madsen 1991). For several well monitored populations it has become clear that January is not the ideal time to count the populations, either because the geese are dispersed over many sites at that time or because they occur in inaccessible areas making a full count difficult. In Great Britain, most populations are, in fact, counted in autumn (Pink-footed Geese, Greylag Geese, Svalbard Barnacle Geese) or spring (Greenland White-fronted Geese, Greenland Barnacle Geese), depending upon the period of the year when the best coverage can be obtained. In continental Europe, additional special population counts are made for Pink-footed Geese (November), Greylag Geese (September), Barnacle Geese (March), Dark-bellied Brent Geese (May) and Light-bellied Brent Geese (November, May) (Table 1). For the more widely dispersed populations, special population counts are difficult to arrange, and in most eastern European countries, additional counts are financially not possible.

For 12 out of 23 populations, reliable annual population estimates can be derived. For the rest, the coverage is insufficient and/or estimates can only be achieved at more irregular intervals through special efforts, e.g. Greenland Barnacle Geese being counted at 3-5 year intervals by aerial survey along the western coasts of Ireland and Scotland, or through periodic surveys with good coverage in all countries. For four populations, Tundra Bean Geese, Lesser White-fronted Geese, Black Sea Greylag Geese and Caspian Sea Greylag Geese, the coverage is currently too poor to allow a reliable estimate of population sizes.

In the central database, count information is stored at three levels: (1) on a site basis (most countries deliver information in thit format; although not before 1992), (2) on a national level (total numbers per country) and, (3) on a population level, interpreted by national coordinators together with the international coordination unit where necessary (e.g. corrected for duplicate counts).

Assessment of productivity

A crude assessment of annual productivity can be derived from counting the numbers of juveniles and older birds in the autumn and winter flocks of geese. Despite several possible pitfalls and sources of bias associated with the sampling, this information has proved useful because it gives an impression of the year-to-year variability in breeding conditions of the geese and because it can be used to calculate a crude apparent annual survival rate when combined with good estimates of population size. Long time series of productivity and population size estimates exist for several populations wintering in west Europe, whereas this does generally not exist for populations wintering in the eastern part of the range (Table 1). The productivity estimates are, however, in many cases based on sampling in single countries, and are therefore potentially subject to bias.

Banding

Ringing with metal rings and subsequent recoveries have enabled the mapping of migration and delineation of many of the goose populations wintering in the Western Palearctic. Since the 1960s, an increasing number of studies have been initiated using either plastic (darvic) legrings or neckbands with colours and individual codes engraved, readable at a distance through telescopes (Table 1). These studies have greatly improved the understanding of dispersal patterns outside the breeding season, population dynamics, ethology and behavioural ecology of geese. However, to date, few studies have lasted more than 10-15 years and few have maintained a high level of activity of marking and resighting. Hence, except for a handful of populations, e.g. Svalbard Barnacle Geese, Greenland White-fronted Geese and Dark-bellied Brent Geese, long-term changes in population parameters or dispersal in response to environmental changes cannot yet be addressed. In the eastern part of the range, few studies have been initiated in any form.

Recently, the attachment of satellite transmitters to geese has enabled the mapping of hitherto unknown migration routes of Lesser White-fronted Geese breeding in Fennoscandia and Light-bellied Brent Geese breeding in Svalbard and Northeast Greenland. The further application of this new technology gives a great potential for mapping migration routes and dispersal of geese in regions thinly covered by observers.

SUMMARY OF THE STATUS, TRENDS AND CONSERVATION OF POPULATIONS

Numbers and trends

Geese breeding in an area extending from northeastern Canada in the west to North Siberia in the east spend the winter in the temperate and Mediterranean zone of the Western Palearctic. Nine species of geese occur regularly, one of which, the Canada Goose, has been introduced from North America. For conservation and management purposes 26 populations are recognised; this includes two populations of Canada Geese, one feral population of Greylag Geese in the British Isles and four populations of White-fronted Geese (Table 2). However, as argued by Moiij et al. (this volume), the White-fronted Goose populations have to be treated as one population, reducing the total number of populations dealt with to 23.

In the 1980s, the total number of wintering geese was estimated at 1.9 million (excluding introduced and feral populations as well as the Caspian Greylag Geese). By the middle of the 1990s, this figure for the same populations could be updated to 3.6 million (Table 2). The increase is partly attributed to a better coverage in the eastern part of the region, but for several populations there has been a genuine growth since the 1980s, e.g. in two populations of Pink-footed Geese, Greenland White-fronted Geese, three populations of Greylag

Geese, three populations of Barnacle Geese, Dark-bellied Brent Geese and Svalbard Light-bellied Brent Geese. In two populations the trend is decreasing: Lesser White-fronted Geese and Iceland Greylag Geese. Two populations number less than 10,000 individuals, viz. the sedentary Greylag Geese in northern Scotland and the Svalbard Light-bellied Brent Geese. The largest population is that of the European White-fronted Goose, which in January 1993 totalled approximately 1.3-1.4 million birds.

Conservation concerns

Of major concern in recent years has been the conservation status of the small and declining populations. The conservation status of the Greenland White-fronted Goose has been focussed upon in recent years because of its relatively small population size (around 20,000 in the early 1980s) and declining use of the traditional habitat, the blanket bog and rough pastures. Following protection in Ireland in 1981, the population has increased, to reach a level above 30,000 in the 1990s. An international conservation plan covering its entire range has been drafted but still awaits signature by the range states.

The population of White-fronted Geese wintering in central Europe has declined from more than 300,000 individuals in the 1950s to less than 100,000 today. However, it is questionable whether this group of birds constitutes a closed population, i.e. there is probably interchange of individuals with the other European populations. It seems likely that the decrease has been caused by a shift in winter range rather than a true population decrease (see Mooij et al. this volume). Birds may have moved either to northwest Europe, where the population has dramatically increased, or to the Black Sea area.

The status of the Lesser White-fronted Goose is alarming. Since the 1940s, the population has crashed in northern Scandinavia, and the same seems to apply to the entire range. Very poor and not updated information exists about the numbers in the central flyway from Siberia to the Caspian Sea, where most of the population is thought to occur. An international action plan has been prepared for the species (see Lorentsen et al. this volume).

The Svalbard population of Light-bellied Brent Geese has fluctuated between 3000 and 6000 since 1980. Recent research has documented that the population breeds in a very restricted range in Svalbard and is in most years subject to a very severe predation pressure from Polar Bears *Ursus maritimus* and Arctic Foxes *Alopex lagopus*, limiting the breeding output and controlling the population size (Clausen et al. this volume).

The status of the population of Red-breasted Goose has improved considerably. Thus, the population estimate has doubled from 35,000 in the 1980s to 65,000-70,000 in the 1990s. This increase is thought to be caused primarily by the improved coverage and synchronisation of counts between Romania, Bulgaria and more recently the Ukraine. The population is still regarded as vulnerable, however, because it is concentrated in very few sites some of which have an unclear protection status. At the same time, following the change in political systems, agricultural practices in the Black Sea region are likely to change, which will possibly affect the feeding opportunities of the wintering geese. An international action plan for the species has been drafted (see Hunter et al. this volume).

Management problems

The geese are increasingly causing conflict with agriculture in Europe, firstly because populations continue to grow, secondly because the geese tend to converge onto farmland, and thirdly because farmers increasingly use crops and farming practices which are more vulnerable to goose grazing. The most severe damage problems have arisen in northwestern Europe, being most profound in the Netherlands and Britain where the highest concentrations of geese are found (van Roomen & Madsen 1992). However, the conflict is likely to exacerbate in the eastern part of the region following the increasing privatisation of land.

So far, management solutions have been sought at a local or regional level. However, it becomes increasingly evident that satisfactory solutions will only be found if problems are defined on a flyway basis, taking into consideration the overall management and conservation of the species involved.

The shooting impact on goose populations has for long been an issue of controversy. There is little doubt that in the past the size of many goose populations were controlled by shooting. With the general relaxation of shooting pressure by regulation of season lengths (ranging from shortening the season to full protection) and refuge creation, most populations have escaped the point of control and the direct impact of hunting is no longer severe. A crucial exception is, however, apparently the Lesser White-fronted Goose where shooting pressure may still be a critical factor (see Lorentsen et al. this volume). Other issues relating to hunting, however, are the possible indirect effects caused by hunting disturbance and crippling. Do these impact on populations? In Pink-footed Geese, recent results suggest that crippling (in the sense of birds being hit by shotgun pellets and surviving in the short term) can be an extra mortality factor which is normally not taken into account (see Madsen et al. this volume).

Future monitoring and research needs

It is, of course, the natural response of a research community to define a set of future objectives which ensure the gainful employment of biologists in that community for the foreseeable future. However, it is clear from this compilation of data that there is a long list of supplementary research requirements which need to be addressed in parallel with improvements and up-grading of the goose monitoring programmes in the Western Palearctic. While it is relatively easy to define the ideal objectives for research programmes, it is another matter to achieve such ambitions. For this reason, in considering future monitoring and research needs, it is important to consider the factors which constrain our ability to obtain the best possible information upon which to base conservation management actions.

In the first instance, our primary objective must be to know what is happening with regards to the abundance of a given population, i.e. how many individuals are there and what is the rate of change in numbers over time? In small populations, geographically limited at least during one period of the life cycle, it may be relatively simple to achieve simultaneous accurate counts, but in larger populations, which are also more mobile throughout the life cycle, this requires greater co-ordination effort and an understanding of the sources of error involved. To establish the best time series database, count organisation and methods should be well planned and constant over time. However, since most goose populations are showing increases in numbers (which inevitably also involves some extension of range), it becomes ever more difficult to standardise effort and minimise count errors.

Having established a reliable method of tracking change in numbers, the secondary objective is to understand the reasons behind these patterns and to assess (as a result) the management tools available that could effect future change in numbers (as agreed, for example, under an international management plan). This requires an understanding of basic population parameters, in particular the patterns of reproduction and mortality operating over time, but on a more regional or local basis, patterns of immigration and emigration. These factors require additional effort. The assessment of recruitment of young can be achieved for most populations by simple field age-ratio determinations in the field, but to track long-term changes in mortality and emigration/immigration ultimately necessitates substantial investment in more sophisticated studies, such as the use of capture/recapture techniques, for example using individual marking programmes.

We should therefore view the future development of monitoring and research needs as a quality hierarchy, with ideal long-term goals, but with more attainable short-term objectives against which we can more easily measure attainment in the next 10 years.

Monitoring of populations

Our role in gathering data on goose populations is clear. We need to be able to deliver data on population size and trends quickly and efficiently to the managers and politicians who require these data. How effective are we in meeting these objectives? As can be seen from the results presented in the review, the answer is very much: "it depends upon the population to which one is referring". In situations where whole populations are confined to single states (as in the case of the Pink-footed Geese of Iceland/Greenland which winter almost exclusively in the United Kingdom) the situation may be extremely good. Coordinated counts are collated from all major known haunts quickly and effectively and the results rapidly reported each year. Nevertheless, even though the expansion in this population has occurred mainly through consolidation of numbers at existing traditionally used sites, inevitably new haunts are being occupied and their discovery remains a matter of some chance. Hence, in a population such as this where number of birds continues to grow, the error from "missed" geese not counted during the census increases, as does the accumulating error from stochastic and systematic sources. It is vital therefore that the current count effort is maintained and improved over the next 10 years, but we must ensure that the system is flexible enough to respond to the expansion in range as well as numbers.

Throughout much of western Europe, count co-ordination between many nations is also highly effective. Most results from western Europe are reported to the Goose Database quickly and efficiently, usually within 6-12 months of the counts taking place, but there is a need to continue to reduce this time period to ensure maximum effectiveness of the database in supplying swift accurate totals for given populations. We also need to be able to supply the results of collation back to the counters and other users more quickly and effectively if the data are to be of maximal use to the various user groups which rely upon these data. Reporting back to the network of counters is an essential (but too often forgotten) part of the process. Without adequate information, it is easy for network fatigue to set in, since contributors will always respond best when they can see that "their" goose counts contribute to some discernible end-product. It is vital, therefore, for the future to establish local, national and international mechanisms of reporting to maintain the enthusiasm of the counters upon which the entire process is reliant.

The quality of coverage also varies considerably with geographical area. While it may be easy to be complacent in western Europe, it is important to remember that it is only in the last few years that the Netherlands have integrated their count network sufficiently well to avoid duplication of counts. There are, inevitably, still gaps in coverage in eastern Europe, and the accounts dealing with the European White-fronted and Tundra/Taiga Bean Goose highlight the need for specific improvement in this area. However, the situation in so many eastern European states has improved immeasurably in the last five years, and it is extremely exciting to see that we now know so much more than we did about goose numbers and distribution than we did in the late 1980s. The challenge is to continue the process of improvement and extend the coverage into the next century. With privatisation of land continuing apace in the former communist states, the pattern of landscape use is about to enter a period of rapid change and with it patterns of goose distribution and abundance. Again, we must be ready to meet the challenge with an ever improving network of counters, data and analysis.

Finally, our knowledge of almost all aspects of geese in the extreme south east of the Western Palearctic is rudimentary to say the least. We have seen the supply of data from Romania, Bulgaria, the Ukraine and some Russian sections of the Black Sea flood into the database in very recent years, as new and exciting coverage of these very important goose areas have become established and it has become possible to input this information into the database. Nevertheless, precious little is known about the eastern Black Sea and Caspian regions, and although weather conditions greatly hamper coverage in many winters (as is the case in inland Turkey for example), there is a great need to extend the current coverage to embrace these areas. It is important that this coverage should also include some research in parallel with census work, as population definition and ecological studies in the Black Sea/Caspian Sea region are virtually non-existent at the present time. With increasing openness and the availability of new sources of funding, the possibility of expeditions to these areas is becoming a more realistic prospect. It is an important objective in the next 10 years to initiate inventory work in these areas to establish reliable baseline assessments of goose numbers and distribution there, but also to establish collaborative linkages with institutes and individuals to ensure an adequate exchange of expertise.

Identification of critical periods and sites in the life cycle

As is clear from the results presented here, the attempts to census geese have tended to concentrate upon population size estimation. This remains an important objective, given the reliance placed upon such estimates for establishing criteria for site safeguard programmes. This has, however, meant that concerted international effort has been concentrated on one or a few total population counts at a specified period of the year - to the detriment of our knowledge of the distribution and abundance at other stages in the life history of the goose populations concerned. We begin to understand, for example, that the pre-nesting condition of female geese may greatly influence reproductive success. Hence, spring staging areas may have important consequences for reproductive output in segments of the population. Similarly, heavy hunting pressure at autumn staging sites which attract large numbers may disproportionately affect elements of the population. It is therefore important to pin-point critical periods and areas in the life cycle of the geese where special measures may be necessary. This should be achieved in concert with attempts to extend count coverage throughout the Western Palearctic to periods outside those months when counts currently take place. It would not only greatly improve our current understanding of the distribution of geese and the phenology of goose migration, but also provide an inventory of important staging areas to underpin site safeguard programmes.

The use of satellite telemetry has added a new dimension to our understanding of migration routes and stopover times at staging areas en route to and from breeding areas. This represents an exciting new tool for locating important staging sites in remote areas where other methods may not be possible. The technique has proved highly successful in the case of the Lesser White-fronted Goose, where the extreme conservation plight of the population necessitated drastic solutions to defining flyways, identifying sites and locating the causes behind the severe declines in numbers (see Lorentsen et al. this volume). Such techniques have an important role in studies of the commoner species also, and it is a pity that technical failure of such devices used on White-fronted Geese caught in arctic moulting grounds has so far failed to resolve some of the controversy surrounding migration routes of the Russian White-fronted Geese and identify hitherto unknown staging areas for site protection (see Mooij et al. this volume).

The census should also, where possible, be extended to the breeding areas, as there is currently very little extensive survey data published regarding precise breeding ranges of goose populations in the Russian arctic. Some data are available, but have yet to be properly recognised in the West and collated for wider circulation. The World Conservation Monitoring Centre is currently mapping (using GIS techniques relating vertebrate distributions to vegetation types) all significant natural resources in the arctic parts of the Palearctic, including goose breeding ranges. This would appear to be an important first step along the road to precise range definition, but this will clearly represent a long-term project for the future.

Population dynamics

It is becoming increasingly clear that simply to census populations and attempt to interpret change is no longer a sound enough footing for the provision of informed management advice. In the case of goose count data, mortality, reproduction and emigration/immigration are all processes affecting population abundance but which are not measurable in terms of head-counts alone. For this reason, it is vital that for critical species, additional data are collected, and research projects established in parallel with the count network.

Reproductive output

In most goose populations, birds in their first winter are usually distinguishable from older birds, enabling some assessment of the percentage young in the population during the autumn and subsequent winter. For these assessments to be meaningful and comparable, it is clear that some regular plan for sampling of young is agreed, established and adhered to. Such sampling design must take account of biases in age ratios encountered in space and time, e.g. in different sectors of a flock (families tend to be on the leading edge), different habitats (families tending to dominate best feeding opportunities) and different regions at different time of the year. Much of the current age sampling structures have become established independently with little co-ordination or sharing of information, and there is a need for the establishment of common standards amongst existing mechanisms to be incorporated into the standard count network and fed into the database with some element of data quality control. In many populations and areas, there are simply no assessments made of age ratios, despite the fact that expert counters are in the field counting geese who could make such assessments. Relatively little extra investment has the potential to greatly extend the power of the current network in gathering data.

Mortality

There are relatively few goose populations in the Western Palearctic for which good mortality rate estimations exist. Sensitivity analysis clearly shows that relatively small fluctuations in adult survival of relatively long-lived goose species have a more profound effect on overall population size than relatively large scale changes in breeding output. The task of measuring adult survival is not helped by the fact that confidence intervals on estimates generated from ringing returns and poorly designed capture/recapture studies often exceed the predicted changes in survival (e.g. before and after protective legislation), rendering statistical comparisons impossible. There needs, therefore, to be a better dialogue between the theoreticists and empiricists to design appropriate techniques for the measurement of survival rates.

Since a very high proportion of mortality is caused by shooting in all hunted populations (and protected ones also), it is becoming ever more vital that assessment of the size of the hunting bag is made for all species. This is particularly important if we are to be able to model the effects of changes in legislation which affect the numbers of geese shot (either as a result of liberalisation or restriction of existing hunting practices). As Johan Mooij and co-authors state in their White-fronted Goose account, wise use of a goose population necessitates international co-ordination of exploitation to ensure fair and equable exploitation throughout the flyway in accordance with agreed aims and objectives for that population. In the next 10 years, it remains a major priority to assess the size and distribution of the hunting bag for each population throughout its range. Under the African-Eurasian Waterbird Agreement under the Bonn Convention, all signatory states are obliged to provide estimates of the hunting bag for all species, and this places the responsibility on governments to provide such data for geese. At present, only Iceland publically provides a very detailed assessment of the numbers of individual geese shot of each species, with a sample of the bag aged to enable some assessment of production and the proportion of young taken in the bag. Such data should be made available for all areas and states, and for all goose populations.

It is of high priority to study what is causing the increased mortality in Pink-footed Geese carrying shotgun pellets (see Madsen et al. this volume). What are the reasons, and is this a problem specific to the Pinkfeet or is it a general problem amongst quarry waterfowl? In the latter case, the problem is of much wider implication, not only as an animal welfare problem but also as a hitherto unaddressed bi-product of shooting affecting population dynamics.

Emigration/immigration

One only needs to read of the differences in opinion over the degree of panmixia in Western Palearctic Whitefront populations (see Mooij et al this volume) to see how important it is to be able define flyways and sub-populations on a broad scale. However, it is equally important to differentiate between observed changes in distributions derived from the counts which are the result of shifts in wintering distribution from those caused by differential population processes in different segments of the population. This is where individual marking programmes have a clear role to play in parallel with the count networks.

Population limitation and regulation

Most goose populations have increased in the Western Palearctic in the last 45 years, and there is general consensus that the increases have not been brought about by improved reproduction rates. Indeed, for some populations, recruitment has decreased with increasing abundance. Consequently, analysts have accredited the increases to declining mortality rates; since most mortality occurs on the wintering grounds, the factors responsible for releasing populations from density-dependent regulation are considered to be manifest on the wintering grounds. Intensification of agriculture has presented increasingly profitable food resources which may have improved annual survival. However, many stable populations have shown a rapid increase in numbers after a particular point in time. For this reason, improved protection (especially provision of refuges and protection from shooting to some degree) is thought particularly significant in causing sudden population expansion, especially as hunting mortality has been considered (on little published evidence) to be additive to natural mortality rather than compensatory (in the sense of killing weaker individuals that would have died anyway).

By contrast, conditions on the breeding grounds have been considered to be fairly constant, with no major changes in relevant protective legislation that would greatly affect population processes. Creation of bird sanctuaries on Svalbard have been implicated in the increase of the Barnacle Goose there, and there are some suggestions that the removal of the work camps in the Russian arctic in recent years have reduced the human exploitation of local goose populations there, but we lack clear linkages between these mechanisms.

In the Canadian arctic, there are signs that over-exploitation of sensitive vegetation types caused by expansion in the numbers of breeding geese at some colonies has caused effects in terms of reduced reproductive output and quality of offspring. However, this phenomenon has not been studied in the Western Palearctic (although the reader will note that it has been touched upon in several accounts) and could be a source of future population regulation on breeding areas. Similarly, another effect of the increases in distribution and abundance of goose species is the increasing inter-specific competition which is manifest at staging areas and perhaps on the breeding and moulting grounds as well.

Predicting population developments in the future

As a research community, we have been proved to be rather ineffective at predicting future trends in goose populations. A levelling off of the numbers of geese in some populations in the past has given false warning of stabilising numbers and simple extrapolation of earlier trends has proved less than satisfactory as a predictive tool. More recently, the existence of long runs of count data have proved essential for the derivation of parameter estimates necessary for more sophisticated simulation modelling of goose populations. Such modelling approaches have provided considerable insights into the effects of catastrophic events on mortality and the consequent population declines, which show that even apparently robust populations are susceptible to stochastic events which cause numbers to fall below thresholds defining unfavourable conservation status. Furthermore, sensitivity analysis has demonstrated that small changes in annual adult survival have a greater effect on overall population size than relatively large changes in breeding success, hence although density-dependence in productivity is the most important *regulating* factor in populations, population size is *determined* more strongly by survival rates.

What such modelling fails to predict is the timing and magnitude of population expansion under conditions where a population escapes from density-dependence. The recent spectacular increase in Iceland/Greenland Pink-footed Goose numbers in the 1990s (see Mitchell et al. this volume) shows what happens when a population with a confined breeding habitat type expands and then adapts to a new nesting habitat. Such plasticity in response should not surprise us as observers of what we already know to be adaptable birds, but it does mean that many predictive modelling approaches are unable to provide precision in population forecasting. For this reason, we make no attempt to predict future population behaviour for any of the populations presented here. For the purposes of management, we feel it appropriate to assume that current trends can be expected to continue for the immediate future, but trust that the collation and provision of these data in this publication will provide the time series for use in modelling approaches which can benefit from such population parameters. Research therefore needs to concentrate on determining the critical periods when density dependence may become manifest, the threshold levels at which they become operative and the strength of such density-dependent processes.

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1 Taiga Bean Goose *Anser fabalis fabalis*

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1. POPULATION REVIEW

1.1 Range

The Taiga Bean Goose breeds in the taiga zone of Scandinavia and western Russia, at least as far as Russian Karelia and the Kola Peninsula. Its range further east is uncertain, although Burgers et al. (1991) report recoveries of birds marked in the Netherlands from western Siberia (see Fig. 2.1 in van den Bergh this volume). In autumn, the majority of Taiga Bean Geese are found at staging areas in southern Sweden, although some also occur in northern Poland and the northern part of eastern Germany in a belt extending along the Baltic Sea coast. In winter, many Taiga Bean Geese remain in southern Sweden as long as weather conditions permit; during cold weather they leave for areas to the southwest. Another part of the population winters just south of the Baltic, although the exact winter distribution in this region is imperfectly known. Smaller numbers winter in the Netherlands, where increases occur during periods of severe weather.

1.2 Delineation of flyways

Neck-banding in the Nordic countries (Nilsson 1984a, Nilsson & Persson 1984, Nilsson & Pirkola 1991, Tveit 1984) has shown that Taiga Bean Geese from breeding areas in Finland and Scandinavia migrate to staging areas in southern Sweden. Taiga Bean Geese from the Kola Peninsula and neighbouring parts of Russia migrate south through Finland and Sweden, and the majority of the population stages in southern Sweden in October. With the first severe frosts in southern Sweden, the Taiga Bean Geese start to leave: a little more than half of the population migrates south over the Baltic, while the remainder gathers in Scania, the southernmost province of Sweden (Nilsson 1984a, 1989, Nilsson & Persson 1984, Nilsson & Pirkola 1986, 1991) where they remain in most winters but leave to the southwest (to Denmark, Germany and the Netherlands) during periods of severe winter weather. A small population migrates from the southern parts of Lapland to winter in Denmark and Britain (Parslow-Otsu 1991). Some Taiga Bean Geese, probably from more eastern breed-

ing areas, apparently migrate south through the Baltic States following the Baltic coast to Poland and northern Germany (L. van den Bergh unpubl.).

1.3 Population trends

Due to the failure to separate the two European races of the Bean Goose (Taiga Bean Geese *Anser fabalis fabalis* and Tundra Bean Geese *A.f.rossicus*) in goose counts, it is not easy to assess population trends for the Taiga Bean Goose. It is thought that the majority of this population stages in southern Sweden during the early autumn. If we assume that these birds derive from Finland, Norway and Sweden, plus the neighbouring parts of Russia (including east Karelia to the Kola Peninsula and around the White Sea), trends in this segment of the Taiga Bean Goose population can be assessed from the mid October counts in southern Sweden. Earlier this century, a general decrease in the number of Bean Geese (subspecies not separated) was reported from western Europe (see summary in Mathiasson 1963). There are some indications from hunting records on important estates in Scania that there was an increase here during the same period. Unfortunately, no counts are available to substantiate these trends.

The first autumn counts of geese in Sweden in November 1956 and 1958 (Mathiasson 1963, Jensen et al. 1962), found 16,800 and 12,800 Taiga Bean Geese respectively. No goose counts were undertaken in Sweden in the 1960s (with one exception in October 1960). In the early 1970s, numbers had increased and I. Ahlén (in litt.) estimated the population at 30,000-40,000 individuals. Regular goose counts started in Sweden in 1977/78, since then October totals have usually varied between 60,000 and 80,000 individuals. Recent counts in northern Germany and Poland revealed a total of some 20,000-30,000 Taiga Bean Geese during the period when peak numbers were found in southern Sweden (L. van den Bergh unpubl.). Thus the total Taiga Bean Goose population is estimated to be c. 90,000-110,000 individuals, probably closer to the latter total.

1.4 Breeding success

Annual censuses of the percentage of juveniles in flocks of Taiga Bean Geese wintering in the Netherlands have been undertaken since the winter 1973/74. During the period 1981/82 and 1989/90, an average of 28.7% juveniles was recorded (Ganzenwerkgroep Nederland 1984a, b, Ganzenwerkgroep Nederland/België 1986, 1987a, b, 1989, 1990, 1991, 1992). An average of 16.7% was recorded at one haunt in the southern part of the Netherlands during 1973/74 until 1980/81 (van Impe 1981).

Recently, data on breeding success have been collected from other parts of the range. During 1992, 1994, 1995 and 1996, 32.5% (n=673), 20.1 % (n=1514),

20.3 % (n=530) and 20.9% (n=1374) juveniles were seen in the flocks south of the Baltic respectively (L. van den Bergh unpubl.). In 1993 and 1994, 19.3% (n=1332) and 23.4% (n=4938) juveniles were found among staging Taiga Bean Geese in Sweden (L. van den Bergh unpubl.).

1.5 Mortality

No specific studies of the mortality rates of Taiga Bean Geese have been published. The first year resighting rate of 359 neck-banded adult Taiga Bean Geese from northern Finland during 1980-1993 was 72% (L. Nilsson unpubl.), whereas the first year resighting rate of young birds known to have fledged was 57%. Considering that some adults may have been overlooked, it is clear that the survival rate for adults in this population was at least 75-80%. Since that period hunting activity has increased. Of X-rayed Taiga Bean Geese, no less than 62% of adults and 28% of yearlings carried shotgun pellets in their tissue (Jönsson et al. 1985).

2. BREEDING GROUNDS AND BREEDING ECOLOGY

2.1 Distribution

Range: The breeding range of the Taiga Bean Goose stretches from Scandinavia into Russia, although it is not known how far east the distribution extends (but see Burgers et al. 1991). In Russia, Filchagov et al. (1985) report that both the taiga and tundra forms of the Bean Goose breed on the Kola Peninsula, as already stated by Alpheraky (1905), but the border between the two forms is uncertain (see Fig. 2.1 in van den Bergh this volume). Taiga Bean Geese definitely breed in Karelia and the Lake Onega district. Further east, the Taiga Bean Goose is said to breed in the Kirov/Vyatka Oblast area and in the Pechora-Ilych Reserve (Lebedeva 1979), although recent information from this part of Russia is lacking. According to Alpheraky (1905) and Burgers et al. (1991), the Taiga Bean Goose also occurs as a breeding bird in the lower Ob Region which is a part of the believed distribution range of *A.f.johanseni* (Delacour 1954). Podzlev (1996) considers the Taiga Bean Goose in Russia as breeding in small numbers in the Krasnoborsk District, which is as far south as 62° N.

In Norway, the Taiga Bean Goose is virtually restricted to Finnmark, but some breeding pairs still exist in areas further south, i.e. North Tröndelag Fylke (Follestad 1994). In Sweden it nests from Jämtland northwards, with a small isolated population in Dalarna and Hälsingland. The breeding population in Sweden is generally scattered with the exception of the northeastern-most part, where it is more dense in the zone of aapa mires close to the Finnish border. In Finland, the highest concentrations of Taiga Bean Geese are found in the aapa mire zone in eastern Lapland, whereas the species is scarce on the palsa mires in the Finnish fjeld zone and absent from the areas with raised bogs in the southern part of the country (Pirkola & Kalinainen 1984b).

Data on breeding population sizes are generally lacking. For the southernmost part of Swedish Lapland, Eriksson & Henricsson (1990) estimated one breeding pair per 1165 ha of suitable wetland habitat, giving about 50-100 breeding pairs for their 16,200 km² study area when unsuitable areas are excluded. Censuses have not been carried out but the breeding populations in Sweden and Norway can be roughly estimated to 500-1000 pairs, whereas the Finnish breeding population is probably in the order of 1500-2000 pairs.

Habitat and feeding ecology: The Taiga Bean Goose is found in the forest zone, where the home range includes different types of mire, mire forest, ponds, small lakes and streams. Spruce mires seem to be a preferred mire type together with more complex mire types. High breeding densities in the aapa mire zone are probably related to the abundance of suitable food plants for the geese (Pirkola & Kalinainen 1984a, b). Mellquist & von Bothmer (1984) considered that the wider distribution in Sweden in earlier years was due to the creation of suitable feeding habitat on mires for foraging geese as a result of intensive hay making activities at that time.

In July, Taiga Bean Goose families move out to the more open flarks of the marshes to feed, preferred grazing items being different *Carex* species and *Scheuchzeria palustris* and *Menyanthes trifoliata* also being much used (Pirkola & Kalinainen 1984a, b). In the latter part of July and in August feeding habits are similar but berries of *Empetrum nigrum* and *Vaccinium myrtiluus* are frequently sought from the spruce mires and adjacent forests. The common *Equisetum* is not much used as food at this time but is much grazed early in the summer and in early autumn.

2.2 Moult migration and moulting areas

Moulting concentrations have long been known from Finnmark in northernmost Norway, where up to 3500 moulting Taiga Bean Geese were counted in 1968, with smaller numbers in other years (Follestad 1994, Tveit 1984). Bianki (1976) reported several flocks of more than a thousand moulting Taiga Bean Geese from the Kola Peninsula. Large moulting flocks of Taiga Bean Geese were also found in northernmost Sweden in former times, but extensive aerial searches there and in northern Finland during the 1970s (Nilsson 1982) failed to find any flocks of moulting Taiga Bean Geese, except for a few small groups. During census work in Åsele Lappmark, the southern part of Swedish Lapland, flocks of moulting Taiga Bean Geese were found, the largest being about 200-300 individuals (Å. Andersson in litt., Eriksson & Henriksson 1990). A moulting place for up to 120 individuals was found, however, close to this area on the Norwegian side of the border (Follestad 1994).

2.3 Research

With the exception of those in northern Finland (Pirkola & Kalinainen 1984b), studies of the Taiga Bean Goose on the breeding grounds have been limited. The Finnish studies included distribution of breeding birds, habitat selection, selection of nest sites and various other aspects of breeding biology. Moreover, neck-banding of breeding Taiga Bean Geese was undertaken annually, at first with the aim of studying migration patterns within the framework of a Nordic Bean Goose Project (Nilsson 1984a, Nilsson & Pirkola 1986, 1991). Later this work continued in a more restricted area to study various aspects of population ecology. Neck-banding and marking has also taken place on the moulting grounds in Finnmark, Norway (Tveit 1984) and in Sweden (Å. Andersson unpubl.).

2.4 Protection and conservation

Some important breeding areas in the Nordic countries are situated within National Parks and Nature Reserves, but these are mostly not designated specifically for waterfowl. The moulting areas in the southern part of Swedish Lapland and neighbouring parts of Norway are included in protection plans but not yet protected (Follestad 1994). In Sweden, experiments have been undertaken with the aim of reestablishing the Taiga Bean Goose in the southern part of the breeding range from which it has disappeared (von Essen 1982).

3. STAGING AREAS

3A. FINLAND

3A.1 Distribution

Range: During autumn, migrating Taiga Bean Goose flocks are seen regularly in many parts of Finland with greatest concentrations in coastal areas, where most flocks seem to congregrate before migrating southwest to Sweden over the Åland Sea (Nilsson 1984a, Nilsson & Pirkola 1991). No larger inland staging sites have been reported but the geese congregrate in flocks at suitable places on the breeding areas during late summer before departure.

Spring migration in Finland follows a similar route to that used in autumn. Small flocks of Taiga Bean Geese can be seen staging at various sites in western Finland during spring migration. The most important staging area is at Liminka in the Oulu district in the Gulf of Bothnia, where up to 10,000 geese regularly congregrate and stage for a period in spring (Fig. 1.1) before splitting up and proceeding to the breeding grounds (Lampio 1984). Moreover, more than 1000 staging Taiga Bean Geese have been counted regularly in spring at Lapua-Ilmajoki and Kristinestad, whereas only smaller flocks have been recorded at other sites.

Habitat and feeding ecology: Staging Bean Geese on spring migration mainly feed on fields with hay or barley stubble (Lampio 1984), to a lesser extent they also feed on sprouting barley, new growth in hayfields and on ploughed fields.

3A.2 Abundance

Phenology: During late autumn, Taiga Bean Geese gather in flocks in the Finnish breeding areas. The migration south occurs mainly in September and, in late September, large numbers of migrating Taiga Bean Geese have been reported arriving on the coast of Uppland in Sweden after the sea crossing from Finland (Nilsson 1984a). During spring, the first arrivals in southwest Finland occur in early April, and the first geese reach Lapland in early May (Lampio 1984). Peak migration in Finland occurs during the last week of April and in early May.

Trends and numbers: No precise data are available, but no marked changes in numbers have been apparent in recent years.

3A.3 Research

Finland was involved in the Nordic neck-banding programme of Taiga Bean Geese (Nilsson 1984a, Nilsson & Pirkola 1986, 1991).

3A.4 Protection and conservation

Hunting legislation: There is an open season for Taiga Bean Geese in Finland from 20 August until 31 December. The estimated bag for the species in Finland is about 4000-5000, with 6600 reported shot in 1994/95 (E. Väyrynen pers. comm.).

Site safeguard: No information.

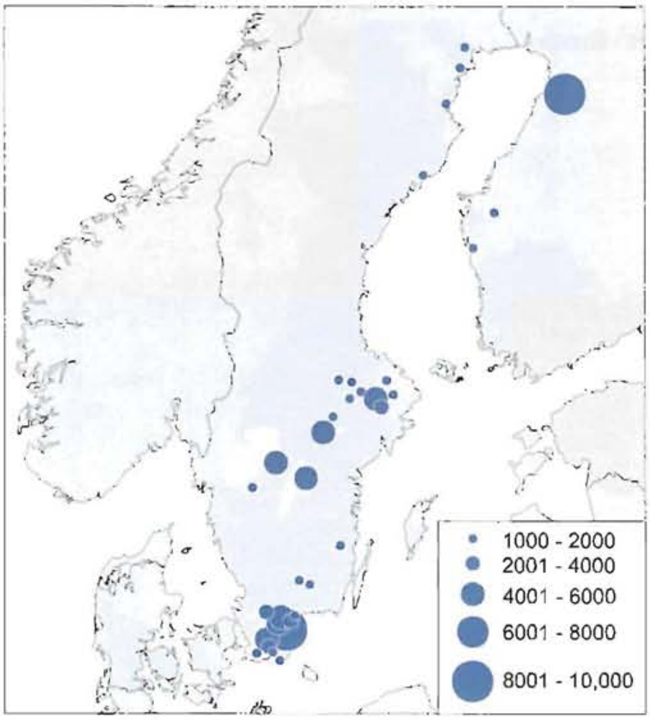

Fig. 1.1. Spring staging areas of Taiga Bean Geese in Sweden and Finland. Only sites that regularly hold more than 1000 geese are shown.

4. STAGING AND WINTERING AREAS

4A. SWEDEN

4A.1 Distribution

Range: During autumn Taiga Bean Geese use a number of staging areas in the southern part of the country from the province of Uppland southwards (Fig. 1.2; Nilsson & Persson 1984), the geese arriving over the sea from southwestern Finland (Nilsson 1984a, Nilsson & Pirkola 1986, 1991).

In the 1960s, the majority of Taiga Bean Geese in Sweden were found staging in the southernmost province, Scania, where they also wintered. A few minor staging areas were known from the Swedish west coast, whereas the geese mostly passed over inland Sweden during autumn migration. When intensive studies started in Sweden in 1976/77, most staging geese in the autumn were still concentrated in Scania, but an important staging area had established at Lake Tåkern, where numbers increased markedly during the 1970s and were high during the 1980s (see below). At the same time, other staging areas also became established, such as Hjälstaviken and Lakes Kvismaren and Östen. The latter sites were already established spring staging areas when the geese started to use them in the autumn.

In Sweden, wintering Taiga Bean Geese are more or less concentrated in Scania and a few sites in neighbouring provinces, using the same sites in Scania as they use for staging in autumn and spring (Fig. 1.3). During the winter, the local distribution of Taiga Bean Geese in Scania changes according to weather conditions. During mild periods, the geese mainly remain in inland areas, whereas a marked movement to coastal sites occurs in cold weather (Nilsson & Persson 1991a), these areas have less snow cover in most winters. Similarly, the northeast part of Scania holds more geese than the southwest during the mild winters, whereas the situation is reversed during cold winters. In even colder weather the geese leave Scania for areas to the southwest, formerly to the Netherlands and Germany, but in more recent years to southeastern Denmark. In the two winters 1985/86 and 1986/87, numbers in Scania and southeastern Denmark were about 30,500, with more geese in Scania in the mild winter of 1986 compared to 1987 (Nilsson 1988a).

In spring, the geese use the same staging areas in southernmost Sweden as during the autumn. Some of the sites later to be used as autumn staging areas were used by the geese in spring (Fig. 1.1), e.g. Kvismaren, Östen and Hjälstaviken. Whereas Hjälstaviken is the only autumn staging area of importance in the province of Uppland, a number of other sites in this province are also regularly used during spring migration, with an estimated total of 10,000-13,000 in the province (Fredriksson & Tjernberg 1996). Spring staging is also common in the neighbouring province of Västermanland, where up to 5000-6000 are regularly seen in

Fig. 1.2. October/November distribution of Taiga Bean Geese. Data: Sweden, maximum counts for each site 1977-1995 (L. Nilsson unpubl. data); Poland and Germany, late October/early November 1996 (L. van den Bergh unpubl. data); Denmark, mean numbers 1984-1992 (Jørgensen et al. 1994); the Netherlands, maximum counts 1990-1997 (L. van den Bergh unpubl. data); UK (Parslow-Otsu 1991, Parslow-Otsu & Kjeldsen 1992).

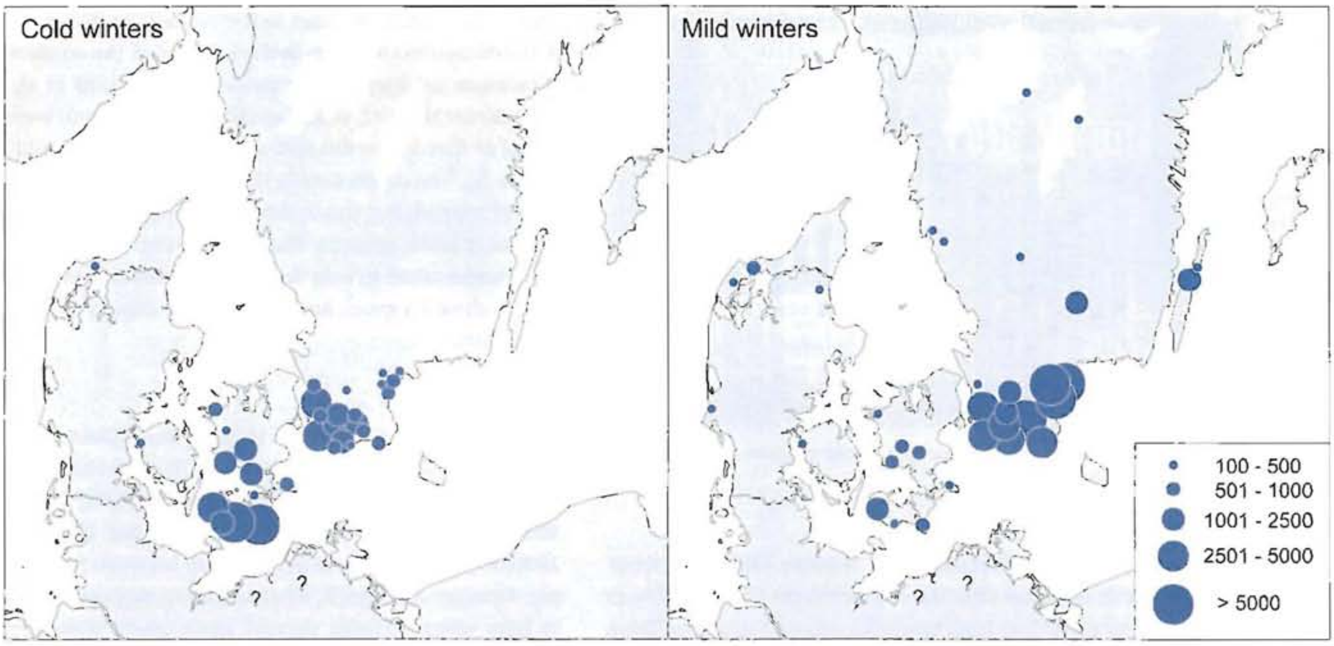

Fig. 1.3. Distribution of Taiga Bean Geese in Sweden and southeastern Denmark during cold and mild (1979, 1982, 1985 and 1987) winters.

spring (Pettersson et al. 1995). In spring, part of the population follows a different migration route than is used during autumn, flying north along the western coast of the Gulf of Bothnia (Nilsson & Persson 1984). Staging areas are known in northern Sweden in the areas around the Gulf of Bothnia.

Habitat and feeding ecology: The feeding ecology of staging and wintering Taiga Bean Geese in Scania were studied by Markgren (1963) and Mathiasson (1963) during the late 1950s and later in the 1970s and 1980s by Nilsson & Persson (1984, 1991a) and Persson (1989). In other parts of Sweden data were collected by Nilsson & Persson (1984). During the early part of the season stubble fields dominated, whereas autumn sown cereals were used later in the season in areas north of Scania. In the 1970s, the Taiga Bean Geese in Scania fed on root crops, mainly sugar beet, although in some districts potatoes and carrots were eaten as soon as such spill was available after the harvest (Nilsson & Persson 1984, 1991a, Persson 1989). During the 1950s no use of sugar beet was reported, the change in feeding habits being related to an increased availability of discarded waste with the introduction of mechanical harvesting. In freezing weather they turned mainly to winter cereals. During mild periods, the geese to a large extent shifted to feed on grassland. In spring, grasslands and winter cereals were mostly utilised. In the 1950s, the main feeding areas in Scania were stubble fields, grasslands and autumn sown cereals.

4A.2 Abundance

Phenology: Taiga Bean Geese arrive in southern Sweden during September, and in some years massive arrivals have been seen on the coast of Uppland in late September (Nilsson 1984a). In some years, several thousand have been seen on staging areas in Sweden as early as mid September. Taiga Bean Geese are only found in small numbers in Scania in September. Peak numbers in southern Sweden north of Scania usually occur during mid October; peak counts in Scania occur later in the season. Normally, mid November counts north of Scania are much lower than October counts and the geese regularly leave some sites by early November. In December there are rarely any geese left in Sweden north of Scania except in exceptional years, the exact time of departure during November varies with the extent of frost periods.

By December, winter numbers stabilise and in mild winters no marked changes in numbers occur before spring migration. The geese leave Scania during March, with some remaining in April depending on weather conditions. During cold periods, cold weather movements to the southwest have been noted but the geese soon return in milder spells. In mild winters the geese move to northeastern Scania as early as January/February.

Spring migration north from Scania starts during March, with peak counts on staging sites in southern Sweden north of Scania generally in late March or April depending on the character of the season (Nilsson 1984a). The geese generally leave the staging sites at Kvismaren and in the provinces of Västmanland and Uppland during late April. Peak counts on staging areas along the Gulf of Bothnia generally occur during the first week of May, probably after a direct flight from resting places in the northern part of southern Sweden.

Trends and numbers: Regular goose counts have been available in Sweden since 1977/78, October counts being especially important as they are undertaken when the majority of the total population of Taiga Bean Geese concentrates in Sweden. During the first years of counts, numbers in October were around 50,000, but November counts in 1978 indicated that the staging population in Sweden was at least 60,000 (Fig.

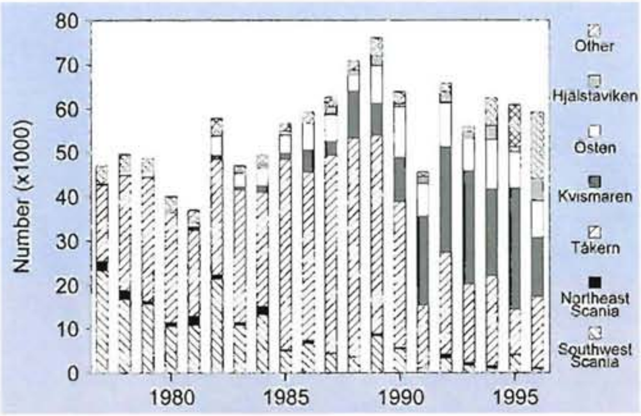

Fig. 1.4. Numbers of Taiga Bean Geese counted at sites in Sweden in October 1977-1995.

1.4, Nilsson & Persson 1984, Nilsson 1988a). October counts were low after the cold winter in 1979 which was characterised by high mortality among wintering Taiga Bean Geese in Sweden (Nilsson 1984a). Numbers then increased to a peak of about 80,000 in 1989, fluctuating around 60,000 in the following years (Nilsson 1979, 1981, 1984b, 1986, 1988a, b, 1991, 1993).

November counts have fluctuated without showing any trend. Data from earlier years are more limited, but Mathiasson (1963) reported 16,800 and 12,800 for early November 1956 and 1958 respectively, whereas 16,000 were found in Sweden during a count in October 1960 (Jensen et al. 1962). Limited counts were organised on staging areas in Scania in October 1971 and 1972, when up to 24,750 were counted at a number of lakes where the maximum count in the regular surveys was c. 14,000. The Swedish autumn population in the early 1970s was probably c. 40,000 (reference in Nilsson & Persson 1984).

Marked changes in numbers have occurred between regions (Nilsson 1988a, 1991). In the mid 1970s, as in earlier years, total staging numbers in Scania were around 20,000 Taiga Bean Geese, numbers then steadily decreased and during recent years only very small numbers were found in Scania in October. When the counts started in 1977, Tåkern was an important area in addition to Scania, the geese having started to use Tåkern as an important autumn staging area some years earlier. Apart from these two big staging areas, there were only a few small staging areas in autumn. During the 1980s, Tåkern dominated markedly with peak counts of up to 45,000 Taiga Bean Geese. During the same period, autumn staging geese started to use two areas, Östen and Kvismaren, previously only used by spring staging geese. Östen reaching peak numbers of c. 11,000 geese. After being used by a few thousand birds in the 1980s, a marked change in the staging habits of Taiga Bean Geese took place in the 1990s: numbers using Tåkern decreased, whereas the number using Kvismaren increased and reached about 30,000 in 1995.

The winter population of Taiga Bean Geese in southern Sweden has varied markedly between years in relation to the overall changes in the population but mostly in relation to variation in the severity of the winters. Maximum January counts recorded c. 35,000 in the mild winter of 1992, whereas only few individuals were found in Sweden in the cold winters of 1982 and 1987 (Fig. 1.5). The count data in the graph give the impression of a trend, but this is mostly an effect of the series of recent mild winters. National spring counts have been undertaken in only few years (Nilsson & Persson 1984), showing much lower totals than during autumn migration.

4A.3 Research

Census: Regular counts of staging Bean Geese have been undertaken in Sweden since 1976, with the aim of covering all important sites (Nilsson 1979, 1981, 1984b, 1986, 1988a, 1988b, 1991, 1993). During 1977/78-1986/87, counts were made monthly between September/October and March, whereas the count programme in later years includes surveys in October, November and January. Some census data are available from earlier years and from some spring staging areas (Nilsson & Persson 1984).

Ringing: A collaborative Nordic neck-banding programme has been running since 1976. Taiga Bean Geese were marked with neck-bands in Scania until 1980. Later the programme concentrated on marking in Finland and making observations of marked geese on the staging and wintering areas in southern Sweden. Moreover, 36 moulting Taiga Bean Geese were marked with neck-bands in southern Swedish Lapland in 1987 (Å. Andersson unpubl.).

Other: Markgren (1963) and Mathiasson (1963) made thorough studies of the winter ecology and especially feeding ecology of Taiga Bean Geese in Scania during the 1950s. Later, intensive studies on habitat selection, field choice, activity patterns, local movements etc. were undertaken in partly the same areas in Scania, during the 1970s and 1980s (Nilsson & Persson 1984, 1991a, b, Persson 1989).

4A.4 Protection and conservation

Hunting legislation: There is an open season in the provinces of Scania and Blekinge during October-December, but hunting is closed each day after 1100 h. Moreover, Taiga Bean Geese may be shot in this area during 1 January - 15 March to prevent damage to autumn-sown cereals. Bean Geese may also be shot to protect crops in the counties of Östergötland, Skaraborg and Örebro during September and October. A few years ago, the open season in Scania was considerably shorter, covering the first three weeks of November. During the hunting season of 1990/91, c. 3000 Bean Geese were bagged in Sweden (Bergström et al. 1992).

Site safeguard: Tåkern and Kvismaren, the two most important staging areas in Sweden, are nature reserves and designated as Ramsar sites. The same applies to Hjälstaviken, another important staging area. Some of the other staging areas are also nature reserves. In Scania, only small parts of the staging and wintering sites are actually in reserves, but three important staging areas Araslövsjön-Hammarsjön, Vombsjön-Sövdesjön and the Foteviken area are designated as Ramsar sites. Two of the staging areas in northern Sweden are also designated as Ramsar sites. Protection normally applies to the roost sites, although the geese make extensive feeding flights to large areas of agricultural land outside the reserves.

Agricultural conflict: The possible damage caused by Taiga Bean Geese to various crops has been discussed for many years in Sweden, damage being reported from winter cereals, rape and grassland. Normally, winter feeding on cereals is of little importance except in extreme weather when trampling can cause losses. The problem with grazing on winter cereals has been addressed several times (Markgren 1963, Jönsson 1982, Wallin & Millberg 1995, 1996) without any clear results as to the extent of damage.

Compensation is not paid for damage, but the shooting of geese to protect certain crops can be undertaken. In some areas with large concentrations of staging Taiga Bean Geese, certain fields are sown with special crops for the geese, often combined with scaring on other fields. These experiments are yielding some success (von Essen 1990).

4B. DENMARK

4B.1 Distribution

Range: Twenty sites are regularly used by Taiga Bean Geese, distributed in two major regions and characterised by geese of distinctively different origin and pattern of occurrence: (1) southeastern Denmark, i.e. southern Sjælland, Lolland, Falster and Møn, has the highest wintering numbers, especially in cold winters. This region is regarded as an extension of the southern Swedish staging and wintering area: in periods with snow and frost, geese move out of Sweden to southeastern Denmark where conditions may be more tolerable. In mild winters, numbers are lower, but the region is still a regular wintering quarter. (2) Northern Jutland: neck-banding has recently shown that at least part of this group comes from breeding grounds in Swedish Lapland and that some of the geese migrate onwards to wintering areas in eastern England (Å. Andersson unpubl., Parslow-Utso & Kjeldsen 1992). Outside these two regions, smaller flocks regularly occur in northwest Sjælland, western Fyn and western Jutland (Fig. 1.3).

Habitat and feeding ecology: In the southeast, Taiga Bean Geese mainly feed on winter cereals, seed grass and waste sugar beet; only at a few sites, do they also feed on rough pastures. In northern Jutland, Bean Geese mainly feed on pastures, stubble fields and winter cereals (Madsen 1986, H.E. Jørgensen, T. Lund unpubl.). The regional differences are probably primarily explained by differences in agricultural practice, cattle and dairy farming being more prominent in the northwest and sugar beet crops being concentrated in the southeast.

4B.2 Abundance

Phenology: In the southeast, a few hundred Taiga Bean Geese arrive in mid/late November, and peak arrival occurs in December-January. The majority leave the region during late February/early March. One site, Holmegaards Mose, is used as a spring staging area and the geese depart from here in late March. In the northwest, Bean Geese arrive in September and numbers peak in October-November and March, respectively. The geese depart from late March to mid April. Only about half the numbers present in autumn are recorded during winter (Jørgensen et al. 1994).

Trends and numbers: In the southeast (including northwest Sjælland and Fyn), 8000-10,000 Taiga Bean Geese winter in mild winters. In cold winters (or during cold spells in mild winters), numbers increase to 18,000-32,000 (Fig. 1.5, Table 1.1). Often peak numbers are reached in February, the coldest month of the

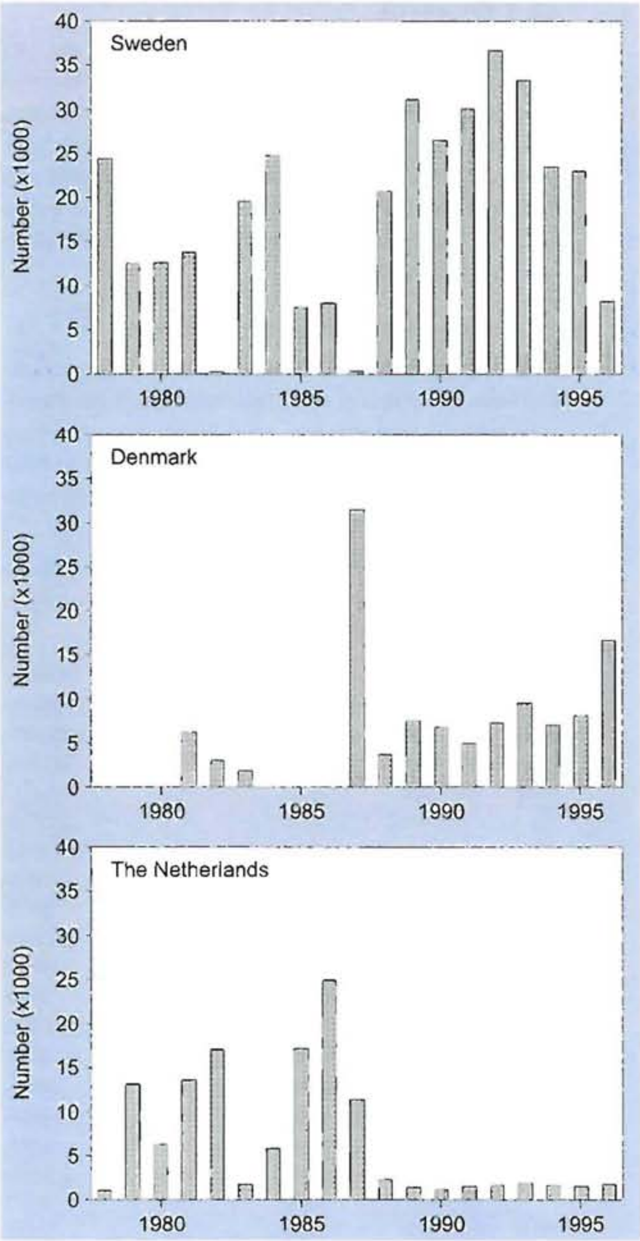

Fig. 1.5. Number of Taiga Bean Geese counted in Sweden, southeastern Denmark and the Netherlands in January 1978-1996.

year. Apart from fluctuations in numbers related to weather conditions, no trend can be discerned. The flock wintering on Fyn has for unknown reasons decreased during this century, from approximately 1000 in the middle of the century to less than 100 in the 1990s (Jørgensen et al. 1994).

In the northwest, exchanges of geese between sites and gaps in coverage have made it difficult to estimate the precise population size. In autumn, approximately 2500 Taiga Bean Geese occur, of which approximately 1000 winter in mild winters. In cold winters, almost all geese abandon the region. The group which is thought to migrate onwards to England is estimated at c. 1000 geese (J.P. Kjeldsen pers. comm.). At some sites (Tjele, Lille Vildmose), numbers have decreased earlier this century but due to lack of counts, it is not certain whether this reflects a genuine decrease in population size or a shift in staging areas.

4B.3 Research

Census: Countrywide counts of Bean Geese are carried out in mid November and mid January (National Environmental Research Institute). In the southeast, the main wintering sites are also covered in February (H.E. Jørgensen). In the northwest, specific censuses and neck-band readings have been made of the group of Bean Geese which is linked to England (M. Parslow-Utso & J.P. Kjeldsen).

4B.4 Protection and conservation

Hunting legislation: Bean Geese have an open season from 1 September to 31 December (in fishing territory until 15 January) but, since 1994, geese can only be shot from 1.5 h before sunrise to 1000 h (from 1997 until 1100 h). Since 1994, Bean Geese have been locally protected in northwest Jutland, in order to provide better protection of the small group of geese which has a distinctive migration pattern between Sweden, Denmark and England and for which the Royal Society for the Protection of Birds (RSPB) has taken measures to protect in England.

Table 1.1. Number of Taiga Bean Geese wintering in southeast Denmark, 1985-96 in relation to weather conditions (source: H.E. Jørgensen unpubl. data).

Year	Month	Weather conditions	Mean monthly temp. (°C)	Number of geese
1985	Feb	Cold	-4.2	>16,000
1986	Feb	Cold	-5.2	20,500
1987	Jan	Cold	-4.7	30,200
	Feb	Cold	-0.5	29,600
1988	Jan	Mild	3.6	1800
	Feb	Mild	2.5	5800
1989	Jan	Mild	4.9	5700
	Feb	Mild	4.6	6800
1990	Jan	Mild	4.3	4700
1991	Jan	Mild	2.2	3700
	Feb	Cold	-0.9	27,300
1992	Jan	Mild	2.8	5700
	Feb	Mild	3.6	8400
1993	Jan	Mild	2.1	8100
	Feb	Mild	1.3	6800
1994	Jan	Mild	2.6	5600
	Feb	Cold	-1.2	8300
1995	Jan	Mild	0.3	6000
	Feb	Mild	3.7	10,900
1996	Jan	Cold	-2.0	15,800

The hunting bag of Taiga Bean Geese has decreased from c. 1200 in the mid 1960s to c. 500 in the early 1990s, possibly reflecting a decrease in the size of the population in northwest Jutland where most Taiga Bean Geese are bagged (Madsen et al. 1996).

Site safeguard: Most of the roosts and parts of the feeding grounds used by Taiga Bean Geese are within European Union (EU) Special Protection Areas and Ramsar sites, but generally, shooting is allowed on the feeding grounds, whereas most of the roosts are unshot, either because of wildlife refuge regulations or voluntary bans.

Agricultural conflict: Damage to crops caused by Taiga Bean Geese is seldom reported. In the southeast, the geese can cause damage to unharvested sugar beet and winter cereals. It is, however, not regarded as a serious problem.

4C. POLAND

4C.1 Distribution

Range: Although Taiga Bean Geese can be found throughout the country, considerable numbers occur mainly in the coastal zone of the Baltic Sea and in the lower Odra valley (Fig. 1.2, Huyskens 1986, L. van den Bergh unpubl.). Along the Baltic coast, Lakes Lebsko and Gardno near Slupsk in particular seem to be important haunts during migration, but are probably not wintering areas. Other lakes in the coastal zone such as Lakes Wicko, Kopan, Jamno, Resko and Liroia Luza are also regularly used by Taiga Bean Geese during migration. Considerable concentrations are found in the Zalew Szczecinski region, especially near Wolin, Kopice and at Lake Swidwie Reserve.

In general, Taiga Bean Geese are mainly restricted to a coastal strip reaching some 50-80 km inland (Fig. 1.2), where they are found in flocks of a few tens to several hundreds of birds throughout the lake districts of Wiekopolski and Pomorski, south to Lake Miedwie. In the lower Odra valley, Taiga Bean Geese mainly visit the area south of Szczecin, especially between Gryfino and Krajnik Dolny. Further to the south, their occurrence seems to be more irregular during autumn, but it is not unlikely that they remain during winter. In October 1996, over 800 Taiga Bean Geese were observed near Lwowek, west of Poznan, which seems to be a regular haunt.

Habitat and feeding ecology: According to recent observations (L. van den Bergh unpubl.) Taiga Bean Geese in Poland feed on pastures as well as on arable land. In the Lake Lebsko-Gardno area they were seen on long-established grasslands, eating leaves as well as roots of grass, but they also visited harvested fields with waste grains, potatoes, maize and fodder beet. In the Ledzin area geese fed on newly sown wheat and stubble fields.

Similar feeding habitats were noted at Zalew Szczecinski and the Wolin Peninsula, where, in addition to feeding on waste from root crops after the harvest, Taiga Bean Geese also fed on rape and winter cereals. Further south, near Kopice and Stepnica, they were also found grazing in marshy pastures. In the Lake Swidwie area flocks fed on winter cereals and maize stubble.

4C.2 Abundance

Phenology: Although no detailed information is available, it seems very likely that the first Taiga Bean Geese reach Poland in late August or during the first week of September. The majority of the population passes quickly through the more eastern areas during the latter part of September and the first half of October. Huyskens (1986) stated that nearly all the geese had left eastern Poland by early November and only a few hundred were found in the Slupsk region during late October 1992 (L. van den Bergh unpubl.). The Zalew Szczecinski-Lower Odra are thought to be a wintering area, but at present no precise data are available. During spring, migration can be observed from March until the latter part of April.

Trends and numbers: As Tundra and Taiga Bean Geese are not separated in the regular counts in Poland, it is hard to judge what proportion of them are Taiga Bean Geese. Based on recent observations during the autumns of 1992-1996, an average of c. 10,000 Taiga Bean Geese occur in northwest Poland during late October and early November. During late October 1996, c. 10,500 Taiga Bean Geese were counted, of which 9700 were staging in the northwestern part of the country (L. van den Bergh, B. van Jaarsveld & D. Tanger pers. comm.).

An important staging area during autumn is Lake Swidwie, situated close to the German border in the far northwest of the country. In this area, numbers of Taiga Bean Geese can be as high as 6750 (1 November 1994), roosting in Poland but mainly feeding in Germany. However, on 31 October 1995 only 150 Taiga Bean Geese used the roost. Feeding conditions were extremely good near Lake Galebeck 50 km to the west in Germany at this time and 5000 Taiga Bean Geese were found there.

According to Dombrowski et al. (1993), 7003, 10,886 and 9720 Taiga Bean Geese were counted in Poland in January 1988-90 respectively. As most of these geese were concentrated in the Slonsk Reserve, the majority were definitely Tundra Bean Geese. However, according to Engel (1991) an estimated 1000 Taiga Bean Geese wintered in westernmost Poland in January 1988, whereas the total stock of wintering Tundra Bean Geese amounted to 40,000.

4C.3 Research

Regular censuses include all waterfowl species (Dombrowski et al. 1993) but no particular attention is paid to the determination of the different distribution and abundance of the two subspecies of the Bean Goose. The only information relating to the two races comes from J. Engel (Slonsk reserve) and A. Dyrcz (Wroclaw).

4C.4 Protection and conservation

Hunting legislation: According to Polish Hunting Law, all goose species occurring in the country may be hunted from 15 August until 15 February. There are no further restrictions, but to obtain a hunting licence a compulsary hunting examination must be passed. The annual goose bag in Poland was estimated at about 6300 during the 1960s, increasing to 12,000 during the 1970s, and 12,600 during the 1980s (Landry 1980, Wieloch 1992).

Site safeguard: Some important haunts of Taiga Been Geese in Poland are situated in protected areas, such as the roosts on Lakes Gardno and Lebsko, which are part of the Slowinski National Park. The Lake Swidwie roost is also situated in a nature reserve. However, the geese feed mainly in agricultural areas without any protection.

Agricultural conflict: In Poland, crop damage caused by geese seems to be of only marginal importance, but may become an increasingly serious problem as a result of privatisation of the former state farms (Wieloch 1992).

4D. GERMANY

4D.1 Distribution

Range: Large numbers of Taiga Bean Geese are mainly found in the northeastern part of Germany, especially along the Baltic Sea coast, and in the valleys of rivers such as the Odra, Peene and Elbe (Fig. 1.2). Strongholds are situated at several locations in the Oderhaf on the island of Usedom, in the Anklam-Wolgast region, at Lake Galebeck, in the lower Odra valley and on the island of Rügen. To a lesser extent, they also occur along the Baltic coast west of Rostock, mainly near the island of Poel-Wismar. Further inland, they can mainly be found in smaller flocks, with the exception of the Schwerin-Güstrow region in the Federal State of Mecklenburg which is very often used for staging and wintering Taiga Bean Geese. Some haunts of considerable importance are situated in what used to be the border area between the former Federal Republic of Germany (FRG) and German Democratic Republic (GDR), especially in the valley of the river Elbe and Lake Schaalsee/Lake Ratzenburg.

In westernmost parts of Germany, Taiga Bean Geese winter mainly close to the Dutch border, feeding on German fields and pastures but roosting in the Netherlands (van den Bergh 1985a, b). Small flocks of these geese can also be observed at several places in the federal states of Schleswig-Holstein and Niedersachsen, especially in the lower Elbe valley downstream of Bremerhaven and in Emsland.

Habitat and feeding ecology: Taiga Bean Geese feed on various crops during autumn and winter. Recent observations (L. van den Bergh unpubl.) found them on stubble fields feeding on waste grain and maize, and visiting arable land with remains of sugar beet, fodder beet, potatoes etc. They also frequently feed on fields of winter cereals and rape, and are often found grazing on long-established pastures along small rivers and near lakes in semi-open landscapes.

4D.2 Abundance

Phenology: The first Taiga Bean Geese normally arrive by early September in northeastern Germany. Numbers increase steadily until late October or early November. On the island of Rügen, the geese remain during the winter as long as weather conditions are favourable, but they rapidly move on during severe cold spells (Dittberner & Hoyer 1993). In normal winters, Bean Geese remain in considerable numbers throughout the northern half of eastern Germany.

Spring migration can be expected from the third week of February in western Germany but usually during March and April in the eastern parts of the country. On Rügen they can occur until late April (Dittberner & Hoyer 1993).

Trends and numbers: Taiga Bean Geese were well known as wintering birds in Germany during the 19th century (Nauman 1842, 1902), as well as during the first half of the 20th century and it seems that they were quite numerous by that time. Detmers (1911) describes huge concentrations staging and wintering in Emsland and, according to Kunze (in Huyskens 1986), thousands could be found wintering at Lake Dummersee until 1940. It seems that the distribution of Taiga Bean Geese has changed dramatically since the 1940s and at the present they are mainly found within the territory of the former GDR.

As Bean Goose subspecies have not been differentiated during goose counts in Germany to date, it is impossible to determine any trend in the numbers of Taiga Bean Geese in recent years. According to observations during 1992-97, an average of at least 30,000 Taiga Bean Geese occur in the southern Baltic region in autumn, of which at least 20,000-23,000 were in eastern Germany (L. van den Bergh unpubl.). These Taiga Bean Geese were recorded at the same time as peak counts were recorded in southern Sweden (L. van den Bergh unpubl.). Large concentrations of Taiga Bean Geese occur on the island of Rügen with peaks of 12,000-15,000 in October, afterwards decreasing (Dittberner & Hoyer 1993), and up to 6000 have been seen on the island as early as the first week of October (3 October 1987 near Gingst). The early arrival of considerable numbers on Rügen suggests the possibility that geese migrate over the Baltic from Estonia, Lithuania and Latvia to Rügen. Intensive migration to Rügen from the east has been reported by Dittberner & Hoyer (1993). This migration is earlier than the migration of Taiga Bean Geese south from Sweden reported by Nilsson & Pirkola (1991).

In October 1995, unexpected numbers of Taiga Bean Geese were found at several locations in the federal state of Mecklenburg: 700 east of Schwerin, 500 east of Wismar, 550 at Lake Bützow, 1150 near Güstrow and 850 at Lake Krakow (L. van den Bergh unpubl.). As this huge area was only visited briefly, higher numbers of geese were certainly staging at that time. During late October-early November 1996 about 6000 Taiga Bean Geese were observed within this region (L. van den Bergh & B. van Jaarsveld pers. obs.). Due to lack of information about races of Bean Geese in eastern Germany, it is not possible to evaluate whether the situation in Mecklenburg has changed recently (cf. Rutschke 1983).

In western Germany, apparently only a few regular haunts exist, all close to the Dutch border in Emsland/Dollard near Meppen and Emlichheim with the roosts situated on the Dutch side of the border (van den Bergh 1985a, b). During the late 1960s and early 1970s, considerable numbers of Taiga Bean Geese were seen in the lower Rhine area (Eberhardt 1971, van den Bergh 1978), where nowadays only very few are found.

4D.3 Research

Regular goose counts have been undertaken in Germany since the 1970s but do not separate between the two subspecies (Mooij 1995). The distribution of the different subspecies in the northern parts of Germany have been studied by Huyskens (1986) and L. van den Bergh (unpubl.). The longterm marking programme in eastern Germany (Litzbarski 1979, Rutschke & Liebherr 1996) is carried out in the range of the Tundra Bean Goose.

4D.4 Protection and conservation

Hunting legislation: In Germany, the Bean Goose is a game species with an open hunting season between 1 November and 15 January. According to Federal Hunting Law, federal states are able to shorten or even close the hunting season for one or more species on their territory. At the present there is no open hunting season for Bean Geese in the federal states Baden-Würtenberg, Hessen, Niedersachsen, Nordrhein-Westfalen and Rheinland-Pfalz.

The annual goose bag has increased considerably in Germany from about 6000 in the 1960s; 7500 in the 1970s; 10,000 in the 1980s and 30,000-40,000 in the 1990s. This is mainly an effect of the dramatic increase in hunting in the federal states of Brandenburg, Mecklenburg-Vorpommern and Sachsen-Anhalt (Mooij 1991, 1995). The high hunting pressure on geese can have a negative influence on the limited population of Taiga Bean Geese staging and wintering in these regions.

Site safeguard: Although a number of important roosts are situated in nature reserves, some of them Ramsar sites, the geese mainly feed on unprotected agricultural areas. However, intensive shooting was recorded close to protected roosts or even within the borders of nature reserves during 1992-95 (L. van den Bergh unpubl.).

Agricultural conflict: No general information is available. Crop damage problems seem to occur in the federal states of Brandenburg, Mecklenburg-Vorpommern, Niedersachsen, Nordrhein-Westfalen and Schleswig-Holstein. Most problems are caused by the more numerous White-fronted Goose *Anser albifrons* and the Tundra Bean Goose.

4E. THE NETHERLANDS

4E.1 Distribution

Range: The occurrence of the Taiga Bean Goose in the Netherlands is mainly restricted to certain areas in the eastern and southern parts of the country (Fig. 1.6). They mainly occur in the provinces of Groningen, Drenthe, Overijssel, Gelderland, Noord-Brabant and Limburg (van den Bergh 1985a, Koffijberg et al. 1997). In recent years a small stock has established at Oostvaardersplassen on the reclaimed polder Zuidelijk Flevoland (van den Bergh 1985a, Ganzenwerkgroep Nederland/België 1991, 1992) and in the Bargerveen area in the southeastern part of Drenthe. During severe cold spells, winter influxes of large numbers of these geese have been observed (van den Bergh 1979). During cold winters, Taiga Bean Geese occur in many areas in the eastern part of the country, with main concentrations on both the regular staging areas and along the rivers IJssel and Nederrijn (van den Bergh 1979, 1985a, b).

Habitat and feeding ecology: During mild winters, nearly all Taiga Bean Geese occur on peatmoor and heath areas, roosting on fens and small lakes and usually feeding on marshy pastures in the valleys of small rivers. To a lesser extent they are found on arable land feeding on remains of maize, sugar beet and potatoes, sometimes also grazing winter cereals. Hazelhorst (1988) mentions grass (50%) and maize stubble (45%) as the main food items for the Engbertsdijksvenen area in Overijssel. For the Peel area in Noord-Brabant, 88% were observed on grassland and 11% on maize stubble (van Noorden 1991). Although Taiga Bean Geese usually occur more or less separately from other goose species, increasing numbers of Tundra Bean Geese and White-fronted Geese have been using the same areas in recent years.

4E.2 Abundance

Phenology: The first Taiga Bean Geese usually arrive in late September or early October at the Kampina site in the southernmost part of the country (M. Slikkerveer in litt.). According to goose-fowlers, this has not changed since the end of the 19th century (Smit 1979, Smit & Terlouw 1991), although the total numbers of wintering Taiga Bean Geese has decreased dramatically since then.

The majority of the geese arrive during November and early December, but seasonal peak counts are often noted as late as February (van den Bergh 1979, 1985a, b, Koffijberg et al. 1997). The Taiga Bean Geese start leaving the Netherlands from late February and during early March, with only a few remaining until late March or even early April.

Trends and numbers: Once a common and well-

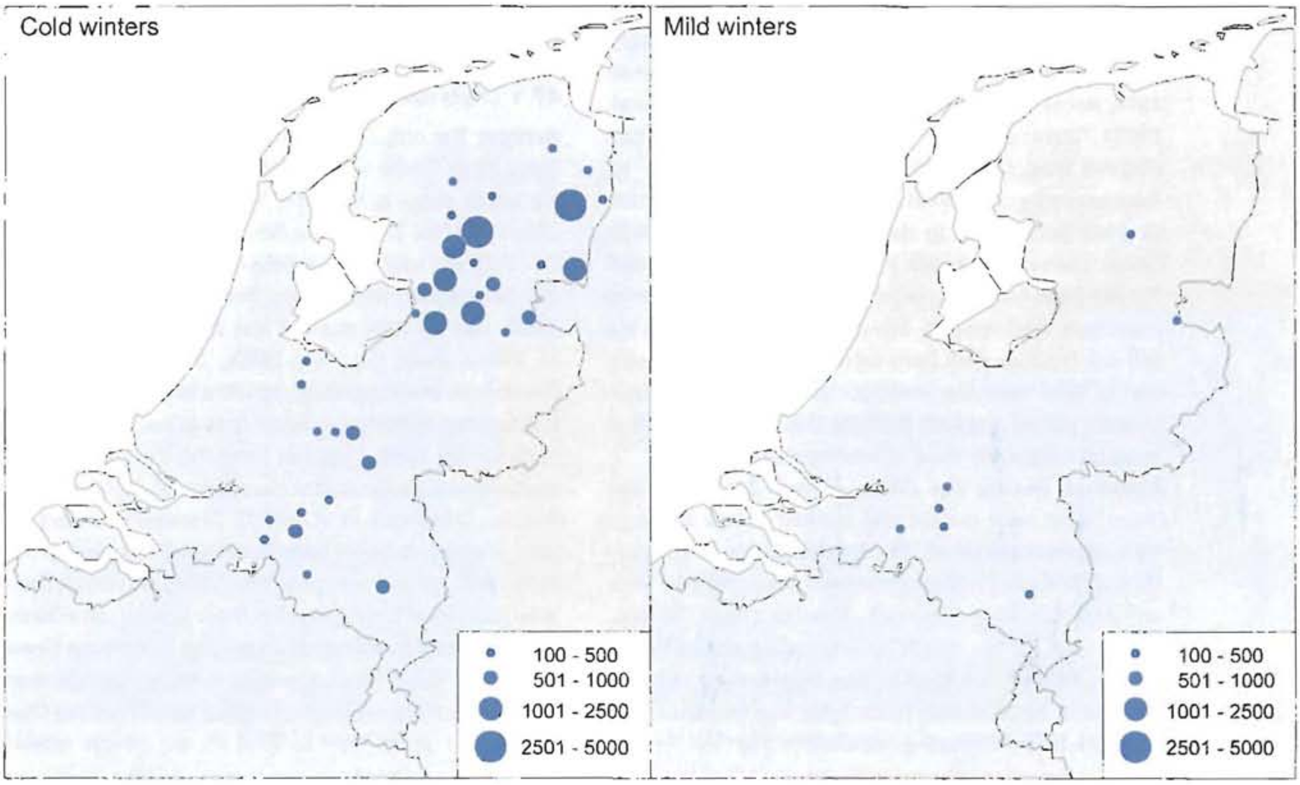

Fig. 1.6. Distribution of Taiga Bean Geese in the Netherlands in cold and mild winters (after Koffijberg et al. 1997).

known wintering bird, the Taiga Bean Goose has obtained the status of scarce or even rare during the last 50 years, only occurring in large numbers during severe winters. The average number of Taiga Bean Geese was c. 1400 during the second half of the 1970s and 1700 in the 1980s (Fig. 1.5, van den Bergh 1985a, Koffijberg et al. 1997). Recent count data suggest that the winter population has decreased to 800 in the 1990s (SOVON Ganzen en Zwanenwerkgroep 1995, 1996) but this apparent decrease is probably due to the subspecies being missed at some sites and/or not all Bean Geese being identified to subspecies level in counts. The wintering population in the 1990s is probably higher, i.e. 1000-1500 birds (Koffijberg et al. 1997). L. van den Bergh (unpubl.) has estimated the number of Taiga Bean Geese for the 1990s at 1460 individuals.

During severe winters, large influxes of Taiga Bean Geese originating from the Baltic wintering population in southern Sweden (Nilsson 1984a, Nilsson & Pirkola 1991) as well as from eastern Germany (L. van den Bergh unpubl.) can be observed in the Netherlands. On average, 17,000 Taiga Bean Geese were counted in 1978-79, 1980-81 and 1981-82, compared to an average of 27,000 in 1984-85, 1985-86 and 1986-87, peaking at 33,000 in the latter season (van den Bergh 1979, 1985a, Ganzenwerkgroep Nederland/België 1984a, b, 1986, 1987a, b, 1989, 1990, Ebbinge et al. 1986, 1987, Lok et al. 1992). However, during the cold spells in the winter 1995/96 and in January 1997, no exceptional numbers reached the Netherlands. In the winter 1995/96, about 1760 were counted whereas in January 1997 numbers reached c. 2000 birds (L. van den Bergh pers. obs.).

4E.3 Research

Census: Regular goose counts in the Netherlands have been carried out since the early 1960s (e.g. Lebret et al. 1976, Rooth et al. 1981, Ebbinge et al. 1986, Lok et al. 1992). Currently, a mid-monthly census scheme is carried out from October to March (SOVON Ganzen- en Zwanenwerkgroep 1995). Since 1975/76 special attention has been given to the occurrence of Taiga Bean Geese (see van den Bergh 1985a). In general, Taiga and Tundra Bean Geese are separated in counts at the most important staging areas. However, many observers are still not familiar with both subspecies and small numbers of Taiga Bean Geese are probably overlooked, both in areas visited regularly by Taiga Bean Geese as well as at many irregularly used wintering sites.

Ringing: During the 1980s, several hundred Taiga Bean Geese were caught and marked (white leg-rings with an inscription) at the regular haunt at Helvoirt (Noord-Brabant) which generated recoveries in west and east Germany, Denmark, Sweden (from the wintering area in the south and breeding areas in the north), Poland and Russia. This information suggests that Taiga Bean Geese from both the northern and southern Baltic wintering populations visit the Netherlands. However, as the majority were marked in a hard winter, the pattern could be somewhat biased. During 1954-86 over 13,000 Bean Geese have been ringed in the Netherlands, of which about 3000 were identified as Taiga Bean Geese (Smit & Burgers 1987, Burgers et al. 1991).

Others: Ecological and ethological research on both Taiga and Tundra Bean Geese wintering in southernmost Netherlands was carried out by van Impe (1980a, b, 1981).

4E.4 Protection and conservation

Hunting legislation: In the Netherlands there is an open season for Greylag, White-fronted and Bean Geese from September until 31 January. Shooting is only allowed from half an hour before sunrise until 1000 h but is forbidden on Sundays and Public Holidays.

Although nearly all roosts of Taiga Bean Geese in the Netherlands are situated in nature reserves, they can be hunted at almost all feeding areas (Anon. 1990, 1993). No information on the hunting bag of Taiga Bean Geese is available but some are amongst the up to 7000 Bean Geese shot annually in the Netherlands (van Oostenbrugge et al. 1991).

Site safeguard: Important roosts for the regular wintering stock of Taiga Bean Geese are situated in the Groote Peel and Dwingelderveld National Parks and in the Kampina, Fochtelooerveen-Esmeer, Engbertsdijksvenen and Bargerveen nature reserves. Only a very small proportion of the feeding grounds is protected.

Agricultural conflict: Although crop damage by geese is an important issue in the Netherlands, due to the limited numbers and habitat choice it does not seem likely that Taiga Bean Geese cause any substantial damage.

4F. GREAT BRITAIN

4F.1 Distribution

Range: The only known British wintering area for the Taiga Bean Goose that has been permanently occupied for many years is the Yare Valley in eastern Norfolk (Parslow-Otsu 1991). The flock which wintered in the Dee Valley in southwest Scotland, and which numbered 400 birds earlier this century, became erratic in the late 1980s and has now more or less disappeared (Owen et al. 1986). Since the early 1980s, 100-150 Taiga Bean Geese have been regularly reported in central Scotland. Colour-ring sightings indicate that at least some of the birds in this flock originate from the Swedish reintroduction scheme described elsewhere (C. Mitchell pers. comm., Cranswick et al. 1992). Moreover, in very recent years Bean Geese have been found at a second site in Norfolk, quite close to the Yare Valley, although there is no indication to suggest that these are the same birds.

Habitat and feeding ecology: The Taiga Bean Geese in the Yare Valley feed on grazing marshes, mainly moving between three different feeding sites (Parslow-Otsu 1991). The geese tend to feed on the poorer quality grass species present in the sward (Allport 1991), especially selecting fields of highest biomass (Sutherland

& Allport 1994). The flock in central Scotland used fresh grass growth covering the bare mud of a reservoir for several winters in the 1980s when the water levels were lowered for maintenance purposes, as well as semi-upland reseeded pasture in the vicinity. In the 1990s, the flock has used upland grass areas, especially reseeded, intensively managed grassland, but studies suggest that the birds are highly mobile and unpredictable in their use of fields. Generally, fields subject to seasonal flooding and without livestock furthest from human disturbance are most used (Cranswick et al. 1995).

4F.2 Abundance

Phenology: In former years, when the number of geese in the Yare Valley was low, arrivals were frequently in January and never earlier than in December (Parslow-Otsu 1991). As numbers have increased, so were first arrivals increasingly seen in late November. Now the first Taiga Bean Geese arrive in mid November and the main arrival is completed before mid December. Normally, geese leave during late February or the first week of March, earlier during mild winters. The close relationship with the geese wintering in northern Jutland in Denmark has been demonstrated over the years by resightings of collared individuals (e.g. Parslow-Otsu 1991). Observations have shown, for example, that the fewer numbers present in 1991/92 compared with the previous winter was due to some birds remaining in Jutland which had wintered in the Yare Valley in 1990/91. The Danish wintering area is also used as a staging area by the British-wintering birds, coordinated observations showing that one flock of geese covered the 650 km between the two sites in 7 h 39 m (Cranswick et al. 1992).

Trends and numbers: The Taiga Bean Goose was apparently common and widespread in Britain in the early part of the 19th century, declining during the latter half of that century. By the middle of this century, there were apparently only three regular flocks: in the Dee Valley, near Loch Lomond and the Yare Valley in Norfolk. In the 1950s, the latter numbered c. 100 but numbers began to increase during the 1970s and continued to build to a maximum count of c. 485 in 1990/91 (Fig. 1.7). In the winter of 1993/94, the Yare Valley flock totalled 305 birds, with a further 365 at the other (apparently new) Norfolk site of Heigham Holmes (probably a cold weather influx). In the same year, the Slammanan flock in central Scotland numbered 135 Taiga Bean Geese.

4F.3 Research

The Yare flock has been studied intensively for a number of years (e.g. Parslow-Otsu 1991, Parslow-Otsu & Kjeldsen 1992), especially since the discovery that some of those neck-banded in southern Lapland staged in northwestern Jutland and then migrated to the Yare Valley. Feeding behaviour and habitat preferences of this flock were the subject of a PhD study in the 1980s (Allport 1991) which has proved important in their effective management (e.g. Sutherland & Allport 1994). The central Scotland flock has been the subject of a study by the RSPB (Cranswick et al. 1995).

4F.4 Protection and conservation

The Bean Goose is fully protected in Britain under the 1981 Wildlife and Countryside Act. The two most important sites in the Yare Valley lack protection status. The Central Scotland flock have been subject to disturbance, and there are a number of threats from opencast coal exploitation of their wintering grounds, from afforestation and from human disturbance, for example, the creation of a shooting range was proposed in the area.

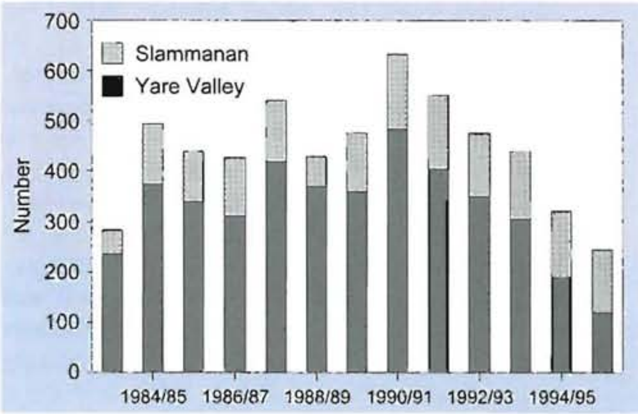

Fig. 1.7. Numbers of Taiga Bean Geese wintering in Great Britain in 1983/84-1995/96. Counts in 1988/89 (Slammanan), 1994/95 and 1995/96 (Yare Valley) are known to be incomplete.

4G. BELGIUM

According to Huyskens (1986), Taiga Bean Geese wintered at several locations in the Kempen area in the north of the country until the 1970s and early 1980s. Haunts were situated near Weelde and Postel, but it seems that no Taiga Bean Geese (or very few) have wintered in these areas in recent years. During 1989, 145 and 105 Taiga Bean Geese were seen along the river Meuse near Maaseik/Aldeneik (Ganzenwerkgroep Nederland/België 1991); small groups are observed each winter in this region with a maximum of 225 in 1995/96 (E. Kuijken pers. comm.). Taiga Bean Geese are only present in very low numbers during severe winters in the polder area, where other species of geese traditionally winter (E. Kuijken pers. comm.).

5. DISCUSSION

Population status: Due to the failure to differentiate between Taiga and Tundra Bean Geese in the count data from Germany and northern Poland, it is difficult to establish the present population status of the Taiga Bean Goose and recent trends in its abundance. Recent autumn expeditions have produced a considerable amount of new information relating to these birds and, as a result, it is estimated that about 30,000 Taiga Bean Geese were found in the region south of the Baltic during the autumn in 1992-1997 (L. van den Bergh unpubl.). Unfortunately, the counts in 1992-1996 were made between the mid-monthly counts in October and November carried out in Sweden, but in most years before the major exodus from southern Sweden. Observations in the autumn of 1997 confirmed that up to 30,000 Taiga Bean Geese were present south of the Baltic in mid October (L. van den Bergh unpubl.), at the same time as peak numbers were recorded in southern Sweden. With the exception of a very low count in 1991, October totals in Sweden have varied between 76,000 in 1989 to about 60,000 in most recent years, whereas November totals have varied between 30,000 and 49,000 for the same period.

The majority of Taiga Bean Geese reach their autumn staging and winter areas via two different routes. One route passes through Finland to staging areas in southern Sweden, continuing on to wintering areas south of the Baltic (although some remain in Sweden). The other route passes through the Baltic States to the areas south of the Baltic. Peak numbers in Sweden generally occur in mid October. Between October and November in recent years, about 13,000-30,000 Taiga Bean Geese leave Sweden going south to Germany and/or Poland (Nilsson & Pirkola 1991). It remains, however, unknown how many of these geese were there at the time of the counts by L. van den Bergh (unpubl. data), but in most years the majority probably arrived later. It might also be that the proportion of Taiga Bean Geese migrating through Sweden or south of the Baltic varies between years which may explain some of the variability in Swedish autumn counts. The Bean Geese leaving Sweden in October/November do not go southwest to Denmark and the Netherlands, as Taiga Bean Geese in those areas arrive much later. When cold periods occur in Sweden in December-January, large numbers of Bean Geese leave Sweden to the southwest for southeastern Denmark and/or northwestern Germany and the Netherlands (Nilsson & Persson 1984, Nilsson & Pirkola 1991). Rutschke & Liebherr (1996) are thus wrong when they indicate that the only migration route for Taiga Bean Geese from Sweden takes them to the southwest.

Assuming that some of the Taiga Bean Geese seen in the southern Baltic in late October and early November arrive directly from the breeding grounds and, as in 1997, arrive already in mid October, about 30,000 Taiga Bean Geese can be added to the October totals obtained in Sweden, giving a population estimate for the Taiga Bean Goose in Europe of 90,000-110,000.

Similarly, with the lack of separation of the two subspecies in German data, it is impossible to determine whether the increase in the Swedish autumn population (from about 20,000 in the 1950s/early 1960s, 40,000 in the 1970s to 60,000-80,000 in the late 1970s/1980s) reflects a genuine trend in the total population of Taiga Bean Geese or whether part of the increase in Sweden is due to changed migration patterns.

Conservation issues: The Taiga Bean Goose is a quarry species in several countries but the species can apparently withstand the present levels of hunting pressure since its numbers increased up to the 1980s and remained more or less stable since then. However, as the population is relatively small, it is necessary to maintain a good monitoring network to assess the situation. It would be especially important in the future to be able to manipulate hunting regulations should the trend in numbers show a serious decline. This is becoming important because of the increase in the general hunting pressure on geese recently in Germany.

Agricultural conflict: Overall, there does not seem to be serious conflict between agriculture and Taiga Bean Geese. Some problems have been reported from Sweden, but in Germany the two subspecies are not normally separated and most problems associated with Taiga Bean Geese probably relate to the Tundra Bean Goose.

Future research needs: For the future management of the Fennoscandian Taiga Bean Geese, it is urgent that the two subspecies are separated in counts. At present, it is impossible to determine whether the Taiga Bean Goose population is stable or increasing. Without identification to subspecies level of Bean Geese staging south of the Baltic, we cannot say whether the increase and later stabilisation of the autumn population in Sweden documented here is real or merely reflecting a redistribution of Taiga Bean Geese between staging areas north and south of the Baltic, i.e. an extension of what has been documented within Sweden in the past two decades. As the distribution of Taiga Bean Geese seems to be most stable in October, there is an urgent need for the numbers present in the southern Baltic sites to be monitored simultaneously with the long-established Swedish October counts.

Whereas the migration patterns, staging areas and winter areas of the Fennoscandian Taiga Bean Geese are well-known as a result of long-term neck-banding programmes (Nilsson 1984a, Nilsson & Persson 1984, Nilsson & Pirkola 1991), there is a disturbing lack of knowledge relating to the more easterly populations of Taiga Bean Geese. Moreover, the eastern limit of the breeding population and the border zone with the Tundra Bean Goose is very poorly known.

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2 Tundra Bean Goose *Anser fabalis rossicus*

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1. POPULATION REVIEW

Throughout the 20th century (but especially since the 1930s) there has been much confusion surrounding the identification and classification of the geographical races of the Bean Geese *Anser fabalis* (Voous 1944, Coombes 1947a, b, Huyskens 1986, Sangster & Oreel 1996). Naumann (1842/1902) and Alphéraky (1905) were the first to try and clarify the "Bean Goose complex". These authors described the Western Tundra race as Bean Goose *Melanonyx segetum* Gmelin, and showed an excellent knowledge of both Tundra and Taiga Bean Geese. Buturlin (1933) renamed the subspecies as *Anser serrirostris rossicus*, but Dement'ev (1936) omitted this race in his revision of the races of Bean Goose.

Delacour (1951, 1954), mainly based on information from Johansen (1945), stated that "the population of northern Russia is mixed *rossicus* and *fabalis*", thereby starting a period of misunderstanding and confusion that was to last for many years (e.g. Ringleben 1957, Bauer & Glutz von Blotzheim 1968, Litzbarski 1974, Rutschke 1973, 1983a, 1987, 1997, Klafs & Stubs 1977, Kolbe 1981, Bezzel 1985) despite the excellent analyses of Coombes (1947a) and Kist (1956). Although Cramp & Simmons (1977) and Roselaar (1977) modified the so called "mixed population" into "*rossicus* or intergrades" (but do not deal with the latter), *rossicus* is still completely ignored by recently published works in Russia (Sokolov 1990) and the Ukraine (Lysenko 1991). On the other hand, Mineyev (1987, 1995) recognised this race, stating that the breeding population of Malozemelskaya and Bol'shezemelskaya Tundras is definitely *A.f. rossicus*. Even to the present day, in most countries where only *rossicus* occurs, they are assigned to a general category of "Bean Geese *A. fabalis*" in goose counts and publications, as if there may be some doubt about their

taxonomic status. In spite of this historical problem, it is now possible to assign most Bean Geese present in the Western Palearctic to the correct race i.e. *fabalis* (Taiga Bean Geese, see Nilsson et al. this volume) or *rossicus* (Tundra Bean Geese). Huyskens (1979, 1983, 1986), van Impe (1980b, 1981a), Erikson (1983) and Sangster & Oreel (1996) suggest classifying the *fabalis* and *rossicus* races as separate species.

1.1 Range

Tundra Bean Geese breed in low arctic northern Russia and western Siberia from the Kola Peninsula in the west (Filchagov et al. 1985, Scott & Rose 1996) to the Taimyr Peninsula (Delacour 1954, Cramp & Simmons 1977). The breeding range extends between the 5°C and 10°C July isotherms (Voous 1960). According to Alphéraky (1905), Delacour (1951, 1954) and others, the boundary between the western form of Tundra Bean Goose *rossicus* and the eastern form *serrirostris* is located on the Taimyr Peninsula.

Bean Geese migrate in late summer and early spring through Russia and the Baltic States (Kischinski 1978, Filchagov et al. 1985) to staging areas in western Poland, eastern Germany, the Czech Republic, Slovakia, Austria, Hungary and Croatia. In Poland and eastern Germany *rossicus* arrives as early as the first half of September, occasionally even during late August, reaching the Pannonic area usually by late September or, more often, during the first half of October (Dick 1987, Faragó 1995). From late October onwards the geese continue, reaching wintering places in western Germany, the Netherlands, Belgium, Luxembourg, France, Spain, Switzerland, Italy, Yugoslavia, Macedonia, Bosnia-Herzegovina, Albania, Bulgaria and Greece (Huyskens 1977, 1986). The wintering range of *rossicus* occurs between the 0°C and 7.5°C January isotherms (van Impe 1987).

Of all Western Palearctic Geese, *A.f.rossicus* is one of the most widespread, occurring in practically all European countries except Iceland and Ireland.

1.2 Delineation of flyways

Bean Geese use two main flyways from the breeding areas, one through the far north, from the White Sea through the Baltic States, the other situated further inland (Kischinski 1978). The breeding population of the Kola and Kanin Peninsulas, Malozemelskaya Tundra and Bol'shezemelskaya Tundra seems to migrate along the White Sea coast via Archangelsk to Lake Onega and Lake Ladoga, via Pskov and Lake Ilmen through the Baltic States to Poland and further west (Kischinski 1978, Filchagov et al. 1985). As both Tundra and Taiga Bean Geese populations of northern Europe use this flyway, what happens south and southwest of Lake Ladoga is not clear. Taiga Bean Geese probably continue their migration both sides of the Gulf of Finland, along the Baltic coast of Estonia, Latvia and Lithuania, whereas

Tundra Bean Geese mainly migrate through the Novgorod/Vitebsk regions, reaching the Polish border mainly between 21° and 24° N and using the coastal route only in small numbers (Fig. 2.1).

The breeding population of Novaya Zemlya, Vaygach, Yamal and Gydan Peninsulas and probably also some geese from western Taimyr migrate first south, following the Ob River upstream to the Chanty-Mansijsk region at c. 60-65° N according to recoveries from ringed geese. From here, they migrate southwest, crossing the Ural Mountains and passing through the valleys of the Kama, Wjatka, Volga and Oka Rivers, to the Moscow region, reaching the Polish border in the Brest region (Kischinski 1978; Fig. 2.1). It is very likely that the majority of this group is heading for central Europe, as suggested by van den Bergh (1984), Huyskens (1986), Dick (1987) and van Impe (1987). The passage of huge numbers of Bean Geese through southeastern Poland and easternmost Slovakia was described by Prazak as early as 1898, so this may long have been the regular flyway to and from central Europe. It seems that an increasing part of this population has changed its autumnal destination during the last ten years, resulting in a large increase in southern Poland (Dyrcz in litt.), eastern Germany (E. Rutschke pers. comm.) and Czech Republic (Hudec & Simec 1994, Anon. 1995, Hudec in litt.) and a dramatic decrease in Hungary (Faragó 1995).

Until the mid 1980s, the majority of this population headed through the extreme southeast of Poland, eastern Slovakia and northeastern Hungary to their Pannonic staging and wintering areas (Fig. 2.2a). Since 1985, an increasing proportion migrates further west, moving into new strongholds near Wroclaw in southwest Poland, where 5000 geese were first reported in October 1986, but where up to 25,000 were counted in 1995 (Dyrcz in litt.). In the southern part of the former East Germany, a dramatic increase has been observed at several locations in the Halle-Leipzig region (E. Rutschke pers. comm.), and in November over 70,000 (1996) and 101,000 (1997) Tundra Bean Geese were seen in the Köthen-Dessau region in the federal state of Sachsen Anhalt (L. van den Bergh pers. obs.). It is very likely that, overall, more than 150,000 geese of this part of the range have changed their seasonal distribution pattern, but they still continue south later on where they contribute to the 'mysterious' concentrations which have been observed in the very south of the Czech Republic and Slovakia in recent years (Hudec in litt., Darolova in litt., Hudec & Simec 1994, Anon. 1995; Fig. 2.2b).

In Poland, the geese from the northern flyway main-

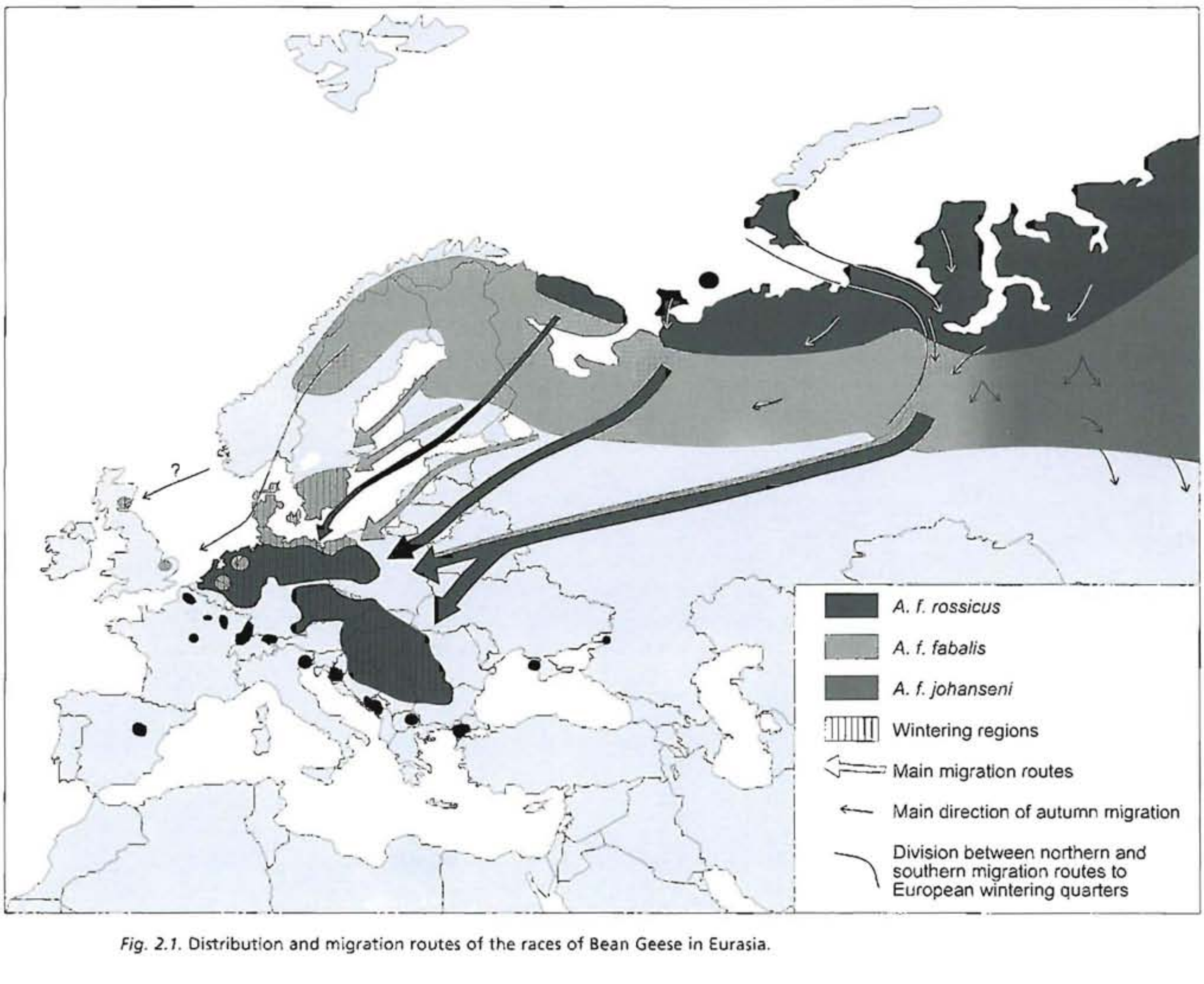

Fig. 2.1. Distribution and migration routes of the races of Bean Geese in Eurasia.

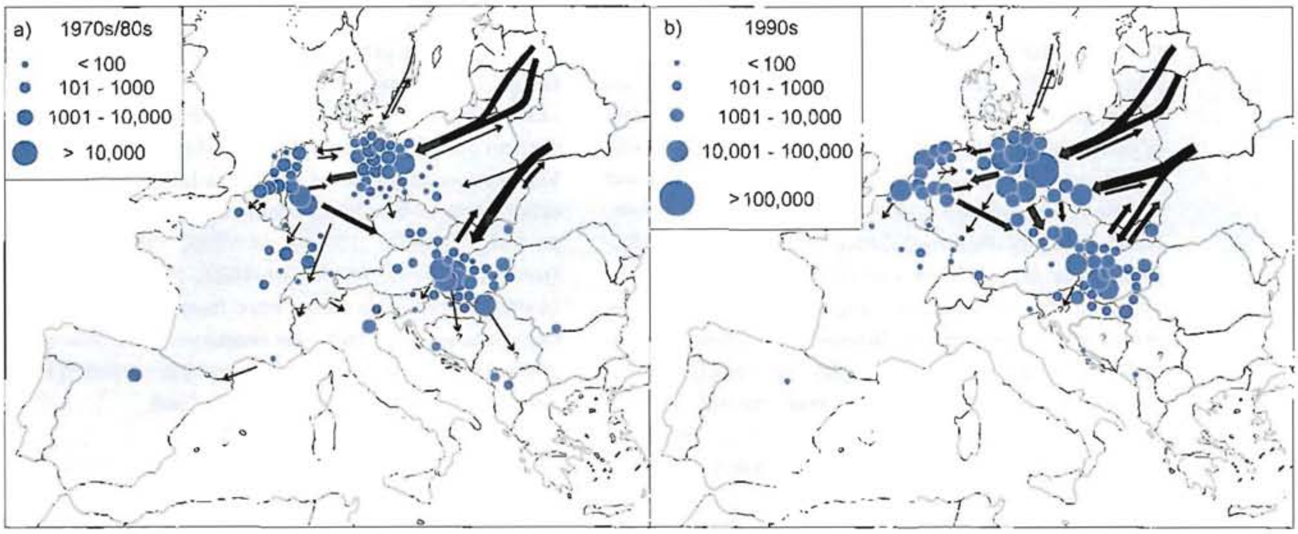

Fig. 2.2. Changes in migration and distribution of Tundra Bean Geese within the European wintering regions: a) during the 1970s and 1980s; b) present situation.

ly move west through Mazurski, Wielkopolski and Pomorski, avoiding the Baltic coast where *A.f.fabalis* mainly occurs, usually as far south as the line Warsaw-Poznan-Frankfurt/Oder (Fig. 2.2). The main stronghold for this group within Poland is the Slonsk reserve near Kostrzin (Majewski 1983), where up to 100,000 Tundra Bean Geese usually stage in autumn (Engel 1991, L. van den Bergh pers. obs.). In October 1996, over 150,000 Tundra Bean Geese were counted in the Slonsk area (L. van den Bergh & B. van Jaarsveld pers. obs.), and in late October 1997, c. 180,000 (L. van den Bergh pers. obs.).

In eastern Germany, *rossicus* is also mainly found inland, reaching the Baltic coast in substantial numbers near Wolgast, Barth, Ribnitz-Damgarten and Wismar-Dassow (Fig. 2.2), and only a few staging on the island of Rügen (Dittberner & Hoyer 1993, L. van den Bergh unpubl.). The most important areas within the northern part of eastern Germany during early autumn are Oderbruch, Lake Galebeck, Lake Müritz, Lake Guelpe and Neolithteich near Köthen.

From the southern Baltic, some geese from the northern flyway (usually 50,000-60,000 birds in mild winters) move to wintering areas in western Europe, whereas the majority of this stock remains in the region, dispersed into numerous small flocks scattered all over westernmost Poland and eastern Germany. Considerable numbers will move south and southeast in December/January to the Czech Republic, Slovakia and the Pannonic region (Fig. 2.2). The wintering *rossicus* population in Spain, which has now almost disappeared, probably reached their wintering region via Switzerland, northwestern Italy and southern France. This is supported by recoveries of two geese ringed in the same flock at Lake Guelpe in November 1973 one of which was shot near Alessandria (Italy) in December 1973, the other bird was shot on 15 December 1973 near Eibar in the very north of Spain (Litzbarski 1979).

The wintering numbers in Italy, which have also now nearly disappeared, probably originated from the Pannonic group, reaching Italy usually through the Transdanubian plain, Croatia and Slovenia (Parodi & Perco 1980), although the goose shot near Alessandria was possibly also heading for the Po Delta.

In late winter and spring, the migration routes are more difficult to determine but, in the south Baltic region, Estonia, Latvia, Lithuania and Russia, the majority of the geese are seen along the same flyways as in autumn (Zhelnin 1962, Kumari 1972, Kischinski 1978, Filchagov et al. 1985). In Belarus, much higher numbers of *rossicus* stage on spring migration, over a considerably broader area and following a more southerly route than in autumn (Kozulin et al. 1995, Kozulin & Mongin 1996). However, in the southern Baltic region the numbers always have been substantially less in spring than in autumn (Rutschke 1983a, Engel 1991). This may be the result of shooting and natural mortality during winter, but a contributory explanation must be that the population divides during the latter part of the season. At least some of the Tundra Bean Geese wintering in western Europe move back through the Pannonic region in late winter (van den Bergh 1984, van den Bergh & Philippona 1986). Perhaps the mass migration of geese (including up to 35,000 Bean Geese, on Hortobagy Puszta on the Great Hungarian Plain during the latter part of February 1992 (Kovacs 1992)) included birds from winter quarters in western Europe. More support for this hypothesis comes from the observation of 50,000 White-fronted Geese *Anser albifrons* in Hortobagy at the same time.

Although there is bound to be some mixing amongst the entire population during the course of a winter, the absence of substantial numbers of ringing recoveries from breeding areas east of the Ural Mountains gives at least some evidence for the fact that the Asiatic birds usually occur in regions where no ringing has taken place (i.e. central Europe).

1.3 Population trends

As *rossicus* is scattered over almost the entire European continent in winter it will always be difficult to assess the real trends in the size of the population as a whole (Fog 1982, Huyskens 1986). As is discussed above, regional shifts in distribution can give a false impression of decreases or increases in population size. The traditional method of estimating population size by mid winter censuses is not appropriate for the Bean Goose, which is highly dispersed throughout almost all of Europe by that time. It is therefore recommended that censuses should be carried out during a short period between 15 October and 15 November, covering all important staging areas within the two main regions, namely the southern Baltic and central Europe (Huyskens 1986, L. van den Bergh unpubl.). Based on the experience of G. Huyskens and P. Maes as well as the results of recent observations (see below), the total population of *rossicus* wintering in Europe certainly exceeds 300,000 birds, as estimated by Wetlands International (Madsen 1991, Rose & Scott 1994), but could number at least 600,000 birds or possibly even more.

Numbers of Tundra Bean Geese on the two flyways (see section 1.2 above) total at least 275,000 (White Sea/Baltic flyway) and 325,000 (inland flyway), and the total number seems to have been more or less stable over the last 20 years (Huyskens 1986, L. van den Bergh unpubl. data 1995-97). Russian ornithologists familiar with numbers on the breeding areas describe decreasing numbers on the eastern tundras of Gydan and North Yamal, whereas numbers are apparently increasing on the western tundra (Flint & Krivenko 1990, Rogacheva 1992, Kalyakin 1995). It is therefore of great importance to continue to gather good overall population census data in the years to come.

1.4 Breeding success

Seasonal assessment of the proportion of juveniles in flocks of wintering Tundra Bean Geese in western Europe (mainly the Netherlands and west Germany) was carried out during 1976-79 (van Impe 1980b, 1981b) and during 1981-1997 (Ganzenwerkgroep Nederland-België 1986, 1987a, 1987b, 1989, 1990, 1991, 1992, L.

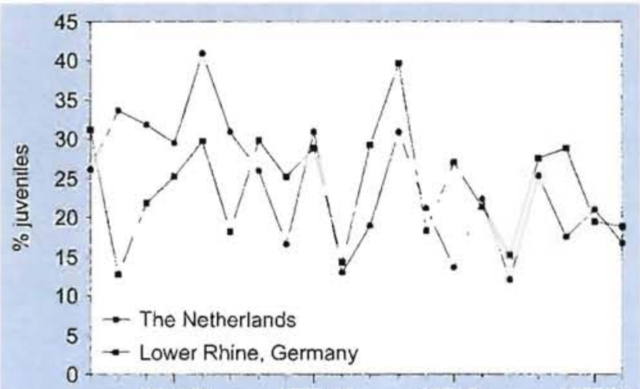

Fig. 2.3. Proportion of first winter Tundra Bean Geese in the Netherlands and in the lower Rhine area in Germany, 1977/78-1996/97. Sources: van Impe (1981b), Ganzenwerkgroep Nederland/België (1984a, b, 1986, 1987a, 1987b, 1989, 1990, 1991, 1992), Mooij (1996), L. van den Bergh (unpubl. data).

van den Bergh unpubl., Mooij 1996). These counts showed that the percentage of juveniles in Tundra Bean Geese varied greatly from year to year, from 41% (1981) and 31% (1982, 1985, 1988) to 9.1% (1992), with an overall average of 21.7% (15 seasons)(Fig. 2.3). Very few assessments of age ratios have been made in other parts of the distribution range, although 10.5% (n=607, 1992), 23.4% (n=205, 1994), 19.8% (n=4325, 1995), 18.1% (n=4423, 1996) and 23.8% (n=6153, 1997) juveniles were found in eastern Germany and western Poland in recent years. In November 1995, 16.7% juveniles (n=480) were recorded in Hungary (all L. van den Bergh unpubl. data).

1.5 Mortality

No annual mortality estimates for Tundra Bean Geese could be found in the literature but given the high hunting pressure in many countries throughout its range (breeding, staging and wintering regions) it is likely to be high. Hunting bag statistics for most species only record the total numbers of all huntable goose species (see Table 5.3 in Mooij et al. this volume), and it is very difficult to determine what proportion of the total bag would have been Tundra Bean Geese. However, in 1985, 11,346 geese - mainly Tundra Bean Geese - were shot on the Little Hungarian Plain (Faragó 1995) and, according to Musicz (1990), the average annual goose bag at Tata (Hungary) is 1000 geese, it is clear that during the non-breeding period hunting mortality is high. The most recent estimates suggest that an average of at least 40,000 Tundra Bean Geese are shot annually in the European wintering countries (van Roomen & Madsen 1992), although it seems certain that this estimate is too low. As substantial numbers of geese would also be wounded and die later, the total annual loss of birds could be as high as 60,000-80,000, which would equate to 10% or more of the total population. A considerable number of geese are also shot in Russia and western Asia in spring, summer and early autumn before natural mortality and predation are taken into consideration. Hence, estimates of 25-30% mortality by several authors for the White-fronted Goose (Rutschke 1987, Ebbinge 1991, Mooij 1995a, 1996) seem to be a reasonable estimate for Tundra Bean Geese too.

2. BREEDING GROUNDS AND BREEDING ECOLOGY

2.1 Distribution

Range: Tundra Bean Geese breed in the tundra subzone of northern Europe and northwestern Asia, from the Kola Peninsula to Taimyr. According to Filchagov et al. (1985) and Scott & Rose (1996), the Iokanga River (66° N, 40° E) on the Kola Peninsula seems to be the westernmost breeding area, with decreasing numbers south of the Strel'na River. This means that all breeding areas on Kola Peninsula are situated north of the Arctic Circle, and this is very probably the case for the entire nesting range of *rossicus*. However, there has been little study of the southernmost extent of breeding *rossicus* and the northernmost breeding limit of *fabalis*. Tundra Bean Geese also breed on the islands of Kolguyev, Novaya Zemlya and Vaygach but at the present the majority of the northern Russian breeding population seems to occur on Malozemelskaya and Bol'shezemelskaya Tundras, according to ringing recoveries during the breeding season (Burgers et al. 1991, see also Mineyev 1981, 1987, 1995). On Novaya Zemlya, Bean Geese breed mainly in the south, north to Matochki Shar at 73° N (Kalyakin 1995). Von Heuglin (1872) stated that *Anser segetum* (a synonym for *A.f.rossicus*) was the most numerous breeding goose species on Novaya Zemlya, especially breeding inland near lakes and small rivers. East of the Ural Mountains they are found breeding on Yamal and Gydan Peninsulas with very few on western Taimyr. According to J. Mooij (pers. comm.), Bean Geese breeding in central and eastern Taimyr are *A.f.serrirostris*. Rogacheva (1992) and Kalyakin (1995) indicate that the breeding population of the tundra in western Siberia (Taimyr, Gydan-Yamal) has tended to decrease, whereas that of the Russian tundra is showing some increase in numbers.

Habitat and feeding ecology: Tundra Bean Geese breed on various types of open tundra, especially on sedge and grass vegetation near lakes or rivers. They feed (on Taimyr Peninsula) on cottongrasses (*Eriophorum scheuchzeri, E. angustifolium*), *Arctophila fulva, Carex stans, Equisetum arvense* and to a lesser extent *Equisetum variegatum, Oxytropus middendorffii* and leaves of *Salix reptans* and *S. polaris* (E.V. Syroechkovsky pers. comm.). During arrival and nesting the geese can greatly affect the cottongrass and moss tundra by their feeding activity, whereas during the moulting period, *Arctophila* brushwood and moss tundra are also exploited and may also be particularly affected by goose foraging activity. After the moulting period, the geese feed on the meadow grass associations in the flooded meadows along the rivers. Over 20% (rarely up to 90%) of the cottongrass-moss associations and meadowgrass associations seemed to be damaged by the geese during that period (Zharkova & Borzhonov 1972).

Breeding biology: Tundra Bean Geese arrive on their breeding areas from the first half of May (Kola-Kanin Peninsulas), but mainly during the latter part of this month or even in the first half of June. On the Kanin Peninsula, the passage of non-breeding birds lasts until at least 28 June (Vinogradov 1994). According to the observations of Mineyev (1987) the spring arrival of *rossicus* on Yugorskiy Peninsula (69° 36' N 60° 13' E) begins during 9-24 May with a peak arrival between 28 May and 15 June. On Novaya Zemlya their arrival starts in late May and lasts until mid June (Litvin & Syroechkovsky 1996) The geese usually arrive in pairs or small flocks of less then 20 birds (Filchagov et al. 1985). After a short period of territorial display the geese rapidly settle and start breeding. The geese are usually very faithful to breeding places, returning year after year to the same spot. Nests are usually built in marshy tundra, often on a hummock close to open water (Filchagov et al. 1985); on the Kanin Peninsula nests are found on raised tundra areas, amongst dunes and on coastal flats (Vinogradov 1994). However, the distribution of the nests in a particular area depends also on the type of the vegetation as well as snow cover (Litvin & Syroechkovsky 1996).

Breeding starts from the third week of May (in the western part of the range) and mid June in the eastern and northern regions (Filchagov et al. 1985, Syroechkovsky et al. 1992, Litvin & Syroechkovsky 1996). No accurate assessment of the density of breeding pairs seems to exist for substantial parts of the breeding range, but during 1986-1988 21, 20 and 60 nests respectively were found in a 20 km² area on Vaygach Island (Syroechkovsky et al. 1992) Altogether more than 500 nests were found during 1986-1988 and 1994-1995 in a study area covering Novaya Zemlya, Vaygach Island and Yugorskiy Peninsula. During 1986, 1987, 1988, 1994 and 1995, average breeding density on Vaygach Island was 2.14 nests/km² compared to 0.2 and 0.6 nests/km² respectively on Novaya Zemlya (1994) and Yugorskiy Peninsula (1995; Litvin & Syroechkovsky 1996). Decreasing densities of breeding Tundra Bean Geese were reported for the period 1950-95 on the Taimyr Peninsula (Table 2.1). Clutch size is 3-6, rarely up to seven eggs, which hatch within 23-29 days (26 days according to Mineyev on Bol'shezemelskaya Tundra, but 23-25 days reported by Litvin & Syroechkovsky (1996) on Vaygach Island).

Table 2.1. Breeding densities of Bean Geese on the Taimyr Peninsula since the 1950s according to Uspenski (1965), Kokorev (1985) and J. Mooij (pers. comm.).

	Western Taimyr *A.f.rossicus* (nests/km²)	Eastern Taimyr *A.f.serrirostris* (nests/km²)
1950-59	5	5
1960-69	2.1 (1.7-2.5)	3.7 (1.5-6.0)
1970-79	0.2 (0-0.3)	1.8 (1.4-2.1)
1980-89	0.1 (0-0.2)	0.2 (0.1-0.6)
1990-95	0.1 (0-0.2)	0.1 (0.1-0.2)

Under favourable circumstances, first chicks appear in the western breeding range during 20-30 June, but in years with late springs, this is delayed until early July (Filchagov et al. 1985). Nesting success on Vaygach Island during 1986-1988 was 4.0%, 84.6% and 95.5% respectively, compared to 44.4% (n=9) and 37.5% (n=24) on Novaya Zemlya and Yugorskiy Peninsula in 1995 (Litvin & Syroechkovsky 1996). On the Kola Peninsula, brood sizes of 1-8 chicks were reported for "Bean Geese" during the 1978 breeding season compared with a mean of 3.5 in 1978 and 1979, decreasing to 3.1 by the time the primary feathers started to grow (n=87 families). In 1980, an average of 3.8 young per pair fledged at Jokange on the Kola Peninsula (n=16 families), where first fledging young were seen during 7-12 July, compared to 18 July on Bol'shezemelskaya Tundra. There is little variation in fledging time within regions (Filchagov et al. 1985).

2.2 Moult migration and moulting areas

From late June onwards, non-breeding Bean Geese (mainly 1-2 year-olds but also including failed breeders) migrate to large or medium sized lakes, surrounded by marshy shores with sedges, grasses, willow scrub, etc. On the Terskiy Bereg (Kola Peninsula), the flock-size of moulting geese (probably *rossicus* and *fabalis*) ranged from 20-60 to 100-150 birds (Filchagov et al. 1985). Bianki (1981) estimated the population of moulting Bean Geese on the Kola Peninsula at 24,000 (1975) and 36,000 (1976), whereas Mineyev (1981) found 115,000 (1973), 129,000 (1974) and 175,000 (1975) moulting Bean Geese on Bol'shezemelskaya Tundra. Scott & Rose (1996) report that 15,000 Tundra Bean Geese moult in the Lumbovka-Ponoy-Reka District, and 50,000 on Vashutkiny, Padimeyskiye and Khargeyskiye Lakes (68° N 62° E). On large lakes on the Yugorskiy Peninsula and Vaygach Island, up to 2000 moulting Bean Geese have been observed, with smaller flocks scattered over small lakes along the coast (Syroechkovsky & Litvin in litt.).

Moulting Bean geese usually stay close to the water, occasionally some hundred meters away from the shoreline. If alarmed the geese will run to the nearest water surface, gathering in a compact flock as far offshore as possible. Moulting of flight feathers takes about 22 days and the majority of Tundra Bean Geese finish this by the second week of August in the west of the range (Filchagov et al. 1985), somewhat later further east. Breeding adults start moulting two weeks after hatching and are capable of flight again at the same time as their chicks. Moulting geese feed especially on the fresh leaves of *Carex aquatilis, C. rotundifolia, C. rariflora, Eriophorum* spp., *Nardus stricta* and *Ranunculus pallassii*. Immediately after the moulting period, the geese fly to coastal tundra areas, feeding on berries of *Rubus chamaemorus, Vaccinium uliginosum, Arctostaphylos alpina* and *Empetrum* spp. and, to a lesser extent, leaves of grasses and sedges (Filchagov et al. 1985).

2.3 Research

Although some excellent Russian authors such as Alphéraky (1905), Zjitkov & Buturlin (1901), Buturlin (1933), Dement'ev (1936), Dement'ev & Gladkov (1967) and Uspenski (1965, 1984) have published books or articles dealing with Bean Geese and despite a variety of research carried out in the breeding and moulting areas, there remains a considerable lack of information on the species. Most articles and books published in the former USSR are difficult to obtain in western countries and are only published in Russian. Since 1989, joint Russian-western European goose research programmes have been established on the breeding areas. Until recently, these programmes concentrated on Brent Geese *Branta bernicla* and White-fronted Geese, but there are now plans to pay increasing attention to Bean Geese in the future. Recent investigations of distribution and ecology of geese and swans were carried out in northwest Siberia (Kalyakin 1995), on Novaya Zemlya, Vaygach Island and Yugorskiy Peninsula (Syroechkovsky et al. 1995, Litvin & Syroechkovsky 1996), on Yamal Peninsula (Ryabitsev 1995) and on Kanin Peninsula (Filchagov 1995).

2.4 Protection and conservation

Hunting legislation: Geese are favoured quarry for local people and sportsmen from abroad throughout Russia and the republics of the former USSR. In the breeding areas, eggs, juveniles and moulting geese have traditionally been harvested by the native inhabitants of northernmost Russia and Siberia (Alphéraky 1905, Seebohm 1901). Today, geese are still an important source of meat for local inhabitants and many are shot or killed on the nest (Vinogradov 1994). According to Zjitkov & Buturlin (1901) White-fronted Geese were easier to shoot than Bean Geese on the Yamal Peninsula as the latter were very alert and shy.

The declines in the western Siberian population of Tundra Bean Geese in recent years (Rogacheva 1992, Kalyakin 1995) could be partly the result of heavy hunting pressure in the main staging area of the Chanty-Mansijsk District, where some 186,000 geese (albeit unidentified to species) were shot on spring migration in 1984 and 1985 (Majewski in Kalchreuter 1991). This total conflicts with the estimated 50,000-70,000 geese shot annually in the entire territory of the former USSR stated elsewhere in Kalchreuter (1991). Hence, much better goose bag statistics are required in order to explain these changes in status of the Tundra Bean Goose and to assess the impact of hunting on this population.
Site safeguard: Although some regular staging areas used by Tundra Bean Geese are protected, the majority of the breeding areas are apparently unprotected at present.
Agricultural conflict: None.

3. STAGING AREAS

Tundra Bean Geese leave their breeding areas mainly during late August/early September. The geese fly 2500-5000 km, mainly through western Siberia and northern Russia, along migration corridors described above. Along these flyways, several important staging areas exist, at which the geese usually stay for a short time during autumn while a stay of longer duration is made during spring. Goose migration, including Bean Geese, in countries which were part of the former USSR has been described in Kischinski (1978), Kumari & Jógi (1972), Zhelnin (1962) and Kozulin et al. (1995).

3A. REPUBLICS ON THE TERRITORY OF THE FORMER USSR

3A.1 Distribution

Range: Migrating from their breeding grounds in northern Russia, Tundra Bean Geese concentrate for some time along the coast and in certain river valleys. Important areas are Mezenskaja Bay and lower Mezen

River, Dvinskaja Bay and lower Severnaja Dvina, the Archangelsk region, Onezskaja Bay, Lake Onega, Lake Ladoga and Lake Ilmen. From there, the majority of the geese seem to fly directly to western Poland and eastern Germany, with only a few important staging haunts mainly in Latvia and Lithuania (Kumari 1970, Kumari & Jógi 1972, Svazas et al. 1989, Raudonikis & Svazas 1991, Zhelnin 1962, 1981). The Lubana Lowlands in Latvia and Lake Zuvintas in Lithuania are of considerable importance to the geese, where 10,000-19,000 Tundra Bean Geese occur on autumn migration (Scott & Rose 1996). According to recent observations in Belarus, autumn migration occurs during the period mid September to late October, with the majority of geese passing through during the first half of October (Kozulin et al. 1995).

The second main flyway, coming from western Siberia, follows the Ob upstream, with important haunts especially in the Chanty-Mansijsk District. This area is also used as a staging area in spring as shown by the considerable numbers of ringing recoveries from this area (Vogeltrekstation Arnhem). In the Chanty-Mansijsk region both Tundra and Taiga Bean Geese occur, but the majority are *rossicus*. The information given by Scott & Rose (1996) that only *fabalis* occurs in this region during migration, is not correct.

Further southwest, staging areas are situated in the valleys of the Kama, Wjatka, Volga and Oka Rivers (Panchenko & Priklonski 1972) and very probable also in some other areas throughout Russia and northern Ukraine. In spring, considerable numbers stage in the Prypiat area of Belarus, where about 10,000 Tundra Bean Geese were counted in 1995 (Scott & Rose 1996). According to Lysenko (1991, pers. comm.), *rossicus* is a scarce migrant in southern Ukraine, but probably considerable numbers pass or even remain for some time in northern Ukraine. In the Ukrainian part of the Danube Delta, the Bean Goose is a rare migrant, seen in small flocks during October-November and March-April, and only occasionally recorded during winter (Zhmud 1996a, b). The occurrence of Russian Tundra Bean Geese on migration along the eastern coast of the Azov Sea, as mentioned by Scott and Rose (1996), is questionable; Ardamatskaya (1996) states that Bean Geese are rare during migration and winter in the northern Black Sea area. Although a proportion of Bean Geese breeding in western Siberia migrate to central Asia, these birds are thought mainly (if not entirely) to be Taiga Bean Geese as described by Alphéraky (1905). Recent field observations by Belik (1996) found no Bean Geese on passage through the north Caspian area during autumn.

Habitat and feeding ecology: Geese switch from natural food to mainly agricultural crops during the course of the autumn. During their stay in the White Sea-Lake Ladoga/Onega region and in the valleys of rivers further inland, they mainly feed on various types of arable crops during late summer and autumn, whereas during spring the majority feed on grassland and cereals but also in natural or semi-natural floodplains.

3A.2 Abundance

Phenology: Based on recovery data from ringed geese (Vogeltrekstation Arnhem), Tundra Bean Geese mainly leave their breeding range before mid September, with only a few remaining until early October. The majority of geese pass through the republics of the former USSR during September and October, while a few geese probably remain to winter in southern Ukraine. Spring migration starts before the end of March with strong passage during April and the first half of May, lasting until the latter part of this month or early June (Kischinski 1978, Filchagov et al. 1985). In Belarus, the duration of the spring migration is 15-30 days, although most birds pass through within a 14-day period (Kozulin et al. 1995).

Trends and numbers: During the last 30 years, remarkable changes in numbers of Bean Geese have been reported from the Baltic States but as both *fabalis* and *rossicus* occur in the region it is difficult to know which race is involved. Kumari & Jógi (1972) highlighted peat moor areas as staging habitat in Estonia, so this may suggest that mainly Taiga Bean Geese are involved. In all republics of the former USSR, there is a complete lack of information about Tundra and Taiga Bean Geese. Analyses of annual counts depends heavily upon our knowledge of the flyways of the two sub-species. As *fabalis* seems to be a typical coastal migrant in the Baltic area (Huyskens 1986, L. van den Bergh unpubl. data), it is likely that the majority of the Bean Geese migrating through the Baltic States (especially in the west) belong to the Taiga race. Raudonikis & Svazas (1991) described two flyways through Lithuania: one along the Baltic coast, the other more inland. Their suggestion that the latter may be used mainly by geese from the western Siberian population is probably incorrect. It seems much more plausible that the birds migrating along the coast are part of the Russian-breeding *fabalis*, heading for wintering areas mainly in eastern Germany, whereas the inland flyway is mainly used by Tundra Bean Geese from northern Russian tundra, west of the Ural Mountains.

3A.3 Research

Research on geese is mainly carried out in the northern breeding and moulting areas, whereas regular censuses of staging and wintering geese are mainly made in southern Ukraine and in reserves such as Oka and Chanty-Mansijsk.

3A.4 Protection and conservation

Hunting legislation: In the states of the Russian Federation there is a 10 day spring hunting season with a daily bag limit of two geese per hunter. The opening date varies locally depending on the timing of the migration. This means that the geese can be hunted from their entry into westernmost Russia right the way to their breeding grounds. There is also an open season post breeding, again depending on the passage of the geese, generally extending from the second Saturday in August or the first Saturday in September until c. 30

September. Since 1988, the native people of the arctic region are entitled to make a living by the exploitation of all waterfowl species, throughout the breeding season, except those that appear in the Red Data Book.

Although no accurate data on the numbers of Tundra Bean Geese shot annually are available, estimates (Majewski in Kalchreuter 1991) suggest some 200,000 geese are shot annually, of which a large number will be of this subspecies.

Site safeguard: Within the migration routes several protected areas are established such as Ustje Obi (Ob River mouth) and Dvuobje in the Chanty-Mansijsk District of Middle Ob River, the Oka valley, Pskovsko-Chudskoye Lakes and some haunts in Estonia, Latvia and Lithuania, but the geese are unprotected outside these reserves.

Agricultural conflict: As the Russian name for the Bean Goose (Gumennik) means "thresher", a vernacular name for birds that feed on harvested fields (Dement'ev & Gladkov 1967), they have clearly long been familiar with arable fields and the agricultural community. No data regarding crop damage caused by geese are currently available.

3B. FINLAND

As Tundra Bean Geese breed and moult on the Kola Peninsula and pass through southern Sweden (Persson 1990, pers. obs.) it is very likely that some migrate through Finland, using the same flyway as *fabalis* described by Lampio (1961, 1984) and Nilsson & Pirkola (1991). If this is the case, the Tundra Bean Geese seen in southern Sweden probably mainly originate from the Kola Peninsula breeding population. Tundra Bean Geese migrating from the White Sea and Lake Onega during autumn, stage in the southeastern-most part of Finland (van Impe 1987).

3C. SWEDEN

3C.1 Distribution

Range: Tundra Bean Geese visit Sweden mostly during autumn migration, usually in very small numbers, and at the same haunts frequented by Taiga Bean Geese (Persson 1990, 1997).

Habitat and feeding ecology: In Sweden, Tundra Bean Geese are usually accompanied by large numbers of Taiga Bean Geese, feeding in the same areas.

3C.2 Abundance

Phenology: Tundra Bean Geese are mainly observed in October and November in southern Sweden, with very few records in September, December, February, March and April (Persson 1990).

Trends and numbers: Usually very small numbers of these geese are seen, although larger flocks have been noted: 350 at Odemarksgården in October 1987, 400 near Vombsjön in October 1977 and 250 at Trolle Ljungby in October 1975 (Persson 1990). During late October 1994, 191 Tundra Bean Geese were seen among 29,750 Taiga Bean Geese throughout southernmost Sweden (L. van den Bergh unpubl.). One of these birds, seen at Lake Tåkern, was ringed at Lake Guelpe, Germany, in October 1992. Another goose marked at Lake Guelpe in October 1989 was observed near Trolle Ljungby in October 1993 (L. van den Bergh unpubl), and at Härnevi in Uppland Province on 11 April 1995 (Persson 1997). These observations provide at least some evidence that small numbers of geese from the southern Baltic autumn population migrates through southern Sweden to eastern Germany.

3D. NORWAY

A very few Tundra Bean Geese pass through Norway in late summer or autumn.

4. WINTERING AREAS

The most important wintering areas of Tundra Bean Geese are situated in the southern Baltic (western Poland and eastern Germany), the North Sea area (western Germany, the Netherlands, Belgium) and in central Europe (Czech Republic, Slovakia, Austria, Hungary Slovenia and Croatia), with usually smaller numbers visiting almost all countries on the European continent.

4A. ALBANIA

4A.1 Distribution

Range: The situation in Albania is poorly known, but Nowak (1980) stated that Bean Geese were "numerous" when he visited the country in 1977. Important haunts are situated along the coast near Shengijni, in the delta of Mati River, at Vlora and probably also at Lake Prespansko Jezero.

Habitat and feeding ecology: No data available, but it seems likely that they exploit the modern agricultural production areas, established during the last 40 years throughout the country.

4A.2 Abundance

Phenology: No data, but as the country is situated at the southern border of the distribution range of *rossicus* it seems very likely that these birds will be here from December until February.

Trends and numbers: No information. No Bean Geese were seen during mid winter census 1994. However, a goose ringed in December 1973 at Lake Guelpe, eastern Germany, was shot in February 1989 on Lezha Isle, Albania, the southernmost recovery of a neck-collared Tundra Bean Goose to date (Helbig 1994).

4A.3 Research

None known.

4A.4 Protection and conservation

No information.

4B. AUSTRIA

4B.1 Distribution

Range: Tundra Bean Geese are usually found in the lower lying parts of the country, especially east of Lake Neusiedl in the Lange Lacke - Seewinkel - Hanság area, roosting in Austria but mainly feeding in Hungary (Leisler 1969, Dick 1987, Faragó 1995). Regular haunts are also situated on the plains of Danube River between Krems and Hainburg and in Vorarlberger Rhinedelta at Bodensee. In the northeast of the country, flocks of various size can be found feeding east of Laa an der Thaya. These birds originate from roosts on the Nové Mlyny Reservoir, north of Mikulov, in the Czech Republic. Small flocks of Tundra Bean Geese occur along the Morava/March Rivers north of Dürnkrut.

Habitat and feeding ecology: In Austria, Tundra Bean Geese are mainly found in agricultural areas on stubble fields, on fields with remains of maize and sugar beet and on winter cereals. Bean Geese feed mainly on maize (85%) and winter cereals (14%) in autumn and using these crops 11% and 89% respectively in spring. During winter they prefer to feed on winter cereals (Dick 1992). Roosts are situated in salt lakes in the Seewinkel/Hanság area, especially on Lake Fertö (Hungary) and Lange Lacke, on banks along the Danube and Morava/March Rivers and on Bodensee.

4B.2 Abundance

Phenology: The first Bean Geese usually arrive during the second half of October in the Neusiedlersee area, but sometimes as early as late September (e.g. one shot on 22 September 1976 near Absdorf, Niederösterreich (Litzbarski 1979)). Pronounced influxes often occur during the first half of November, continuing until December. In mid winter, *rossicus* can be found scattered over most haunts in the country, but from mid February they concentrate in the Neusiedlersee region again. The majority of the geese leave during the first half of March, only very few birds remaining until the latter part of the month.

Trends and numbers: Numbers of Bean Geese seem to be more or less stable over a longer period of time, but depending on weather and food conditions they can fluctuate from year to year. Although Dick (1992) stated that numbers of Bean Geese were stable (with an average of 20,000 birds during autumn) annual peak numbers have decreased in Neusiedlersee area as well as on the Danube Plain. This may be an effect of the newly established stronghold at Nové Mlyny in South Moravia, Czech Republic. Since the 1992/93 season, the numbers of Tundra Bean Geese staging in the Neusiedlersee region have decreased dramatically. In recent years only up to 7000 Bean Geese were counted in this area during autumn migration. Simultaneously, numbers have increased in South Moravia as well as on the Danube Plain in Slovakia (Dick et al. 1994, A. Darolova in litt., K. Hudec in litt.).

4B.3 Research

Research on waterfowl and wetlands is mainly carried out in the Neusiedlersee-Seewinkel area, but no special attention is paid to Bean Geese. Important information has been published by Leisler (1969), Lebret (1969) and Dick (1987). The annual waterfowl and goose census programme covers most of the important haunts in Austria (Dick et al. 1994).

4B.4 Protection and conservation

Hunting legislation: In the federal state of Burgenland, the main staging and wintering region in Austria, the hunting season extends from 1 August until 31 January without any bag limit or other restriction. Geese are often hunted very close to their roosts, sometimes from neighbouring vineyards or from hides in the feeding areas. The annual goose bag increased from c. 2000 geese during the 1960s and 1970s to c. 3000 geese during the 1980s, then decreased to c. 1500 geese during the beginning of the 1990s, mainly shot in Burgenland (82%). The goose bag includes Greylag Geese *Anser anser*, White-fronted Geese and Bean Geese (Dick et al. 1994).

Site safeguard: As the Neusiedlersee-Seewinkel area has been a Ramsar site since 1982 and has had the status of National Park since 1992, at least part of this important region is now well protected. However, increasing agricultural activities, especially viticulture and the transformation of semi-natural grassland into arable farmland, has changed a major part of this area during the last 50 years. The recent protected status has already resulted in some hunting restriction in the southern part of Neusiedlersee as well as in activities to re-establish the semi-natural grassland habitats in the Hanság and Seewinkel area. An overall nature management programme has been prepared and a total hunting ban is proposed (Dick et al. 1994).

Agricultural conflict: Crop damage by geese locally can be an important issue in Austria, especially in Burgenland, but no damage specifically caused by Bean Geese has been reported (Dick 1992). However, as Bean Geese prefer to feed on winter cereals during winter, they do undoubtedly contribute to the problem. Although there have been no investigations, it seems that there has been no increase in the extent of the damage overall (Dick 1992).

4C. BELGIUM

4C.1 Distribution

Range: Tundra Bean Geese are mainly found in northwest Flanders between Antwerp and Knokke close to the Dutch border, in the Creek area between Watervliet and Assenede and the lower Schelde polder area. These birds roost on Hooge Platen and Saeftinghe, the Netherlands. East of Antwerp they occur in Kalmthout and at a few places northwest of Turnhout, along the Dutch border with the roost on Dutch side. During cold spells in winter Tundra Bean Geese are more common in Belgium, also visiting the Oostkustpolders and the Yzar valley (Kuijken 1981, Ganzenwerkgroep Nederland/België 1986, 1987a, 1987b, 1989, 1990, 1991, 1992, Meire et al. 1987, Meire & Kuijken 1997).

Habitat and feeding ecology: In Western Flanders, Tundra Bean Geese use the flat, open arable polders, where they mainly feed on fields with remains of sugar beet, potatoes and maize, sometimes also feeding on winter cereals. Small flocks of Tundra Bean Geese mixing with large flocks of White-fronted and Pink-footed *Anser brachyrhynchus* Geese often prefer permanent grasslands. The geese northwest of Turnhout occur in a completely different landscape, namely cultivated former heath areas, mainly feeding on meadows or maize, using a small lake in the woods near Chaam (the Netherlands) as a roost, or roosting in the Biesbosch (the Netherlands) some 30 km to the north (van den Bergh 1985, M. Slikkerveer pers. comm.). In the Border Meuse valley, river grasslands are preferred.

4C.2 Abundance

Phenology: First geese arrive in Flanders by late November or early December, peaking usually in January or in the first half of February. Bean Geese leave Western Flanders mainly in late February but in the Kempen, northwest of Turnhout, flocks of several hundred geese can be found until the second week of March and exceptional records from mid April exist (Kuijken et al. 1997).

Trends and numbers: Numbers of *rossicus* staging and wintering in Belgium are strongly dependant upon the severity of the winter and the occurrence of flocks on the Dutch side of the border. During mild winters, small numbers (tens to some hundreds) are usually counted, mostly amongst flocks of White-fronted and Pink-footed Geese, while during cold spells influxes of up to several thousand birds have been recorded (Meire et al. 1989). During the cold winter of 1995/96, some 1750 Tundra Bean Geese were recorded in the Creek area in late January (De Smet 1997) and in February 1996, a flock of 2500 was recorded in Kalmthout (Meire & Kuijken 1997).

4C.3 Research

No special attention is paid to Bean Geese in Belgium except the monthly goose counts, between mid October and mid March, which cover all important areas in Flanders.

4C.4 Protection and conservation

Hunting legislation: In the Damme region, which is especially important for Pink-footed and White-fronted Geese, hunting ceased in a 450 ha area protected in 1960; a 3000 ha area protected in 1968/69, and a 6230 ha area protected in 1980. Since 1981/82, a national shooting ban protecting all migrating and wintering geese has been in place in Belgium (see map in Kuijken & Meire 1987, Meire & Kuijken 1991).

Site safeguard: All Bean Geese in Flanders feed on arable fields or pastures in agricultural areas mainly designated as Special Protection Areas under the European Union Birds Directive (E. Kuijken pers. comm.).

Agricultural conflict: As *rossicus* occurs only in very small numbers crop damage is of no importance in Belgium.

4D. BOSNIA-HERZEGOVINA

4D.1 Distribution

Range: Tundra Bean Geese mainly occur in the northern part of the country on several locations in the Sava Valley. Flocks of these geese can also be found in the Lake Hutovo Blato area.

Habitat and feeding ecology: No data, although Bean Geese mainly used arable fields in the former Yugoslavia.

4D.2 Abundance

Phenology: Bean Geese mainly occur in December-March.

Trends and numbers: No accurate data are available from recent years. According to Mikuska & Kutozovic (1982) Bean Geese visit the Bosnia-Herzegovina region especially during cold spells with snow in the northern part of the former Yugoslavia.

4D.3 Research

None known.

4D.4 Protection and conservation

Hunting legislation: No available data, but the hunting season very probably runs from 1 September to 1 March, without any restrictions. No data exist regarding hunting bags.

Site safeguard: Within Bosnia-Herzegovina the only goose haunt with a protected status is the Hutovo-Blato area.

Agricultural conflict: No information.

4E. BULGARIA

4E.1 Distribution

Range: There is no evidence that substantial numbers of Tundra Bean Geese visit Bulgaria (Michev et al. 1991), but unknown haunts may exist along the Danube River (in northern Bulgaria) and in the far southeast, close to the Greek border.

Habitat and feeding ecology: No data.

4E.2 Abundance

Phenology: No data, but *rossicus* probably occur in Bulgaria during December-February.

Trends of numbers: Mid winter counts in 1993 and 1994 found 33 and 11 birds respectively in Bulgaria (Wetlands International Goose Database).

4E.3 Research

Apart from the regular goose counts no special research is done on Bean Geese in Bulgaria.

4E.4 Protection and conservation

Hunting legislation: Protected.

Site safeguard: Some important goose haunts in Bulgaria are legally protected, such as Lake Srebarna and Lake Durankulak.

Agricultural conflict: No problem.

4F. CROATIA

4F.1 Distribution

Range: By far the most important area for Tundra Bean Geese in Croatia is Kopaci Rit, where the River Drava joins the Danube. There are also some haunts of smaller flocks of Bean Geese along the Drava and Sava Rivers. In the Adriatic coastal zone some areas in the Split region are used as haunts by mostly small flocks of Bean Geese.

Habitat and feeding ecology: Within the Kopaci Rit area most geese feed on natural or semi-natural pastures. Outside the reserve, Bean Geese usually feed on arable land (Mikuska 1975).

4F.2 Abundance

Phenology: Tundra Bean Geese arrive in Kopaci Rit from late September until December, formerly concentrating in this area in tens of thousands although it seems that the situation has changed during recent years. The more southerly haunts are reached in late November, December or January. Usually geese stay in Croatia until late February or early March.

Trends and numbers: In late autumn, there were 10,000-50,000 Bean Geese at Kopaci Rit (Mikuska & Kutuzovic 1982, Lebret 1982). It seems likely that the situation will have changed dramatically as a result of the Balkan war since this was an area of heavy fighting activity.

4F.3 Research

Regular goose counts are carried out, no other research on Bean Geese.

4F.4 Protection and conservation

Hunting legislation: In Croatia, the hunting season for geese extends from 1 November until 31 December. Although no information about the size of the annual goose bag is available, it is thought to be high because of the generally high levels of hunting activity in Croatia. However, the considerable hunting tourism, especially from Italy, which existed before the Balkan war, seems to have ceased in recent years.

Site safeguard: Although Kopaci Rit was a well protected area before the war, its present status is unclear. It is very likely that during the war, few geese or other waterfowl wintered in this area in any numbers.

Agricultural conflict: No information.

4G. CZECH REPUBLIC

4G.1 Distribution

Range: Tundra Bean Geese are mainly limited to two parts of the country: southern Bohemia and southern Moravia, of which the latter is the most important. In other parts of the country staging and wintering areas are situated at Lake Jesenice near Cheb and at Lake Nechranice near Chomutov, as well as near Rozkos in northeastern Bohemia.

Habitat and feeding ecology: In the Czech Republic, Bean Geese mainly feed on winter cereals and maize, most roost on man-made reservoirs (Hudec in litt.).

4G.2 Abundance

Phenology: Arrival begins from the last week of September, but occurs mainly in October and lasts until December. Spring migration used to start in mid February and lasted until the first week of April. However, in recent years, after the completion of the reservoir at Nové Mlyny in the south of the country, the seasonal pattern changed dramatically, with movements starting progressively earlier, initially to early January, then to late December and in 1995 to mid December. Before 1982, the autumn passage was heavier than in spring, but later on, numbers during spring predominated. Now, numbers peak in mid winter.

Trends and numbers: In southern Bohemia numbers of geese were formerly very high at Trébon and Ceské Budejovice but, after a dramatic decrease during the first half of the century, a few hundred geese remained here during 1960-1980, mainly staging on autumn migration. At present, southern Moravia is by far the most important region, supporting up to 30,000 staging Tundra Bean Geese. The new stronghold, Nové Mlyny Reservoir, near Pohorelice, has held increasing numbers of Bean Geese since 1982, and some 50,000 geese have occurred during late autumn and winter (Hudec in litt., Hudec & Simec 1994, Anon. 1995).

4G.3 Research

No special Tundra Bean Goose research, but the main haunts are counted during the international censuses.

4G.4 Protection and conservation

Hunting legislation: Under the New Hunting Act 134/1996, *Anser* geese may be hunted from 1 September until the end of February without other restrictions. Formerly, the hunting season continued until the end of December (Hudec 1974, Hudec & Pellantova 1985). In some haunts in the Czech Republic, especially in Southern Moravia, tourist hunting of geese, mainly by Italian hunters, occurs.

Site safeguard: Most goose haunts in the Czech Republic have no official site protection, but the Nové Mlyný Reservoir, the Trebonsko Rybniky area and Lednicke Rybniky are protected areas.

Agricultural conflict: With the increasing numbers of Bean Geese staging and wintering in the Czech Republic, crop damage seems to be an important problem (Urbanek 1992), especially in the Breclav District, although no compensation for reported damage has been paid to date.

4H. DENMARK

Very few Tundra Bean Geese occur in Denmark, usually in flocks of Taiga Bean Geese (Jørgensen et al. 1994).

4I. FRANCE

4I.1 Distribution

Range: Tundra Bean Geese visit northeastern France, especially Alsace-Lorraine and Champagne Districts. In the valleys of the Loire, Allier and Indre Rivers, flocks of up to several hundred Bean Geese occur regularly, while smaller numbers can be seen in northwest France. Further south only few can be found in the Brenne area, the Landes and Camargue.

Habitat and feeding ecology: Bean Geese occur in France in open, arable landscapes, feeding on spilled grain, maize and other crops in the fields after harvesting. They also graze on fields with winter cereals and meadows (Mouton 1984, Pascal et al. 1992).

4I.2 Abundance

Phenology: In autumn, first Tundra Bean Geese can be expected from late October onwards, but numbers generally remain low until early December. The wintering population is present from December until February, regularly peaking in the latter month. After the February peak, numbers usually rapidly decline with few remaining until the end of March (Yésou 1991).

Trends and numbers: Once a relatively common and widespread wintering bird, at present relatively few occur, with a national average count of 2350 geese (1990-1994, Wetlands International Goose Database). In recent years, numbers have continued to decrease. Peak numbers in February may be the result of influxes during cold spells but they may also comprise geese returning from wintering areas further south (Fournier et al. 1983, Yésou 1991). Influxes of Bean Geese during severe cold winters were described from 1962/63 when 1600, "among them a certain number of *A.f.rossicus*", were counted in France (Hubert 1963), whilst up to 10,000 were counted in February 1979 (Wetlands International France Annual Reports, Yésou 1987, 1991).

4I.3 Research

Regular goose censuses are carried out each winter throughout France.

4I.4 Protection and conservation

Hunting legislation: With the exception of Alsace, Bean Geese are huntable from 1 October until the end of February without further restriction. No recent data about the hunting bag are available, but, according to Yésou (1987), about 5-10% of the Bean Geese staging in France were killed by hunters during 1983-84.

Site safeguard: Although some roosts, such as Lac du Der and Lac de la Foret d'Orient (Champagne) are protected areas, most Bean Goose haunts in France are unprotected.

Agricultural conflict: Crop damage caused by Bean Geese occurs exceptionally, with damage limited to growing winter cereals on one or two fields during a season (Riols in litt.).

4J. GERMANY

4J.1 Distribution

Range: A remarkable dividing line exists along the border which used to exist between the former East and West Germany, with nearly all strongholds of Tundra Bean Geese situated east of this line. Along the Baltic coast, only a few haunts are visited by Tundra Bean Geese, namely near Wolgast, Barth, Wismar and Dassow. All other coastal areas used by geese support Taiga Bean Geese and White-fronted Geese. By far the most important strongholds of the Tundra Bean Goose within eastern Germany are situated further inland with huge concentrations in Oderbruch near Seelow, at Lake Galebeck/Lake Putzar, in the Lake Guelpe - Havelland - Rhinluch area, at Lake Müritz, in the Magdeburg - Halle - Leipzig region and along the Elbe River near Wittenberge and Dömitz - Boitzenberg. In November 1996 and 1997, huge numbers of Tundra Bean Geese were counted at a roost near Köthen in the federal state of Sachsen Anhalt (L. van den Bergh & B. van Jaarsveld pers. obs.), a region which was already mentioned as important by Naumann (1862/1902).

Away from these strongholds, flocks of hundreds to several thousand Tundra Bean Geese can be found scattered all over eastern Germany (Schröder 1969, Rutschke 1983a, 1986, 1987, 1990). In western Germany, small flocks of *rossicus* occur along a few rivers, such as the Oker, Weser and Main, but only in the lower Rhine valley downstream of Düsseldorf, in the Emsland area in the far northwest of the country and in the valley of the central Rhine south of Karlsruhe can substantial numbers be found (Berndt & Wehfer 1972, Gerdes 1994, Mooij 1991, 1993, 1995a, b).

Habitat and feeding ecology: In Germany, Tundra Bean Geese mainly use agricultural areas with large arable fields. In autumn, they feed mainly on harvested fields on the remains of maize, grain, sugar beet and potatoes, the latter two root crops assuming increasing importance in the course of the season. Also winter cereals, rape, grass, etc. are eaten during winter. In late winter and spring, they feed mainly on pastures and winter cereals (Mooij 1984, 1992, Gerdes 1994, Rutschke 1983b).

4J.2 Abundance

Phenology: In eastern Germany, first Tundra Bean

Geese usually arrive during the second or third week of September, occasionally by the end of August. Peak numbers usually occur during October, although large concentrations can occur as early as late September, for example, 50,000 Bean Geese in Kreis Waren on 28 September 1980 (Kremp & Krägenow 1986). By early November, the geese are on the move again, heading to the west or south (Stichmann & Timmerman 1965, Naacke 1976, Rutschke 1977, 1997, Litzbarski 1979). In western Germany, the first migrants to the Netherlands can be observed in late October and by that time *rossicus* also arrive in the regular haunts in Emsland and in the lower Rhine valley (Hummel 1976, 1977b, 1980, 1981, 1982, 1983, 1984, Mooij 1991, 1995a, b).

During mild winters huge numbers of Tundra Bean Geese remain in eastern Germany, distributed in small flocks scattered over the entire region (Von Knorre et al. 1986, Mooij 1995a, b). However, during severe cold, especially with heavy snow, the majority move further west (Hummel 1971, 1977a, 1985) reaching the Netherlands, Belgium or even France. This happens mainly during cold spells in the first half of the winter season, while during severe cold in February the geese usually remain where they are.

During late autumn and winter a proportion of the population migrates to the south (Czech Republic, Slovakia, Hungary etc.) while during the second part of the winter season, especially in February, movements can be observed through western Germany to the Pannonic region (van den Bergh 1984, van den Bergh & Philippona 1986). Spring migration takes place from the latter part of February (west Germany) and the first half of March (eastern Germany) until mid April (Rutschke 1977, 1997).

Trends and numbers: During the 1970s, the total number of Bean Geese staging in the former East Germany was estimated at 100,000-150,000, whilst 150,000-200,000 Bean Geese were counted in the first half of the 1980s (Stubbe 1982, Rutschke 1987). These numbers did not include concentrations of Tundra Bean Geese from Slonsk (Poland), mainly feeding in the Oderbruch area in eastern Germany which is not mentioned as a goose haunt by Rutschke (1983a). In November 1984, 1995, 1996 and 1997 at least 80,000, 94,000, 153,000 and 179,800 Tundra Bean Geese were counted here respectively (L. van den Bergh unpubl.). According to Huyskens (1986) it seems very likely that by the early 1980s at least 300,000 Tundra Bean Geese were staging in the southern Baltic region during late autumn. Recent censuses of Bean Geese amounted to 226,000, 305,500 and 278,700 respectively during November 1990-92 but this number also includes Taiga Bean Geese (Mooij 1995b) of which 20,000-23,000 usually occur at that time (L. van den Bergh pers. obs.). In autumn 1996, over 350,000 Tundra Bean Geese staged in eastern Germany, mainly concentrated in the Lower Odra Valley (> 159,000), the Lake Müritz-Lake Krakow area (> 27,500), Lake Guelpe (> 23,000) and in the coal-mining area south of Halle (c. 36,000), whereas in November 1996 about 73,000 were counted at a roost near Köthen (L. van den Bergh & B. van Jaarsveld pers. obs.). In autumn 1997, over 390,000 Tundra Bean Geese were counted in eastern Germany, of which 162,000 were at Oderbruch; 101,500 near Köthen; 28,000 at Lake Guelpe; 20,000 along the Elbe River between Wittenberge and Boitzenburg; and 9150 at Lake Galebeck (L. van den Bergh pers. obs.).

In western Germany, the lower Rhine valley developed from a wintering area with several thousand Tundra Bean Geese in the late 1960s (van den Bergh 1977, 1978, van den Bergh et al. 1986, Eberhardt 1971) to a haunt supporting over 40,000 each winter in the 1970s (Mildenberger 1982, Mooij 1996, Möller 1981, 1982, van den Bergh 1983a, pers. obs., van den Bergh et al. 1986). This situation lasted until the early 1980s, when increasing numbers of White-fronted Geese began to dominate this area and there has been a dramatic decrease in the numbers of rossicus to average 8000-13,000 during the last ten years (Mooij 1995a, b, 1996, L. van den Bergh pers. obs.)

4J.3 Research

In addition to regular goose counts, carried out throughout the country since the 1960s, a ringing and marking project on Bean Geese has been running at Lake Guelpe since 1971 (Litzbarski 1977, 1979, Fleischer 1982, Rutschke 1997), coordinated by the "Zentrale für Wasservogelforschung und Feuchtgebietsschutz in Deutschland" (ZWFD). Studies of goose ecology and crop damage caused by geese has been carried out at several places (Litzbarski & Loew 1976, Fleischer 1982, Mooij 1979, 1984, 1993, 1996, Gerdes 1983, 1994, Gerdes et al. 1978, Rutschke 1958, 1967, 1973, 1987, Rutschke & Schiele 1979) some of which continue to the present.

4J.4 Protection and conservation

Hunting legislation: Tundra Bean Geese may be hunted in Germany between 1 November and 15 January. According to the Federal Hunting Law, federal states are allowed to shorten or even close hunting of one or more game species. Hunting of Bean Geese is presently closed in the federal states of Baden-Württemberg, Hessen, Niedersachsen, Nordrhein-Westfalen and Rheinland-Pfalz. In Germany, the annual goose bag has increased in recent times, from about 6000 in the 1960s to 30,000-40,000 in the 1990s. This increase is most pronounced in the former East Germany, in the federal states of Brandenburg, Mecklenburg-Vorpommeren and Sachsen-Anhalt (Mooij 1992, 1995a, Rutschke 1993).

Site safeguard: Although a number of roosts (surrounded by narrow buffer-zones) are protected (e.g. Lake Galebeck, Lake Putzar, Lake Guelpe, Neolithteich near Köthen), intensive hunting activity takes place at almost all important haunts in eastern Germany. Shooting takes place mainly on the morning or evening flight, very often close to the roosts and (based on advertisements in several hunting magazines as well as observations in the field, L. van den Bergh unpubl.) hunting

tourism takes place at several locations (e.g. Oderbruch, Lake Galebeck, the island of Rügen and Neolithteich near Köthen).
Agricultural conflict: Crop damage conflicts caused by waterfowl are reported from several federal states (e.g. Brandenburg, Mecklenburg-Vorpommeren, Nordrhein-Westfalen, Niedersachsen, Schleswig-Holstein). As no central registration system for crop damage exists in Germany, it is impossible to state for what portion of the total yield-loss Tundra Bean Geese may be responsible.

4K. GREECE

4K.1 Distribution

Range: Although no haunts for Bean Geese are mentioned by Timmerman et al. (1976), Nisbet & Swift (1963) recorded huge numbers wintering in the Deltas of the Evros, Axios, Nestos and Strimon Rivers as well as at Porto Lago. It seems that Greece has lost its importance for Bean Geese completely during recent times, nowadays only visited by very few birds each winter (Handrinos 1991).
Habitat and feeding ecology: No data available.

4K.2 Abundance

Phenology: No data available, but very likely mainly seen during winter (December-February).
Trends and numbers: Once a common wintering bird, at the present only a very few Bean Geese are seen, mainly in flocks of other grey geese (Handrinos 1991). According to information sent to the Wetlands International Goose Database, numbers were as low as nine in January 1987, three in January 1988 and 16 in January 1993. It is not known which migration route was used by the geese to reach their former Greek wintering places, but as they were only found in very small numbers in Bulgaria and Romania but were once very common throughout former Yugoslavia, it is very probable that they originated from the stock using the Pannonic region in autumn. On the other hand, it is possible that Bean Geese seen on migration in the Ukrainian part of the Danube Delta (Zhmud 1996a, b) and Odorheiu Secuiesc in Romania (Szabo in litt.) were heading for Greece.

4K.3 Research

Annual monitoring of mid winter goose numbers.

4K.4 Protection and conservation

Hunting legislation: During the open hunting season (15 August until 16 February) all goose species are hunted in Greece. Handrinos (1991) considered that high hunting pressure is a major problem, but no accurate data about the hunting bag are available.
Site safeguard: Although some important goose haunts (especially the roosts) in Greece are protected in some form or other (some are at least partly Ramsar sites), the geese may be hunted without any restriction on the feeding grounds in the agricultural areas. In spite of Ramsar status, most areas suffer ecological problems caused by drainage and reclamation of marshland for agriculture (Handrinos 1991).

4L. HUNGARY

4L.1 Distribution

Range: Tundra Bean Geese are mainly found in Transdanubia, covering the western part of the country. There are also several haunts of less importance on the Great Hungarian Plain east of the Danube River (Faragó 1995).
Habitat and feeding ecology: The main roosts are situated in shallow lakes and fishponds on the Little Transdanubian Plain, such as Lake Öreg tó at Tata, Lake Fertö, Lake Velence with Dinnyési Fertö, Lake Balaton, Kisbalaton and Soponya. In recent times also the Gemenc area in the Danube valley has become of increasing importance. In Hungary, Tundra Bean Geese feed on various crop remains after the harvest, such as maize, grain, sugar beet, potatoes, etc. Maize can be of major importance (Sterbetz 1971, Philippona 1983, van den Bergh & Philippona 1986, Faragó 1994). After sowing, newly sown cereals are eaten and in late winter the majority of the geese can be found on fields with winter cereals. According to Sterbetz (1971, 1979a, b), Tundra Bean Geese profited from the large scale industrial production of maize, but after the political changes of recent years, the availability of this source of food has decreased. This may have caused changes to the diet as well as to the seasonal distribution of the geese.

4L.2 Abundance

Phenology: Tundra Bean Geese arrive in Hungary from late September onwards, with a dramatic influx during late October and early November (Keve 1972, Sterbetz 1982, Lebret 1982, Faragó 1991, 1995). After the November peak, numbers decline until March (Fig. 2.4). Although it is very likely that some autumn staging geese move on to wintering haunts outside Hungary, observations during winter suggest that, by dispersing and scattering over almost the entire Trans-

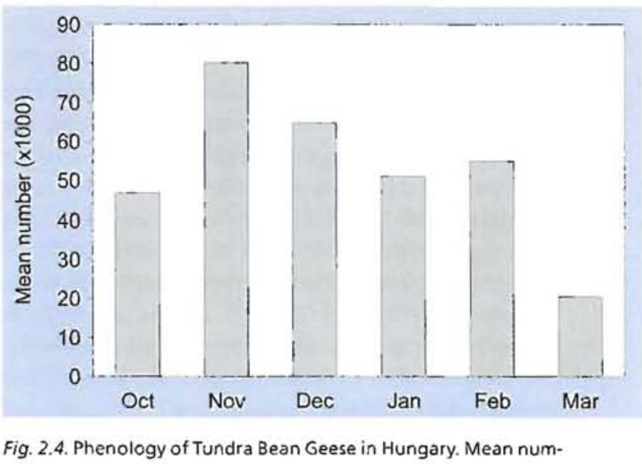

Fig. 2.4. Phenology of Tundra Bean Geese in Hungary. Mean numbers in each month in the 1990s (source: Faragó & Jánoska 1996).

danubian Plain, thousands of Bean Geese may escape observation (L. van den Bergh unpubl.). In late February and early March, influxes of Tundra Bean Geese, among them birds from western European wintering areas have been observed at Tata (van den Bergh 1984, van den Bergh & Philippona 1986) peaking with 40,000-70,000 at the Lake Öreg tó roost.

Trends and numbers: Although Bean Geese were regular and numerous winter visitors in Hungary during the first half of the century (Keve 1972), there are some doubts about their subspecific status. According to Johansen (1962) nearly all Hungarian Tundra Bean Geese should be classified as a mixed population of *fabalis/rossicus*, but nowadays it is widely accepted that they are *rossicus* (van den Bergh & Philippona 1986, Huyskens 1986, Faragó 1995). During the period 1972-1982 steadily increasing numbers were counted in Hungary (Sterbetz 1982) with an average peak number (November) of 36,500. However, this number was certainly too low, as during late autumn 1980 at least 150,000 Tundra Bean Geese were counted in central Europe, including Hungary, the Neusiedlersee area in Austria and Kopaci Rit in Croatia (Lebret 1982). During the period 1983-1991 the situation was less clear. Initially, numbers seemed to increase rapidly to 196,750 in 1984, but subsequently decreased dramatically to less than 100,000 since 1988 (Fig. 2.5). The average seasonal peak count for the five-year period 1986-1991 was 91,600 (maximum 126,000)(Faragó 1993, 1995, Faragó et al. 1991). The November peak in 1993 was 43,240 geese, whereas 70,270 Tundra Bean Geese were counted during January 1994 (Wetlands International Goose Database). However, during a visit at the most important haunts on the Transdanubian Plain during the first half of November 1995 at least 86,000 Tundra Bean Geese were counted, which suggests that there could still be over 100,000 *rossicus* in this region (L. van den Bergh & D. Tanger pers. obs.).

4L.3 Research

Regular counts are organised throughout the country and collection of ecological data is organised by the Hungarian Waterfowl Research Group.

4L.4 Protecting and conservation

Hunting legislation: During 1970-1988, the hunting season for Bean Geese was from 1 October to 15 January, but from 1988 onwards was prolonged to 31 January (Faragó 1995). The average goose bag in Hungary was about 7500 geese at the end of the 1960s (Rutschke 1973), 3000-6000 during the 1970s, but this increased greatly during the early 1980s, culminating in 11,400 geese shot in 1985. Thereafter, a decrease was recorded from 1985 in Transdanubia and after 1992 on the Great Hungarian Plain (see Faragó 1995 for details).

Site safeguard: Although some of the major roosts of Bean Geese are protected (Hortobagy, Kardoskut, Gemenc, Öreg tó, Lake Fertö, Lake Velence-Dinnýes, Balaton East, Kisbalaton) and some of them Ramsar sites, shooting is allowed in nearly all feeding areas.

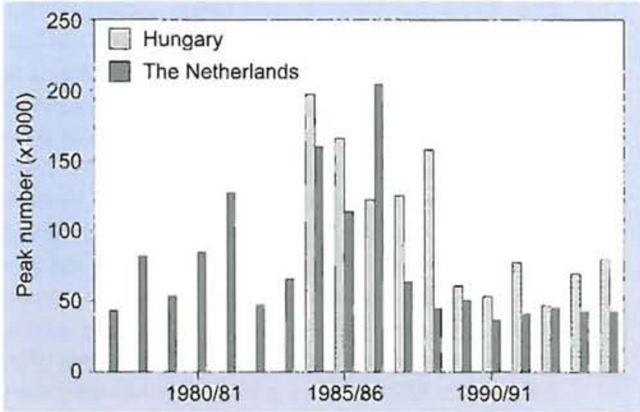

Fig. 2.5. Seasonal/annual peak numbers of Tundra Bean Geese in Hungary and the Netherlands. Note: the 1986/87 peak number in the Netherlands is an estimate. Source: Hungary - Faragó (1995) and Wetlands International Goose Database; the Netherlands - SOVON Ganzen en Zwanenwerkgroep (1995, 1996).

Agricultural conflict: Although crop damage caused by waterfowl occurs locally in Hungary, until the early 1990s no conflicts were reported nor were claims for compensation received (Faragó 1992).

4M. ITALY

4M.1 Distribution

Range: Staging and wintering Tundra Bean Geese are mainly restricted to northeast Italy (Perco 1991). The southern Po delta and the Comacchio Lagoon (Boldreghini & Montanari 1991) as well as Friuli-Venezia Giulia and eastern Veneto (Parodi & Perco 1980) are visited by flocks of a few hundred to several thousand Bean Geese in winter.

Habitat and feeding ecology: On the flat, open plains of northeastern Italy, Bean Geese feed on arable land, eating spilled and left over crops after harvest as well as winter cereals. Their roosts mainly are situated in lagoons along the Adriatic coast (Perco 1991).

4M.2 Abundance

Phenology: Italy is a wintering quarter, with the geese usually arriving in late December, but especially during January, often peaking in February (Boldreghini & Montanari 1991). Although the majority of Tundra Bean Geese leave Italy by late February, they may remain until the beginning of March (Perco 1991). During the 19th century Bean Geese were seen frequently in northeast Italy from October to March (Schiavuzzi in Parodi & Perco 1980).

Trends and numbers: Until the early 1970s, Bean Geese wintered only in very small numbers in the Province of Grosseto and the Campagne of Manfredonia (Timmerman et al. 1976). However, a subsequent increase started in northeast Italy perhaps as a result of the new hunting law, which gave protection to Bean Geese (as well as other geese (Parodi & Perco 1980)). In the winters 1977/78 until 1979/1980, 4000-5000

Bean Geese and White-fronted Geese occurred in the region, but in spite of their protected status and the banning of all hunting activity in an area of 35,000 ha at Mezzano, Comacchio Lagoon, numbers have decreased steadily since then. Although a peak of 5550 Bean Geese was counted in winter 1986/87 (Perco 1991), the decreasing trend has continued, with only 16 birds counted in January 1994 (Wetlands International Goose Database). It is very likely that most of the Italian wintering Bean Geese originate from the Pannonic group, migrating through southern Hungary, northwest Croatia and Slovenia to reach northeast Italy (Parodi & Perco 1980). As one goose, ringed in November 1973 at Lake Guelpe (east Germany) was shot near Alessandria, close to the Po River, in early December 1973 (Litzbarski 1979), it seems possible that this route is used on the way to the Italian wintering area.

4M.3 Research

No special research; regular goose censuses are carried out every season.

4M.4 Protection and conservation

Hunting legislation: Under Italian hunting law, all goose species have been protected since the mid 1970s. Although goose shooting is prohibited, hunting activities appear to be the most serious source of disturbance. Shooting bans have little or no effect when hunting of other species is still allowed in goose areas (Perco 1991).
Site safeguard: Although most of the roosts of Bean Geese are situated in protected areas, some of them Ramsar sites, their feeding grounds in agricultural areas are mainly unprotected.
Agricultural conflict: According to Parodi & Perco (1980) no agricultural conflicts occurred at the time of writing.

4N. LUXEMBOURG

Few Tundra Bean Geese winter in Luxembourg. They occur mainly from December until February and their numbers have decreased since the 1970s/early 1980s. During 1983-94, an average of 76 geese were counted, peaking at 165 in January 1986. In 1985, 1988 and 1991 the annual peak was as low as 40, 30 and 37 birds respectively (Wetlands International Goose Database).

4O. MACEDONIA

4O.1 Distribution

Range: Although during winter small flocks of Tundra Bean Geese can occur all over the country it seems that no regular haunts support substantial numbers at the present. However, Timmerman et al. (1976) gave the following as regular sites: Vadar, Crna River, Ohrid, Prespa and Dojran Lakes.
Habitat and feeding ecology: No data available.

4O.2 Abundance

Phenology: Although no data are available, it is to be expected that Tundra Bean Geese occur in Macedonia mainly during December-February.
Trends and numbers: As Stresemann (1920) does not mention Bean Geese, it is uncertain if substantial numbers occurred in the region at that time. However, according to Karanov (in Makatsch 1950) Bean Geese were not uncommon wintering birds near Skopje. Timmerman et al. (1976) cited six areas where small numbers of Bean Geese occurred in the 1970s. No accurate data are available from the 1980s and 1990s.

4O.3 Research

There are no data about any goose counts or studies in Macedonia.

4O.4 Protection and conservation

Hunting legislation: As there is no information to the effect that the situation has changed after the independence of Macedonia, it is very probable that the hunting season for Bean Geese continues to open from 1 September until the end of February (Lampio 1983).
Site safeguard: Within Macedonia, at least three sites are protected: Lake Djoran, Lake Ohrid and Lake Prespa.
Agricultural conflict: No data available.

4P. THE NETHERLANDS

4P.1 Distribution

Range: Until the 1960s, the range of wintering Tundra Bean Geese was unclear. According to Coombes (1947b, 1951) and Huyskens (1986), most birds probably wintered in the southwestern part of the Netherlands, covering the entire province of Zeeland (Slob 1977), the southwestern part of Zuid Holland and the western part of Noord-Brabant. Nowadays, haunts of Tundra Bean Geese may be found scattered throughout the country, and are reviewed in van den Bergh (1983b, 1985) and Koffijberg et al. (1997). Strongholds are situated in the provinces of Groningen and Drenthe (especially the Veenkoloniën and Fochtelooërveen area), the reclaimed polders in the Lake IJsselmeer area (especially Noordoostpolder), the Wieringermeer and island of Texel in Noord-Holland, areas along the IJssel, Nederrijn and Waal Rivers in Overijssel and Gelderland, the Delta area in Zeeland and the westernmost part of Noord-Brabant and the Peel area in southeast Noord-Brabant and central Limburg. In some areas (Veenkoloniën/Dollard in Groningen and areas in the eastern part of Gelderland), there is interaction with haunts on the German side of the border, such as the Dollart/Emsland area in Niedersachsen and the lower Rhine valley in Nordrhein-Westfalen (Gerdes et al. 1978, van den Bergh 1983a, Gerdes 1983, 1994, van den Bergh et al. 1986).
Habitat and feeding ecology: Roosts are situated on various types of open water: fresh, brackish or even

salt. In the Delta area geese usually roost on sandy or muddy banks in the estuaries, while up to over 20,000 Tundra Been Geese use a roost on Steile Bank, a sandbank close to the Frisian coast of Lake IJsselmeer. Along the main rivers, artificial lakes (e.g. sand or gravel pits) are often used and in the east and south of the country, geese roost on lakes and fens in heath and peat bog areas (van den Bergh 1985, Koffijberg et al. 1997). During the first half of the winter, Tundra Bean Geese mainly feed on arable fields on the remnants of crops such as sugar beet, potatoes, maize or grain. During January and February more and more geese switch to grass and autumn-sown cereals.

4P.2 Abundance

Phenology: Although a few birds arrive during the latter half of October, the majority of the population that winters in the Netherlands can be expected from the first days of November onwards. Usually, first flocks are observed in the Delta area, the main river district and in the Noordoostpolder. The build-up of numbers in the northern part of the country is mainly concentrated in the Noordoostpolder during November and early December (De Jong & Philippona 1975, Philippona 1977, 1985), while in southwestern Netherlands, the main aggregation usually occurs on Schouwen-Duiveland at that time. Peak numbers usually occur in January (mild winters) or February (hard winters). In mild winters, Tundra Bean Geese leave the country from early February onwards. During this period, relatively large numbers of geese aggregate in the northern part of the country, in the provinces of Drenthe and Groningen. By mid March, most birds have usually departed. However, in severe winters when numbers in February are still high throughout the country, spring migration may not occur before the end of February and continues well into March (Rooth et al. 1981, Ebbinge et al. 1986, Lok et al. 1992, Koffijberg et al. 1997).

Trends and numbers: Although Tundra Bean Geese have established several new haunts in the 1970s and 1980s, overall wintering numbers have not increased much since 1970. The regular wintering stock numbers about 40,000-60,000 individuals in mild winters (Rooth et al. 1981, Ebbinge et al. 1986, Lok et al. 1992, Koffijberg et al. 1997). However, during severe cold spells, especially in eastern Europe, much higher numbers are present as many geese from regular wintering haunts in eastern Europe migrate into western Europe. During the severe winters of 1984/85, 1985/86 and 1986/87, for example, peak numbers as high as 160,000, 124,000 and 204,000 were counted respectively (Ganzenwerkgroep Nederland/België 1987a, 1987b, 1989). In the recent mild winters in the 1990s, numbers reached about 43,000 (Fig. 2.5).

4P.3 Research

Monthly censuses are carried out October-March throughout the country. In addition to this monitoring program, field samples of the proportion of young are made each season. The long-term ringing project on Bean Geese which marked over 14,000 birds from 1954, stopped in 1989/90. These ringing activities have provided good evidence that the majority of the Tundra Bean Geese wintering in the Netherlands originate from breeding areas on Malozemelskaya and Bol'hezemelskaya Tundras, whereas birds originating from other regions visit western Europe to a lesser extent (Speek 1978, Speek & Speek 1984, Burgers et al. 1991). Research has been carried out on the impact of geese grazing on farmland (Groot Bruinderink 1987) and on arable land (Teunissen 1996). Van Impe (1980b) reports ecological and ethological observations.

4P.4 Protection and conservation

Hunting legislation: Only Bean Geese, White-fronted Geese and Greylag Geese may be hunted in the Netherlands between 1 September and 31 January, and only between half an hour before sunrise until 1000 h. Shooting is prohibited in many areas where roosts are situated, but the feeding areas are mainly unprotected. In recent times, the total annual goose bag in the Netherlands has increased from about 7000 during the 1960s to 60,000-70,000 during the first half of the 1990s (Anon. 1993). Of these c. 70% were White-fronted Geese (Ebbinge 1991, Mooij 1995a, 1996) and Greylag Geese were also included, so it seems that hunting pressure on Bean Geese in the Netherlands is not very heavy. However, according to official statistics (Anon. 1990), during 1985/86 to 1988/89, an average of 6.8% of the Bean Geese (including Taiga Bean Geese) staging and wintering in the Netherlands were shot. Since the late 1980s, use of a stock of live decoys to lure wild geese close to a hide has been prohibited.

Site safeguard: Most of the roosts used by Tundra Bean Geese are situated in protected sites.

Agricultural conflict: Crop damage caused by waterfowl is an important issue in the Netherlands and compensation for yield loss by Bean Geese is mainly paid in November, January, February and March, only on arable land (van Oostenbrugge et al. 1992).

4Q. POLAND

4Q.1 Distribution

Range: With the exception of the coastal zone along the Baltic Sea, Tundra Bean Geese can be observed throughout the country during migration, but their staging areas are mainly situated in the west. By far the most impressive stronghold is the Slonsk reserve near Kostrzyn at the junction of the Warta and Odra Rivers, where over 150,000 Tundra Bean Geese occur together with considerable numbers of White-fronted and Greylag Geese during autumn. In the southwest, substantial numbers can be found especially in the Wroclaw-Mylicz region, while flocks of up to several thousand occur regularly on several sites in the northwest, such as Lake Miedwie, Lake Morzycko and Lake Swidwie.

Habitat and feeding ecology: Most roosts are natural lakes and river systems, but occasionally geese can be found roosting on man-made reservoirs. In autumn and winter Tundra Bean Geese mainly feed on arable fields, eating crop remains in the fields after harvesting, e.g. spilled grain, maize and beet (Dzieciolawski & Frankiewiecz 1970). Later, they feed on cereals, rape and pastures, especially during spring migration (Wieloch 1992).

4Q.2 Abundance

Phenology: Tundra Bean Geese migrate through Poland from late August, but mainly during September-October and early November. Subsequently, very few geese remain in eastern and central Poland (Dobrowolski et al. 1984, Huyskens 1986, Tomialojc 1990, Engel 1991, L. van den Bergh pers. obs.). Wintering geese are usually concentrated in the west, their numbers greatly dependant upon weather conditions. Hence, in January 1987, during a severe cold spell, no geese were found at nine important roosts, while in January 1988 (a mild winter) 30,500 Bean Geese were counted at 12 roosts, most of them in the Slonsk area (Engel 1991). Influxes of geese can be observed from late February in western Poland, especially in the Odra valley. It seems that during spring migration (March-April) the geese mainly stage in two regions: northwest Poland, where the main concentrations are in the Slonsk reserve, and the valleys of the central Narew and lower Biebrza Rivers in the northeast of the country (Engel 1991).

Trends and numbers: In Poland, peak numbers occur usually during a short period of time in autumn. As overall censuses are only available since 1992 for mid winter, it is not possible to analyse any trend. However early November counts in 1984, 1995, 1996 and 1997, covering the entire Slonsk area found 80,000, 94,000, 153,000 and 180,000 Tundra Bean Geese respectively (L. van den Bergh unpubl.). It is thought that the large numbers observed in 1996 and 1997 were the result of a shift of geese that used to stage elsewhere in the southern Baltic region and does not reflect an increase in the total *rossicus* population. In the Wroclaw region, increasing numbers of Tundra Bean Geese, up to 25,000 or more, have staged and wintered since 1986 (Dyrcz in litt.). This is also a result of a shift in the distribution pattern during autumn migration (see earlier). The number of wintering Bean Geese is greatly dependant upon weather conditions and can fluctuate between almost nil to over 80,000 (Wetlands International Goose Database). Spring numbers amount to about 60% of the numbers counted in autumn.

4Q.3 Research

As geese are game birds, ornithologists have been less interested in counting or observing them (P. Majewski & J. Engel pers. comm.), although an excellent description of Taiga and Tundra Bean Geese was made by Ferens & Wasilewski (1977). However, since the late 1980s regular censuses have been made, covering only part of the country (Engel 1991, Dombrowski et al. 1993). Apart from these censuses no special research on Bean Geese is done at present.

4Q.4 Protection and conservation

Hunting legislation: All goose species occurring in Poland may be hunted between 15 August and 15 February, without further restrictions. To obtain a hunting licence, one has to pass the obligatory hunting examination. In Poland the annual goose bag (all species) was estimated at about 6300 during the 1960s, about 12,000 in the 1970s and about 12,600 in the 1980s (Wieloch 1992).

Site safeguard: Some roosts, such as the lower Odra Valley, the Slonsk area, Lake Swidwie, Lake Gardno and Lake Lebsko as well as the Biebrza valley are protected areas, with a hunting ban or restricted shooting regulations (Engel 1991, Wieloch 1992). In general, no feeding grounds are protected as they are mainly situated in agricultural areas.

Agricultural conflict: Crop damage caused by geese seems to be of minor importance at present, but may become an increasing problem in the future (Wieloch 1992).

4R. ROMANIA

4R.1 Distribution

Range: Bean Geese are uncommon visitors in Romania, occurring in small numbers throughout the country during winter (Munteanu et al. 1991).

Habitat and feeding ecology: In Romania, Bean Geese feed on arable land, eating the remains of various kinds of crops after harvesting as well as winter cereals. However, in the Danube Delta, Bean Geese are described as aquatic feeding birds (Radu 1979).

4R.2 Abundance

Phenology: Based on phenological data from neighbouring areas it seems very likely that Bean Geese occur in Romania from October until the latter part of March or the first half of April.

Trends and numbers: According to Munteanu et al. (1991) the Bean Goose was an unknown species in Romania at the beginning of the century. This is not very likely as the species was a regular and numerous wintering bird in Hungary, Yugoslavia and Greece at that time. However, at present, Bean Geese are still uncommon away from a few regular haunts. One of the Romanian haunts, mentioned by Munteanu et al. (1991) is Cefa, close to the Hungarian border, an area which forms part of the Hungarian goose haunt of Biharugra, where *rossicus* occurs regularly. Prior to the winter of 1988/89, up to 5000 Bean Geese were counted in this area, whereas afterwards their numbers have decreased rapidly to only 14 birds counted during 1990/91 (Faragó 1995). It is remarkable that no wintering areas are known in the Danube valley in southern Romania nor in the Moldavia District in the northeast of the country. The occurrence of the two races (Taiga and Tundra) of Bean Geese in Romania is not yet clear; Catuneanu et al. (1978) include a picture of a Taiga Bean Goose and Radu (1979) mentions only Taiga Bean Geese as occuring in the Danube Delta.

4R.3 Research

Regular mid winter censuses are made only in the Dobrodja, other areas are counted irregularly.

4R.4 Protection and conservation

Hunting legislation: As an average of 117 Bean Geese have been counted in Romania during 1988-92 (Wetlands International Goose Database) it cannot be an important quarry species. The hunting season for geese is open from 15 August to 15 March, with hunting prohibited during the night.
Site safeguard: Only the goose roosts in the Dobrodja/Danube Delta area are protected, but the feeding areas are mainly situated in unprotected areas.
Agricultural conflict: None.

4S. SLOVAKIA

4S.1 Distribution

Range: Tundra Bean Geese are mainly restricted to the southern part of the country, using roosts on the Danube River and feeding on the plains of the Danube and Vah Rivers, east of Bratislava. Small flocks can also be found along the Morava River. In the far east of the country Lake Zemplinska Sirava near Michalovce is of considerable importance, especially during migration (Huyskens in litt.).
Habitat and feeding ecology: The roosts of Bean Geese are mainly situated in natural and semi-natural areas along the Danube and Morava Rivers, but also man-made reservoirs like those in the Kraiova basin and Zemplinska Sirava are used by the geese. They mainly feed on waste maize and other crops that remain on the fields after harvesting, eating winter cereals and grass especially in the latter part of the winter season.

4S.2 Abundance

Phenology: Although the first Bean Geese can arrive during mid September (Hudec et al. 1967), most arrive in October, continuing until the first half of November. After the passage of migrating flocks relatively small numbers usually remain during winter, but recently large influxes have been recorded in mid winter. Spring migration starts by late February in the western part of the country whereas major movements in the eastern regions mainly occur from the first week of March until April, with high numbers of staging Bean Geese in the Michalovce region. This area is situated in a geological depression of the Tatra and Karpat Mountains and probably this is the main migration route to and from the central European wintering region.
Trends and numbers: The Podunajska Nizina area east of Bratislava is an important Bean Goose haunt where up to 20,000 geese occurred each winter in the 1960s and 1970s (Hudec et al. 1967, Timmerman et al. 1976). Although numbers decreased steadily during the 1980s, with only 1700 birds on average during mid winter counts in 1990-1995 (Wetlands International Goose Database), recently up to 40,000 geese (White-fronted Geese and Bean Geese, predominantly the latter species) were counted along the Danube south of Bratislava (Hudec and Simec 1994). Further east, some areas in the Komarno Storovo region, such as Duajske Luhy and Cenkov are haunts for up to several thousand Tundra Bean Geese. The creation of a new reservoir near Michalovce has changed the situation in the east of the country. Formerly, small numbers of geese were usually found on the lowlands of the Laborec River (Timmerman et al. 1976). The new reservoir Lake Zemplinska Sirava has developed rapidly into an important roost, with main feeding areas situated south of Sobrance (Huyskens in litt.).

4S.3 Research

Mid winter censuses have been carried out in Slovakia since the early 1990s, but no other research on geese is done.

4S.4 Protection and conservation

Hunting legislation: In Slovakia, the open season for hunting geese extends from 1 October until 31 December. No information on the size of the annual hunting bag is available.
Site safeguard: The Zemplinska Sirava Reservoir and the Duajske Luhy area are protected.
Agricultural conflict: No information.

4T. SLOVENIA

4T.1 Distribution

Range: Tundra Bean Geese are found at several locations in the Drava valley in the northeast of the country as well as locally in the valley of Szava River.
Habitat and feeding ecology: Most Bean Geese feed on remains of crops in harvested fields and winter cereal fields. When the river floodplains are inundated, the geese also graze these.

4T.2 Abundance

Phenology: Although some birds can be seen during late October and in November, increasing numbers are usually observed from December until February.
Trends and numbers: Although Timmerman et al. (1976) does not mention any goose haunt in Slovenia, it seems unlikely that the present haunts are genuinely new. Bean Geese staging on the Transdanubian Plain may move into Slovenia during cold spells. Mid winter censuses of 1992-1994 resulted in 1100, 220 and 750 geese respectively (Wetlands International Goose Database), although up to 4000 Bean Geese were counted in January 1994 at the Ormoz Reservoir (Vogrin 1996). The variation in numbers is also an indication of the possibility that the size of the Slovenian population is linked to the weather conditions in central Europe.

4T.3 Research

Since the early 1990s the coverage of the national censuses have improved so that Slovenia now delivers regular counts.

4T.4 Protection and conservation

Hunting legislation: In the former Yugoslavia, Bean Geese had no open season in Slovenia and this situation has not changed since independence.

Site safeguard: At present, the Drava River between Maribor and Ptuj is protected as a Landscape Park and between Maribor and Ormoz is listed as an Important Bird Area, which qualifies as Ramsar site status.

Agricultural conflict: No conflict has been reported to date.

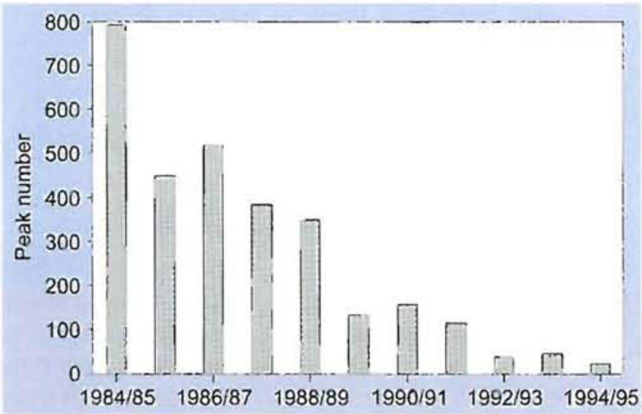

Fig. 2.6. Seasonal/annual peak numbers of Tundra Bean Geese in Spain (Rodriguez & Palacios 1996).

4U. SPAIN

4U.1 Distribution

Range: Tundra Bean Geese are mainly restricted to the northwestern part of the country, especially the Duera Basin (Persson & Urdiales 1995) and the Embalse de Ricobayo near Zamora (Rodriguez & Palacios 1996).

Habitat and feeding ecology: In the Duero Basin, wintering Tundra Bean Geese mainly feed on spilled grain and winter cereals (Otero 1983). At Ricobayo Reservoir, geese graze winter cereal fields within a 14 km radius of the roost (Rodriguez & Palacios 1996).

4U.2 Abundance

Phenology: The first geese normally arrive in Spain during late November and early December, peaking in January and leaving again during the latter part of February (Otero 1983).

Trends and numbers: Once a numerous wintering bird of which hundreds of thousands occurred in the Duero Basin (Bernis 1963), nowadays Tundra Bean Geese are nearly extinct in Spain. According to Otero (1983) and Persson & Urdiales (1995), the main decline in numbers took place in the 1950s resulting in a wintering population of about 5000-10,000 at the beginning of the 1960s. During the last three decades, Bean Geese have disappeared almost completely (Fig. 2.6) and only 23 birds were reported in 1994/95 and 21 in 1995/96 (Rodriguez & Palacios 1996).

4U.3 Research

Mid winter censuses are carried out, no other research.

4U.4 Protection and conservation

Hunting legislation: In Spain, there is no hunting season for Bean Geese.

Site safeguard: None.

Agricultural conflict: During the first half of the century when Tundra Bean Geese were numerous in the Duero Basin, they caused some damage to the crops,and every village had its own "ganseros", boys whose responsibility it was to scare geese away from the crops (Persson & Urdiales 1995).

4V. SWITZERLAND

4V.1 Distribution

Range: Tundra Bean Geese occur only in the northern and western parts of the country. It is very likely that western Switzerland once formed part of the main flyway between the southern Baltic and wintering places in southern Europe, as a Tundra Bean Goose, ringed on 1 November 1974 at Lake Guelpe, east Germany, was seen near Solothurn, Switzerland on 30 November 1974, and another ringed in November 1973 at the same place was shot in December 1993 near Alessandria, northern Italy (Litzbarski 1979).

Habitat and feeding ecology: No accurate data available.

4V.2 Abundance

Phenology: Bean Geese are mainly seen in Switzerland from the latter half of November until March.

Trends and numbers: There are no traditional wintering haunts of Tundra Bean Geese in Switzerland. They only appear in small numbers at a few locations close to open water such as Bodensee and Lake Neufchateau. Flocks of several hundred can be found in Switzerland, especially during severe winters in northwest Europe, rarely high up in the mountains. During mid winter censuses in the period 1993-1995, 89, 89 and 44 Tundra Bean Geese were counted respectively (Wetlands International Goose Database).

4V.3 Research

No special research on geese is done in Switzerland.

4V.4 Protection and conservation

Hunting legislation: No information available.

Site safeguard: Although the Bodensee (Austria/ Germany/Switzerland) is partially protected (Scott & Rose 1996), no information is available about the protection status of Bean Goose sites in Switzerland.

Agricultural conflict: Due to the very low numbers of Bean Geese staging or wintering in Switzerland it is unlikely that they cause any crop damage.

4W. UNITED KINGDOM

Tundra Bean Geese are only seen occasionally in the United Kingdom, mainly in flocks of Taiga Bean Geese or Pink-footed Geese at the eastern coast (M. Parslow-Otsu pers. comm).

4X. YUGOSLAVIA

4X.1 Distribution

Range: Tundra Bean Geese are mainly found in the north of the present Yugoslavian Republic especially in the Vojvodina and Danube Regions, as well as on the plains of the Sava River in Serbia. To the south, they occur locally in Montenegro, but nowadays usually in very small numbers. They seem to occur rarely in the Dalmatic District (Mikuska & Kutuzovic 1982).

Habitat and feeding ecology: As elsewhere, Tundra Bean Geese feeding on arable fields on the remains of maize, grains, sugar beet and other crops, also grazing winter cereals and grass. In winter, Bean Geese are scattered throughout much of the country (Mikuska & Kutuzovic 1982).

4X.2 Abundance

Phenology: First Tundra Bean Geese can be expected in the northern part of the Yugoslavian Republic by late September. Peak numbers usually are reached during November, later geese move further south and disperse into smaller flocks (Mikuska & Kutuzovic 1982). They leave the country mainly during late February and the first half of March.

Trends and numbers: As the political situation in the region has changed dramatically in recent times, it is hard to obtain a proper assessment of the wintering population of *rossicus* within the borders of the former Yugoslavia. However, there is no doubt that the numbers of staging and wintering Bean Geese have decreased enormously during the last 10 years. The results of mid winter censuses during 1987-1995 (except 1994) give an average of 891 Bean Geese counted in the entire country (Wetlands International Goose Database).

4X.3 Research

No special research apart from the regular goose censuses carried out since the mid 1980s.

4X.4 Protection and conservation

Hunting legislation: In the former Yugoslavia the hunting season for Bean Geese was open from 1 September until the end of February (Lampio 1983). Although there is no recent information about any changes in hunting regulation, it is thought that geese are frequently hunted close to their roosts in spite of the hunting ban in these areas.

Site safeguard: Some roosts in Vojvodina, such as Lake Belo Blato, are legally protected but the feeding areas are unprotected.

Agricultural conflict: No information.

5. DISCUSSION

Population status: Since the 1950s contradictory reports of decreasing or increasing numbers of Bean Geese *Anser fabalis* have come from different parts of Europe. In general, a reduction of the size of the wintering population was reported from the southern half of the European continent, whereas increasing numbers were reported further to the north. To provide an effective analysis of the changes in the entire European wintering population, it is necessary to separate the two races concerned: Taiga Bean Geese and Tundra Bean Geese, since the two races mainly use different migration, staging and wintering areas.

The majority of Tundra Bean Geese winter on the European continent, particularly in western Poland, Germany (although relatively few winter along the coast of the Baltic Sea), the Netherlands and central Europe (Hungary, Austria, the Czech Republic, Slovakia, Croatia and Yugoslavia). Within this area, which stretches from the Baltic to the Mediterranean and from the Atlantic Coast to the Black Sea, *rossicus* originate from two discrete areas: one breeding area in the northern Russian tundra and another from Novaya Zemlya, Vaygach, and the Yamal and Gydan Peninsulas perhaps as far east as western Taimyr.

All goose species wintering in the western Palearctic have undergone considerable changes in distribution and abundance during the latter half of this century as a result of changes in political, agricultural and hunting patterns. The socialist systems established in most of the countries in eastern and central Europe during the 1950s led to dramatic changes in the agriculture of this region. Farms which were previously privately owned were amalgamated and transformed into extensive state farming units, producing mass monocultures of certain crops such as maize, corn, rape and sugar beet, a system which rapidly became very attractive to geese (Sterbetz 1971, 1979). It is remarkable that during the same period in which decreasing numbers of Bean Geese were reported from most countries in southern Europe (Bernis 1963, Jouanin 1970, Perco 1991, Mikuska & Kutozovic 1982, Fournier et al. 1983, Handrinos 1991), a considerable increase was occurring in central Europe (Sterbetz 1979a, Dick 1987), the southern Baltic region (Rutschke 1973, 1983a, 1986) and western Europe (Eberhardt 1971, van den Bergh 1977, 1978, Ganzenwerkgroep Nederland 1977, 1980, Mooij 1979, 1982).

Although there is no evidence that these large-scale changes in distribution and local abundance of staging and wintering Tundra Bean Geese in different parts of Europe have been affected by the situation in the breeding areas, Russian ornithologists consider that the density of breeding Tundra Bean Geese was considerable/ higher in the 1950s and 1960s (H.V. Rogacheva & E.V. Syroechkosvky pers. comm). Recently, decreasing numbers have been reported from the Gydan and Yamal Peninsulas (Rogacheva 1992, Kalyakin 1995), whereas an increase has been observed in the region from Yamal to Timanskaya tundra (Syroechkovsky et al. 1995). The Tundra Bean Goose appears largely to have been displaced from the Kanin Peninsula during staging by increasing numbers of nesting Barnacle *Branta leucopsis* and Brent Geese (Vinogradov 1994).

As stated earlier, the Wetlands International Goose Database lacks sufficiently good information to produce any complete population estimates (Pirot et al. 1989, Madsen 1991), as most of the available censuses have been carried out in January. By that time, Tundra Bean Geese are scattered all over Europe, which makes it impossible to gather accurate count information enabling comparative assessments of total population size. Therefore, it is essential that coordinated annual censuses are carried out at the main strongholds in autumn to determine population size and trends in the future (c.f. Huyskens 1986).

Experience gained during counts in autumn 1995-97 indicates that counts should be made in late October-early November, and cover Poland, east Germany, the Czech Republic, Slovakia, Burgenland in Austria, Hungary and Croatia when the entire population is concentrated in relatively limited number of areas. In autumn 1995, about 307,550 Tundra Bean Geese were counted in the southern Baltic (western Poland and east Germany) of which 286,500 were present at just eight sites. In autumn 1996, over 350,000 were counted, of which 320,000 occurred at just five sites, and in autumn 1997, 396,000 were counted, of which over 346,800 occurred at six sites (L. van den Bergh unpubl.). One of these areas, Neolithteich, near Köthen in the federal state of Sachsen Anhalt, has been reported as an important staging area for geese in winter (Rochlitzer 1995, Scott & Rose 1996), but appears to be even more important in autumn: numbers counted in autumn 1996 were, 73,000 Tundra Bean Geese and 34,000 White-fronted Geese, and in 1997, 101,500 Tundra Bean Geese and 23,700 White-fronted Geese. The Köthen region was mentioned by Naumann (1842/1902) as being regularly used by enormous concentrations of Bean Geese.

In autumn 1995, c. 97,000 Tundra Bean Geese were counted in the Czech Republic, Slovakia, Austria and Hungary together, mainly concentrated in five areas of which one was previously completely unknown. This area, a reservoir near Chomutov in northwest Tsjechia was a roost for about 8800 Tundra Bean Geese in mid November 1995. The other haunts were all situated in the Transdanubian Plain. The presence of 30,000 Tundra Bean Geese in the Gemenc Reserve in Hungary in 1995, maybe suggests a shift of geese from former concentrations in the Kopaci Rit reserve in Croatia. According to Faragó (1995), the peak number of Tundra Bean Geese for Gemenc was 10,000 in 1986, followed by a decrease in numbers.

Given at least 307,500 Tundra Bean Geese in the southern Baltic region and at least 97,000 in central Europe, the size of the entire *rossicus* population would have stood at over 400,000 at that time. However, central and southeastern Poland, eastern Slovakia, part of the Czech Republic, Croatia, several haunts in Hungary as well as some important regions in the southern part of eastern Germany were not included in the autumn 1995 census, so it is certain that considerable numbers of geese occurred in these areas which were not counted. According to information received subsequently from A. Dyrcz, J. Mooij, E. Rutschke, J. Engel and others, it seems likely that the numbers of *rossicus* staging in the southern Baltic region in autumn 1995 was at least 435,000 geese. This means, that at that time at least 535,000 Tundra Bean Geese were present in Europe. The 1996 and 1997 surveys found strong evidence that at least 600,000 Tundra Bean Geese were staging in Europe, of which about 450,000 appeared in the southern Baltic region by late October-early November (L. van den Bergh unpubl.).

Does this number constitute the entire *rossicus* population or does part of the western Siberian breeding stock winter in central southern Asia? As described earlier, Bean Geese from the breeding population of western Siberia migrate upstream along the Ob River to the Chanty-Mansijsk District during August to September. The majority turn southwest, heading for wintering areas in Europe, whereas other geese continue their migration to the south and southeast. Amongst over 1500 recoveries of Bean Geese ringed in the Netherlands during winter, only six were reported from central Asia. All of these recoveries involved aberrant birds for one reason or another, so it seems unlikely that substantial numbers of *rossicus* migrate to or through central Asia, which is more likely to be the main range of the Eastern Taiga Bean Geese *A.f.johanseni*, as described by Delacour (1951, 1954). However, this has never been proved by field observations.

According to Johansen (1962), Keve & Mikuska (1973), Mikuska & Kutozovic (1982) and others, *A.f.johanseni* is a regular winter visitor to Hungary and Yugoslavia, and it is recorded from southern Ukraine (V. Lysenko pers. comm.). Since the late 1970s, *johanseni* has been observed almost every winter in western Europe (van den Bergh et al. 1979, van den Bergh 1980 & unpubl.) and recently in the southern Baltic region (L. van den Bergh unpubl.). It is not unlikely that flocks of this subspecies also turn off to the southwest in the Chanty-Mansijsk District, heading to central and eastern Europe together with the Tundra Bean Geese and small numbers of *A.f.fabalis*, of which considerable numbers apparently occur in the lower Ob region (Burgers et al. 1991). However, no ringing recoveries of pure *rossicus* birds have been received from central or southern Asia so far and it seems plausible to assume that the entire population winters on the European continent.

Conservation issues: There is no doubt that hunting is by far the most important source of mortality in Tundra Bean Geese. Open seasons for hunting Bean Geese exist in nearly all regions where important numbers of Tundra Bean Geese occur. In fact, Tundra Bean Geese may be hunted on their breeding grounds, at staging areas and along migration corridors as well as on their wintering grounds. Shooting is practised close to the roosts, under unfavourable light conditions during early morning or evening flights. As many countries only report the size of the total goose bag or total waterfowl bag, it is impossible to make an informed estimate of the annual loss caused by hunting activity.

Apart from shooting by local hunters, tourist hunting is well established in many important regions. According to recent advertisements in hunting magazines, sportsmen are welcome to join goose shoots in east Germany, Poland, the Czech Republic and Hungary. Serious problems as a result of this activity have been recently reported at major strongholds such as Oderbruch, Lake Galebeck, on the island of Rügen and near Köthen and Halle (all in Germany) as well as at Lake Nové Mlýný in Czech Republic (L. van den Bergh unpubl.). Hunting tourism, in combination with heavy local hunting activity, was probably a major factor involved in the dramatic decrease in numbers of geese on the Great Hungarian Plain (Craandijk 1944). This highlights the necessity for the creation of large, hunting-free refuges for geese throughout the entire migratory corridor such as those which have been established in North America for many years.

Agricultural conflict: In almost all countries within Europe, Tundra Bean Geese are associated with arable habitats. Their local names very often reflect the type of landscape in which they occur or their feeding habits (e.g. Saatgans, Oie des Moissons, Gumennik). During autumn and through the major part of the winter they feed mainly on waste crops which remain on arable fields after harvesting. They thus cause no damage to these crops. In the latter part of winter, especially in February and March, they increasingly feed on winter cereals and pastures, but will stay on arable fields as long as exploitable sources of food are available. Amongst the countries in which substantial numbers of Tundra Bean Geese occur, only two countries, Germany and the Netherlands, report considerable crop damage caused by Bean Geese. Other countries report little or no damage at all. In Germany, an average of 1-1.5 million DM (US$ 550,000-810,000) per year is paid for compensation for yield loss, of which 75% was estimated to have been caused by White-fronted Geese and Bean Geese. In the Netherlands, an average of Hfl 490 (US$ 240) and Hfl 27,500 (US$ 13,500) respectively is paid for damage to pastures and arable crops, caused by Bean Geese. Crop damage caused by Bean Geese is only a marginal problem in Poland, the Czech Republic, Slovakia, Austria and Hungary (van Roomen & Madsen 1992), hence, the Tundra Bean Goose is responsible for very little crop damage and yield loss on a European scale.

Future research needs: There remain many questions about the origins and movements of the Tundra Bean Geese staging and wintering in Europe, so it is important to initiate ringing programmes on the breeding and moulting areas as has already been done for the White-fronted Goose population on the Taimyr Peninsula. On staging and wintering areas, it is also important to continue the existing programmes, such as the marking programme at Lake Guelpe in Germany. Unfortunately, the long term ringing programme in the Netherlands ceased some years ago. Seasonal observations of the reproductive success in as many flocks of Tundra Bean Geese as possible should be organised throughout the wintering range, as these data are very important to obtain information about the recruitment into the population.

International conservation: As several very important strongholds for Bean Geese are situated along the borders of different countries, it will be necessary to coordinate better monitoring and conservation effort on an international level. Great changes in the local distribution of Tundra Bean Geese have taken place within Europe in recent years and there is no doubt that as the political map of Europe changes in coming years, great changes will occur in agriculture and the distribution of Tundra Bean Geese will change again. There is a clear need to monitor these changes and adjust conservation management policies accordingly. Such international coordination as is required to monitor and manage the population requires some form of framework if local and national effort is to be most effectively harnessed at the international level. Owen (1992) offered some conservation objectives which could be achieved under population action plans that might, for Tundra Bean Geese, include:

- provision for detailed monitoring of numbers, breeding success and mortality so that trends and declines below some critical threshold or 'safe limit' can be swiftly detected;
- strategic provision of safe roosts and feeding areas throughout the population's traditional range, and management of local populations so that they use alternative feeding areas rather than farmland;
- sensitive control of hunting and shooting under licence in relation to population trends and absolute numbers.

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3 Pink-footed Goose *Anser brachyrhynchus*: Iceland/Greenland

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1. POPULATION REVIEW

1.1 Range

The Pink-footed Goose breeds primarily in central Iceland and in smaller numbers along the east coast of Greenland, mostly from Kangertittivaq/Scoresby Sund (c. 70° N) to Nordmarken, northern Germania Land (c. 77° N; Boertmann 1991, 1994). East Greenland is a major moulting area for this population. In early autumn, birds migrate to winter exclusively in Britain (Fig. 3.1). The British wintering population is discrete from the Svalbard population wintering in the Low Countries and Denmark. Its wintering range is now associated with farmland, taking advantage of reservoirs, other freshwater bodies and estuaries for roosting (Owen et al. 1986). Large concentrations can occur in early autumn, especially in east central Scotland making annual population estimates at this time the best assessment method. There is considerable redistribution in winter especially to sites further south (particularly to Lancashire and Norfolk) with peak numbers occurring in Norfolk in January. Birds at the southern limit of the wintering range begin their northward migration through Britain in late winter probably in response to grass growth. They leave Britain from mid April and stage in the southern lowlands and other coastal areas of Iceland before departing for the breeding grounds in central Iceland or Greenland where they arrive from mid May onwards.

1.2 Delineation of flyways

Mass summer ringing in Iceland in the early 1950s (Scott et al. 1953, Scott et al. 1955) and autumn ringing in Britain (Boyd & Scott 1955) underpins our knowledge of the migration routes, phenology and winter distribution. During the 1950s, over 14,000 Pink-footed Geese were newly-ringed in Iceland and another 14,000 were caught in Britain. Since 1987, just over 2000 Pink-footed Geese have been caught in Britain at Martin Mere (Lancashire), Loch Leven (Tayside) and a number of other sites in Scotland and these have been fitted with individual plastic leg-bands and collars. Subsequent analysis of ringing and resighting data, particularly individually marked birds has confirmed movements within winter in Britain and the timing of passage through Scotland and Iceland (Fox et al. 1994). Studies in Iceland have also provided a basis for understanding of patterns of occurrence there in spring (Fox et al. 1992). Ringing has confirmed the discreteness of the Svalbard and Iceland/Greenland populations although a very small number of individuals marked in Denmark have been recorded in the British wintering range (Ebbinge et al. 1984, C. Mitchell & J. Madsen unpubl.).

1.3 Population trends

Due to former confusion with the Bean Goose *Anser fabalis* no data exist to show how common the Pink-footed Goose was in Scotland before the 20th century, although it is considered to have been a scarce winter visitor (Berry 1939). Until the early 1900s, there were few data to suggest that Pink-footed Geese bred in Iceland in appreciable numbers (see Freme 1955), although remains of geese have been found in Hvannalindir, central Iceland which date back to 1770 (Skarphéðinsson 1983). The status of the Iceland breeding population in the early part of the 20th century is uncertain. Berry (1939) suggested that from 1890 to 1930 the Pink-footed Geese breeding in Iceland increased and extended their range, yet the expansion may have been held in check as a result of some human exploitation, when a number of colonies (e.g. at Grafarlönd) are known to have been almost wiped out (Einarsson 1983). However, the colony at Hvannalindir, an area inaccessible to egg collectors, also declined during the same period.

Regular autumn counts are available from Britain from the early 1950s (Fig. 3.2) although systematic roost counts from other periods during the winter have been carried out on a regular basis. The censuses provide an accurate assessment and suggest that the pop-

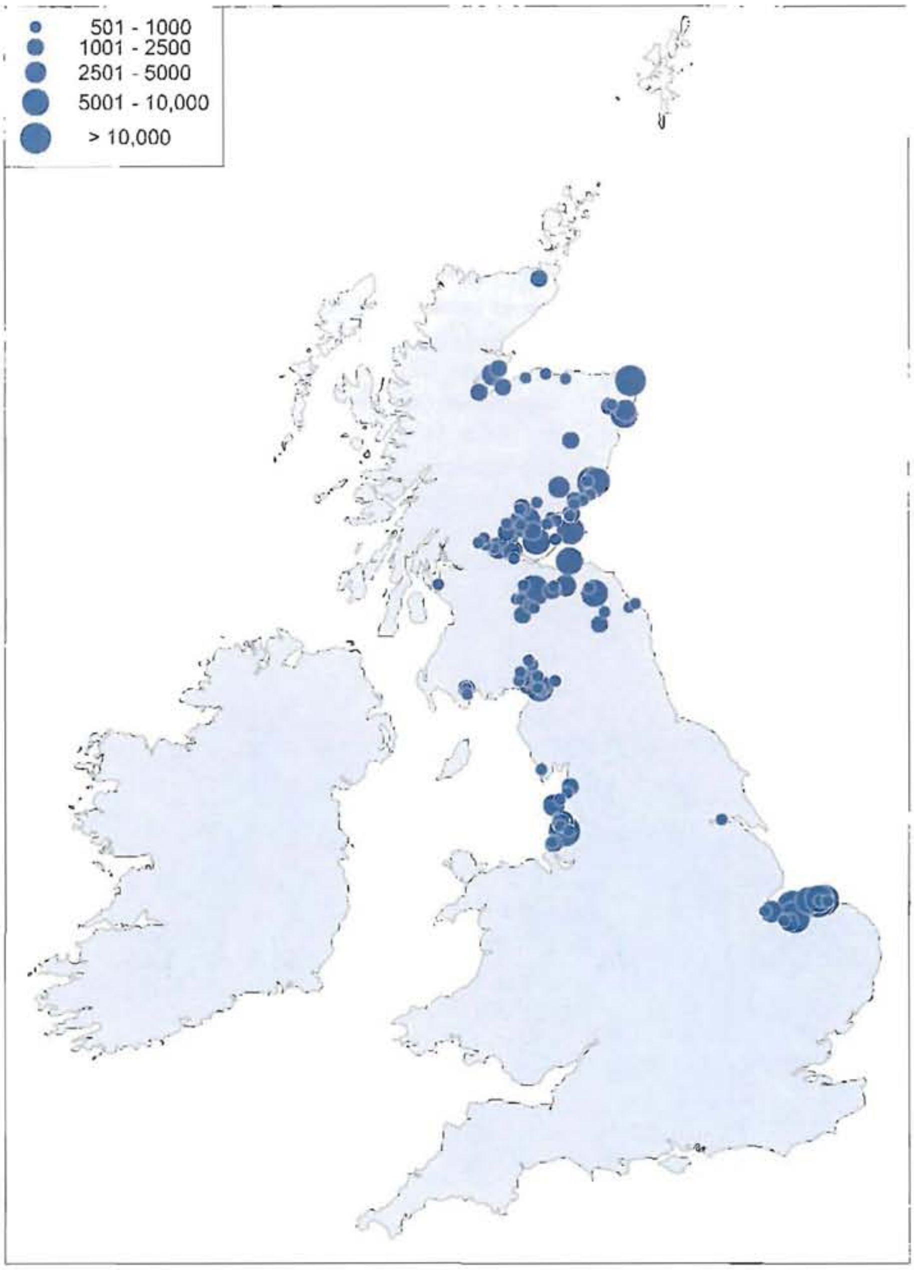

Fig. 3.1. Distribution of Iceland/Greenland Pink-footed Geese in the UK. Based on five-year means 1991-1996.

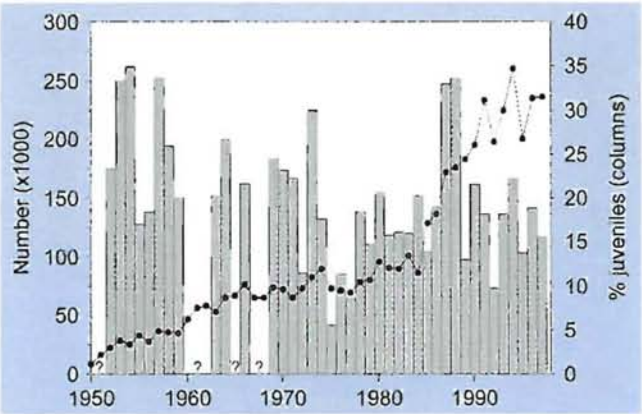

Fig. 3.2. Population change in Iceland/Greenland Pink-footed Geese since 1950 and breeding productivity (% juveniles in autumn flocks) since 1952. In many years before 1970 sample sizes were small. ? No data.

ulation has increased from c. 20,000-30,000 birds in the 1950s to c. 200,000-250,000 individuals in the mid 1990s. The substantial increases, particularly during the early 1980s, are attributable to a decline in overall mortality perhaps due to site safeguard of important winter roosts and improved winter feeding conditions (Fox et al. 1989).

During the early autumn, 99% of the population can be counted on as few as 30 roost sites (e.g. Mitchell 1996). Dramatic increases in the number of geese using some roosts have mirrored the general population increase (e.g. Loch of Strathbeg, Dupplin Loch, Snettisham, Southwest Lancashire, Montrose Basin, Westwater Reservoir and Loch Leven).

1.4 Breeding success

The long-term (1970-1995) mean for proportion of

Table 3.1. Five year mean breeding success of Iceland/Greenland in Pink-footed Geese, 1970-1994.

	Mean % young	Mean brood size
1970-74	20.8	2.1
1975-79	11.7	1.9
1980-84	17.7	2.0
1985-89	22.5	2.4
1990-94	17.9	2.1

young in the autumn population is 17.9% (±1.35 s.e.) and there has been no significant trend (F_{25}=0.15, P=0.70, Fig. 3.2; Table 3.1) in breeding success during the last 26 years. Breeding success has always been variable in this population; between 1950, when recording began, and 1992, the proportion of juveniles in the autumn population varied between 48.8% and 5.6%. However, sample sizes up to 1970 were small (often less than 1000 birds aged), and, since that year, the proportion of young in autumn flocks has only exceeded 25% in three years. Using all age counts (from 1950), a density-dependent reduction in productivity was evident up to the early 1980s, a process that was adequate to explain the pattern of growth and stability until that time (Pettifor & Rowcliffe 1995). Since that time, the number of successful breeding pairs returning to the wintering grounds has steadily increased, partly providing an explanation for the recent resumption of rapid growth in the population. Density-dependence in productivity from the mid 1980s to 1992 could not be detected.

Over 50% of the variation in breeding success was related to meteorological variables on the wintering grounds in spring prior to departure and on the nesting grounds (Fox et al. 1989). As the number of birds in the population has increased there has been no apparent decline in breeding success with over 30% young being recorded in 1987 and 1988. It is suggested that the lack of decline in breeding output may be due to an extension of the breeding range into new areas where breeding success is comparable to that in the former range. The mean brood size during 1970-1995 was 2.09 (± 0.07 s.e.) and also shows no significant trend (F_{23}=2.14, P=0.16; Fig. 3.3; Table 3.1).

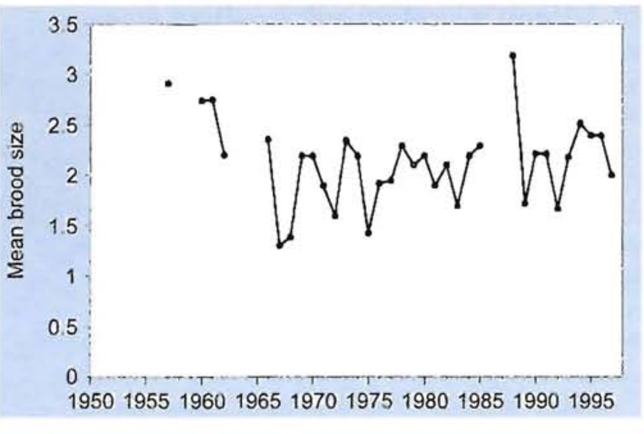

Fig. 3.3. Changes in mean brood size since 1957 in Iceland/Greenland Pink-footed Geese. In many years before 1970 sample sizes were small.

Geese wintering in different parts of the autumn range in Britain can exhibit different levels of breeding success although annual patterns are correlated (a good breeding season means a high proportion of young in all areas, whilst a poor season is reflected in low productivity - as in 1992). It has been important to obtain estimates in the field of the proportion of young geese in as many different areas as possible, although the significance of the differences has not been fully examined.

1.5 Mortality

The Pink-footed Goose is legal quarry throughout its range. Crude adult survival rates (November to November) based on age ratios and census data (after the method of Ogilvie & Boyd 1976) were 0.80±0.04 s.e. for 1951-1960, 0.80±0.02 for 1961-1970, 0.86±0.03 for 1971-1980 and 0.88±0.02 for 1981-1990, suggesting some absolute increase in survival over the period, partly as a result of the 'predator swamping' effect of a relatively constant hunting bag taken from an expanding population (Fox et al. 1989).

Comparisons of estimates of survival based on ringing recovery data from 1950-1958 and 1987-1991 showed no significant change in adult survival rate (86% as against 85% respectively, Bell et al. 1995). First-year survival rates were lower for the more recent data (58%) than for the 1950s (77%), but given the low precision of these estimates, it cannot be inferred that there has been a significant decline in juvenile survival rates (Bell et al. 1995). Estimated annual survival rates using capture-recapture models based on resightings of leg-ringed birds were 79% for adults and 54% for first-years, although both were likely to be under-estimates due to differences in resighting effort and local emigration effects (Bell et al. 1995).

Pettifor & Rowcliffe (1995) showed that no trends were discernible in the estimated annual survival probability when plotted against lagged population size either when using data from years 1960-1992, or when restricted to 1975-1992. They concluded that, although density-dependence in productivity is the most important *regulating* factor in the population, the size of the population is *determined* more strongly by survival rates.

2. BREEDING GROUNDS AND BREEDING ECOLOGY

2A. ICELAND

2.A.1 Distribution

Range: The breeding range was traditionally centred on Þjórsárver, a remote wet meadow area in the central Iceland plateau, associated with the glacial melt rivers draining the Hofsjökull. The highest density of nests in this area (and in other colonies) occurs on river banks

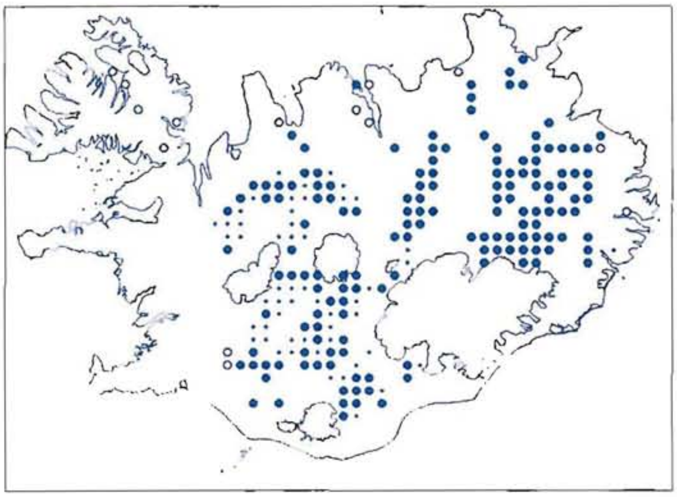

Fig. 3.4. The breeding distribution of Pink-footed Geese in Iceland based on a 10 km grid. Large dots indicate confirmed breeding, small dots probable but unconfirmed breeding, and open circles old or irregular breeding records. Data from the forthcoming Icelandic Breeding Bird Atlas, kindly provided by K.H. Skarphéðinsson.

and along burns - the first sites to become snow free in spring. Breeding also occurs on inaccessible cliffs and riverbanks (again the first to become snow-free) where predator avoidance may be important. Much of the restricted breeding distribution, which was still evident in the 1950s, may have been the result of human exploitation during the early part of this century, when a number of colonies were known to have been reduced as a result of egg collecting (Einarsson 1983). In the 1960s, it seems that improved conditions on the wintering grounds (leading to a gradual increase in numbers) resulted in recolonisation of areas away from the major inland concentrations, notably Þjórsárver, usually in *Carex*-dominated wetlands which occur in the interior. It seems likely that the recolonisation of many formerly occupied nesting areas led to some overgrazing of local food resources, and perhaps decreasing breeding performance, most importantly at Þjórsárver. Recent resurvey of nesting areas studied in earlier years suggests that the total number of nests in Þjórsárver fell from 10,697 in 1970 (95% confidence intervals 9059-12,335) to 10,384 in 1981 (9006-11,793) to 6437 in 1996 (5101-7774) using identical aerial survey techniques (Garðarsson 1997). By the late 1970s, density-dependent factors operating on these interior sites were probably swamped at the overall population level by the breeding success of birds starting to consolidate at recolonised colonies (e.g. a doubling in the breeding population at Hvannalindir between 1976 and 1980, Skarphéðinsson 1983). In the well studied Jökulsá á Fjöllum area, there were 670 pairs in 1981 and 1600 pairs in 1988 (K. Skarphéðinsson in litt.). In northeast Iceland, the number of nesting Pink-footed Geese has increased dramatically, as the number of nests at almost all of the older colonies has increased and several new colonies have been formed. Numbers in eastern Iceland have increased from c. 1800 pairs in 1981 to c. 4000 in 1988 (K. Skarphéðinsson in litt.). The annual mean growth rate in the number of nesting pairs at 16 studied colonies was 8.3%, similar to the general growth rate in the population at that time 8.5% (from Fox et al. 1989). With the recent increase in population, the breeding range expansion has brought increasing numbers into lowland areas (Fig. 3.4), where birds nest on islands in areas and habitats formerly associated with the Greylag Goose *Anser anser*, even down to sea level (Skarphéðinsson & Guðmundsson 1990).

Habitat and feeding ecology: Breeding in the interior occurs on inaccessible flat oasis areas and in cliff colonies. In the eastern interior of Iceland breeding sites are primarily in (i) river gorges on ledges, pinnacles or steep cliff ledges, (ii) islands, river banks and braided river flats, or (iii) on cliff sites, some of which are many kilometres from the nearest river (K.H. Skarphéðinsson in litt.). Palsa or tussock nesting is scarce in eastern Iceland and generally a high proportion of nest sites are accessible to Arctic Foxes *Alopex lagopus*.

After hatching, families tend to aggregate into larger groups, often of several hundred when the young are 10-20 days old, at about the time the adults become flightless. They tend to remain gregarious thereafter, often moving long distances on foot from the nesting areas. Non-breeders tend to separate from the breeding pairs, forming loose flocks.

Pink-footed Geese eat green parts, roots and fruits of a wide variety of tundra plants. The main foods include rhizomes and the seeds of Alpine Bistort *Polygonum viviparum*, shoots of Horsetail *Equisetum variegatum*, and cotton grass *Eriophorum*, and in the autumn, the seed heads of sedge *Carex* spp. Adults feed at first on leaves and catkins of Willow *Salix glauca*, switching gradually to graminoids (*Carex, Calamagrostis stricta*) which form nearly the whole diet in July and early August. At first, goslings take more herbs and *Equisetum* than adults (Garðarsson 1976). From August, the leaves and ripened fruit of crowberries *Empetrum nigrum* and *E. hermaphroditum* become increasingly important, coinciding with the movements of geese from marshes to higher and drier areas.

2A.2 Moult migration and moulting areas

There is a massive moult migration from Iceland to northeast Greenland in early June involving many thousands of non-breeding birds. The most important Icelandic non-breeding moulting concentration occurs in Eyjabakkar, on an area of vegetated sand flats in the middle of the Jökulsá glacial melt river draining the Vatnajökull in eastern Iceland, where 9000-13,000 birds have moulted (Fox et al. 1987, Skarphéðinsson in press). Other important moulting areas for non-breeding birds occur around Þjórsárver and the Þjórsá River where c. 5800 birds were counted in 1991, and around the Blanda River, north of the Hofsjökull glacier with 1700 birds also in 1991 (Skarphéðinsson in press).

2A.3 Research

Pink-footed Geese were extensively ringed in Iceland in the 1950s (Scott et al. 1953, Scott et al. 1955) which generated a large number of recoveries and defined mortality rates and migration routes at that time. Ringing recommenced in 1987 with an expedition to eastern Iceland (Fox et al. 1987) and to Alfsgeirstungur in 1996 (Mitchell et al. 1997).

In the early 1970s, when Þjórsárver was threatened with inundation as a result of damming glacial melt rivers, a programme of study of the ecology of Pink-footed Geese was initiated by Professor Arnþor Garðarsson from the University of Reykjavik, funded by the Icelandic National Energy Authority. His important studies at that time gave considerable insight into the breeding biology, feeding ecology and food production available to foraging geese (see Garðarsson 1974, 1976, the latter translated into English for Boyd 1976). Garðarsson showed that Þjórsárver may have accounted for 70% of the Iceland/Greenland Pink-footed Goose population of the time, concluding that no other comparable aggregation has occurred in recent historical times. Clutch size was constant at around 4.6 eggs per female during 1971-1974, hatching success equated to a mean of 2.62 young per initiated nest and the mean number of young alive in late July was 1.76. Nest density decreased during 1971-1974, from 115 (±34 s.e.) nests km^{-2} in 1971 to 75 (±23 s.e.) nests km^{-2} in 1973 and 1974. Nest density was shown to be the key factor determining production of young per unit area, since survival at the early stage of breeding varied little between years. Data on gosling growth and adult weight dynamics were also studied in detail. Studies were also carried out on the diet and food available to the geese in Þjórsárver, where geese grazed between 13% and 37% of vascular plant production in studied areas.

A population review based on aerial counts throughout Icelandic was made in 1970 (Kerbes et al. 1971). In 1973, an ethological study of breeding Pink-footed Geese was carried out in Þjórsárver by Ian Inglis, who observed the behaviour of nesting pairs from a hut overlooking an important portion of the breeding area (Inglis 1976, 1977, Lazarus & Inglis 1978). Studies at Þjórsárver showed that nest success varied according to how early nests were initiated and the ability of individual females to gain sufficient food during their short absences from the nest (Inglis 1977). However, recesses by some females increased the tendency to vacate the nest again, and the duration of the recesses grew greater. Inglis (1977) concluded that breeding experience may be a crucial factor governing the strength of nest attachment.

Brood sizes were measured just after hatching, before fledging and after fledging in south and northeast Iceland in 1987 and post-fledging brood sizes were measured in 1988 (Patterson & Giroux 1990). In 1995, a research project was started at The Icelandic Institute for Natural History focussing on the effects of hunting on goose populations. The project includes studies of population parameters, examination of wings from the hunting bag and the compilation and analysis of bag statistics (Sigfusson 1996).

2A.4 Protection and conservation

At present the Icelandic Government is signatory to the Ramsar Convention, with Þjórsárver declared a Ramsar site. Some breeding colonies are within sites protected by the Nature Conservation Act, with access to Þjórsárver being forbidden from 1 May to 10 June. Some breeding areas continue to be threatened by hydro-electric schemes. Extensions to existing electricity generating dams to the south continue to edge nearer the most important breeding concentrations (including Þjórsárver) and proposed schemes in the north and east of Iceland will inundate important moult sites there. In 1981, the Icelandic Parliament passed legislation that gave the state owned power company (Landsvirkjun) permission to develop hydro-electric power on the Jökulsá i Flotsdal river system. The prerequisite for harnessing the river system is a huge dam that would inundate the Eyjabakka moulting oasis. To date there are no formal plans for protecting these unique areas.

2B. GREENLAND

2B.1 Distribution

Range: Pink-footed Geese breed in East Greenland from Kangertittivaq/Scoresby Sund (c. 70° N) northwards Germania Land (c. 77° N; Meltofte 1976, Boertmann 1994), where breeding is thought to be scattered (Madsen & Mortensen 1987). Breeding has also been confirmed in the Ammassalik area (c. 66° N) and probably in the Akerninnarmiit/Skjoldungen area (c. 63° N). Numerous non-breeders, including a large contingent from Iceland, moult in the area (Boertmann 1991).

Habitat and feeding ecology: Breeds in areas with lush meadow vegetation, nesting on top of river banks, cliffs, large hummocks, etc. (Madsen et al. 1984, Boertmann 1994). Moulting birds utilise a range of habitats, but generally favour extensive lowland sedge-rich meadow areas close to early-thawing open water such as lakes and rivers, but including the sea. The *Carex subspathacea* meadows associated with the coast or floodplains of major rivers are favoured areas (Madsen & Mortensen 1987). During the moult the geese are extremely wary and depend on a safe area of water serving as a refuge with nearby food supplies (sedge dominated marshes), grazing up to 200-250 m from the refuge. Food intake was estimated at 149 g organic material per 24 h which accounted for up to 100%, and c. 60-69%, of above ground primary production of a *Carex subspathacea* marsh in 1983 and 1984 respectively (Madsen & Mortensen 1987). The geese spent 41-46% of the 24 hours grazing. Madsen & Mortensen (1987) argued that the moulting grounds in Jameson Land had reached carrying capacity. Pink-footed Geese competed with Barnacle Geese *Branta leucopsis* for resources with the latter suffering from the presence of the former. Moult coincided with the onset of growth and peak nutrient levels in the vegetation and it was suggested that Pink-footed Geese undertake a moult migration to east Greenland to avoid competition for resources with breeding geese in Iceland and because they gain advantage from a growing, nutritious vegetation (Madsen & Mortensen 1987).

2B.2 Moult migration and moulting areas

The major moult migration from Iceland to Greenland has been well described with birds arriving during late June and early July (Christensen 1967; Meltofte 1976, Madsen et al. 1984). The major moulting range extends from Kangertittivaq/Scoresby Sund (c. 70° N) to Germania Land (c. 78° N), with further records north to Kronsprins Christian Land (c. 80° N) and Peary Land (c. 83° N; Boertmann 1994) and south to Ammassalik (c. 66° N) and Akerninnarmiit/Skjoldungen (c. 63° N; Boertmann 1994). Large numbers of moulting Pink-footed Geese concentrate in Germania Land (9000 Boertmann 1991), Hochstetter Forland (6500 Boertmann 1991), Jameson Land (6000 Madsen 1984; Madsen et al. 1984), Hold-with-Hope (3000 Boertmann 1991, J. Turner in litt.) and Woolaston Forland (2000 Boertmann 1991). Southward dispersal and main departures from the Greenland breeding and moulting grounds begins in late August when Pink-footed Geese cross to the interior of Iceland joining the breeding/moulting stock there. Moulting flocks are common along coastlines, in wide rivers and on lakes with open views on all sides.

2B.3 Research

Although many avifauna accounts exist from northeast Greenland which mention Pink-footed Goose numbers (and therefore to some extent identified key areas) there was very little research carried out prior to 1980. The threat of extensive oil exploration and potential exploitation in Jameson Land, northeast Greenland, during the early 1980s initiated an environmental impact research programme by the then Ministry of Greenland. Despite the applied nature of studies, much ecological research was derived from the work (e.g. Madsen 1984, Madsen & Mortensen 1987). In more recent times, efforts have been concentrated on the identification of important areas following the continued increase in population size, in particular to identify areas of outstanding importance ahead of mineral exploration proposals (e.g. Boertmann 1991). Pink-footed Geese were ringed at Hold-with-Hope, northeast Greenland in 1988 (J. Turner in litt.).

2B.4 Protection and conservation

The Pink-footed Goose is legal quarry hunted during an open season in spring and autumn although there is little information relating to hunting bags. Born (1983) estimated that 500-1000 geese (both Barnacle and Pink-footed) annually were shot by the hunters of Ittoqqortormiit/Scoresbysund, the only settlement within the main range of Pink-footed Geese in East Greenland. Two major moulting areas with small breeding populations are protected as Ramsar Sites, namely Heden (Jameson Land) and Hochstetter Forland, protecting an estimated 13,000+ birds (Jepsen et al. 1993). Earlier threats from oil exploitation in northeast Greenland (Madsen 1984, Madsen et al. 1984), especially due to increased disturbance (Mosbech & Glahder 1991), subsided due to abstraction costs, but could recur with price changes.

3. STAGING AREAS

3A. ICELAND

3A.1 Distribution

Range: Analysis of spring ringing recoveries, resightings and counts of Pink-footed Geese shows major concentrations in the southern lowlands of the country (c. 17-21° W; Fox et al. in press) and at other coastal localities (e.g. Skagafjörður, Húnavatnssýla etc.). The lowlands of Rangárvallarsýsla and Árnessýsla supported up to 12,000 Pink-footed Geese during late April-May in 1989-92. Pink-footed Geese tend to arrive in the more southerly part of south Iceland and gradually move inland, probably in response to growth patterns of grass, following the progress of the thaw.

Habitat and feeding ecology: Extensive surveys in 1989-92 showed that prior to movement to the nesting grounds in the interior, Pink-footed Geese fed mainly on intensively managed grasslands of the southern lowlands (Fox 1993). Faecal analysis showed that geese feeding in hayfields foraged almost exclusively on the most commonly reseeded species *Phleum pratensis*. *Phleum* shoots had a higher protein content yet similar fibre content to most grasses present in hay fields. Geese grazed predominantly on the youngest (and shortest) leaves of *Phleum* which also had higher protein content and less fibre than older leaves and attached dead leaves, which were rarely taken by geese. Recently created grassland habitat has increased the opportunities for female geese to supplement their reserves during the crucial prelude to clutch initiation by selecting the highest quality plant species and the most nutritious parts of the forage.

3A.2 Abundance

Phenology: Pink-footed Geese arrive in southern Iceland from mid April (typically 18-24), with numbers peaking during 28 April-1 May, but they generally leave the lowlands by mid May (Fox et al. in press). Individually marked Pink-footed Geese were present in the same fields on the same farm for up to nine days. The main departure from the east Greenland breeding/moulting areas commences in late August towards Iceland to join the breeding/moulting stock there. There is little evidence of staging in Iceland lowland areas in autumn en route to Britain. The first arrivals in Britain arrive from late August to mid September.

Trends and numbers: There are no accurate census data for anywhere in Iceland. The geese pass through the southern lowlands in spring and autumn over a large area which makes accurate counting difficult. Up to 12,000 Pink-footed Geese were counted in late April and early May during 1989-92 in the southern lowlands (Fox et al. in press), and it seems likely that the entire population stages in Iceland at some point, although there is considerable turnover. In autumn, Pinkfeet are rarely seen in lowland areas away from breeding areas. The species appears to depart for the wintering areas in Britain direct from the summering areas and no major aggregations are reported in lowland agricultural areas as in spring. This habit may explain the relatively small Pinkfoot bag in recent years (Sigfusson 1996).

3A.3 Research

Between 1989 and 1992, The Wildfowl & Wetlands Trust (WWT) initiated a series of spring expeditions to study Pink-footed Goose staging ecology in the lowlands of southern Iceland prior to the breeding period. The work concentrated on phenology, habitat use and potential changes in body condition achieved during the staging period (Fox 1993, Fox et al. 1991, 1992, Boyd & Fox 1992, 1995).

3A.4 Protection and conservation

Hunting legislation: The main legislation in Iceland relating to the geese is the Bird and Mammal Protection Act of 1994. Under this legislation, annual hunting licences are granted only on submission of a record of the number and species taken in the previous year. There are over 20,000 gun licences issued in Iceland, and in 1995, when hunting licences were required for the first time, 11,200 hunting licences were issued (12,200 in 1996). Although the geese are protected in spring there may be considerable numbers killed illegally at this time. There is no limit to the hunting bag at present, but bag statistics are available from 1995 onwards so the size and extent of the kill each year may be assessed. Due to the habit of remaining in the relatively remote interior prior to autumn departure, the Pink-footed Goose bag is relatively modest (c. 10,500 in 1995, compared with 30,000 Iceland Greylag Goose, Sigfusson 1996).

Agricultural conflict: Although unlikely to cause significant agricultural damage, complaints are received from individual farmers. Only one licence has been granted in the last decade to shoot Pink-footed Geese in spring for the purpose of preventing damage.

4. WINTERING AREAS

4A. GREAT BRITAIN

4A.1 Distribution

Range: The present range of the species has not changed markedly since the review of Ogilvie & Boyd (1976). The winter distribution is essentially the east and south of Scotland, northwest and east England (Fig. 3.1). A contraction of range on the wintering quarters from the early 1950s to the early 1970s (with particularly dramatic increases in numbers in east central Scotland) has reversed in recent years as a result of increasing numbers using agricultural land in Lancashire and sugar beet tops in north Norfolk (e.g. Gill, Watkinson & Sutherland 1996), where up to 20% (1982) and 41% (1994) respectively, of the mid winter totals have been counted (Forshaw 1983, Mitchell 1995). Numbers on the Lincolnshire side of the Wash have not recovered to earlier (1950s) levels despite the increase in the population as a whole. Despite an eight-fold increase in numbers, the early autumn distribution of Pink-footed Geese in Britain has remained congruent with earlier years, with birds particularly loyal to roosts. However, a number of new roosts have been occupied during the last 15 years in central Scotland (Bell & Newton 1995). This is in contrast to the northeast of Scotland, where numbers have greatly increased, but the birds remain loyal to traditionally occupied sites (Loch of Strathbeg and Meikle Loch, Bell et al. 1988). Resightings of individually marked birds show dispersal from Scotland into Lancashire and Norfolk followed by late winter movements northwards through England and southern Scotland to important staging areas in east and northeast Scotland and the Moray Firth (Fox et al. 1994).

Habitat and feeding ecology: The main winter habitat is thought to have been saltmarsh (Owen 1976), but from late last century the species has moved inland to feed on farmland, taking advantage of reservoirs, other freshwater bodies and estuaries for roosting (Owen et al. 1986). Pink-footed Geese tend to be conservative in their use of roost (Owen et al. 1986), although these may be shifted locally in response to disturbance or feeding conditions (Giroux 1991). In northeast Scotland, 82% of Pink-footed Geese foraged within 8 km (median distance 4 km) of traditional roost sites (Bell 1988).

Broadly, Pink-footed Geese use stubble fields in autumn gleaning the spilt grain, moving to root crops (if available) in mid winter, but with grassland predominating after autumn in most studies of habitat use (Forshaw 1983, Bell 1988, Gill 1996). More recently, Fox et al. (1994) put these patterns into a national context, suggesting that Pink-footed Geese feeding mainly on grass in spring (principally *Lolium perenne* the main constituent of the sown sward) are responding to a gradient of plant growth, particularly the high protein content associated with the onset of growth. The geese utilise the late occurrence of the 'spring bite' in northern staging areas as they move towards their ultimate destination - the breeding grounds of Iceland and Greenland.

4A.2 Abundance

Phenology: Pink-footed Geese generally start to arrive in early to mid September, especially at the major sites, building in early to mid October. The arrival is pronounced at well-defined staging areas before late autumn dispersal, especially in northeast Scotland (Loch of Strathbeg) eastern Scotland and the Lothians/Borders areas (Newton et al. 1990, Brown & Brown 1992);

62,000 Pink-footed Geese were counted at Dupplin Loch in October 1994, constituting almost a quarter of the population at this one site. Peak numbers occur at major sites generally in the middle of October (Newton et al. 1990) with up to 99% of the whole population counted on as few as 30 sites (Mitchell 1996). There is considerable redistribution in winter especially to sites further south, particularly to Lancashire and Norfolk with peak numbers occurring in Norfolk in January (Gill et al. 1997). Pink-footed Geese start to move north again as early as February when numbers peak in the Fylde and the Solway estuary (e.g. Mawby 1995). Pre-migration peaks in numbers on the Ythan Estuary, Loch of Strathbeg and on the Moray Firth are recorded in late March (Mitchell 1995). The return passage to Iceland starts in mid/late April, with passage still evident from ground based observations on the Western Isles (e.g. Dix 1991). This appears to differ little from patterns recorded from observations earlier this century (Berry 1939) and in the late 1950s and early 1960s (Marr et al. 1959). The first arrivals in southern Iceland have been recorded from c. 18-24 April, continuing into early May (Fox et al. 1992).

Trends and numbers: Since the 1950s, the total population has increased eight-fold from c. 20,000-30,000 to 200,000-250,000. The numbers of Pink-footed Geese counted during the annual autumn censuses show a steady increase with three distinct phases of growth: 1) growth at about 14% per annum in the 1950s-mid 1960s; 2) near stability at just under 100,000 from the mid 1960s to the mid 1980s; 3) growth at 11% per annum to a high point of over 200,000 from the mid 1980s to 1992 (Pettifor & Rowcliffe 1995).

4A.3 Research

Census: In 1956, Hugh Boyd, at the then Wildfowl Trust, was instrumental in putting together a reliable system for estimating the size and distribution of the population on its winter grounds, latterly maintained by WWT. Cooperation with a volunteer counters network together with professional reserve wardens ensures regular and simultaneous coverage of the species range throughout Scotland and England in the autumn. Additional organised counts during the spring were made in the 1960s and have been undertaken annually since 1982. Organised mid winter counts have been undertaken since 1993-94. The network of daytime counts of waterfowl undertaken throughout Britain (WeBS) provides some additional monitoring of individual site use, although to be effective for geese the counts need to be carried out at dawn or dusk as birds flight to or from the roost.

Detailed roost counts have been carried out at some individual sites for many years (e.g. monthly roost counts at Loch Leven since 1966; monthly roost counts in north Norfolk since 1989). Some local feeding and distribution studies have involved detailed roost monitoring throughout the winter months (e.g Hearn & Mitchell 1995, Bell & Newton 1995).

Ringing: WWT undertook extensive ringing during the 1950s based mainly on catches made in the autumn. Between 1950 and 1959 over 14,000 Pink-footed Geese were ringed including some 3000 retraps. This has generated 3753 recoveries and knowledge of the movements (Boyd 1955, Fox et al. 1994) and population dynamics (Boyd 1956) of the species was greatly advanced. The autumn weights of Pink-footed Geese in northern Britain were examined by Beer & Boyd (1962) and Elder (1955). Since 1987, Pink-footed Geese have been caught in smaller numbers at a numbers of sites in northern Britain (mainly Martin Mere and Loch Leven) and these have been fitted with plastic leg-rings and/or plastic neck-collars.

Other: Local feeding studies have demonstrated seasonal changes in the diet of Pink-footed Geese apparently responding to, and in part driven by, seasonal changes in the habitats available (e.g. Newton & Campbell 1973; Bell 1988; Cranswick 1992; Hearn & Mitchell 1995). In Lancashire, Forshaw (1983), and more recently WWT (unpubl.), showed that root crops (potatoes and carrots) formed a substantial part of the mid winter diet, but from December/January onwards an increase in the use of new grass was apparent. The factors that determined the habitat choice of Pink-footed Geese wintering in north Norfolk were examined by Gill (1994). The geese fed exclusively on arable land and detailed studies of their distribution from 1990-93 showed strong preferences for feeding on the remains of unharvested sugar beet. The major features determining the use of sugar beet fields were the distance of the fields from the roost site and the risk of disturbance associated with the fields.

Clipping experiments to measure yield loss in fields which support Pink-footed Geese, together with measuring goose grazing levels from dropping densities were carried out in northeast Scotland in the late 1980s (Patterson 1991). There was evidence that goose grazing was associated with significant loss of yield, but there was great variability in the degree of loss suffered at any given level.

Patterns of roost use in northeast Scotland in the late 1980s were studied using radio-telemetry. These showed that Pink-footed Geese changed their roost approximately once every ten nights between December and April, and on average, each bird visited 3.4 roosts returning to the same sites on many occasions (Giroux 1991). Daily movements and habitat use of individual geese were studied in northeast Scotland during winter and spring (Giroux & Patterson 1995)

Examinations of shot Pink-footed Geese at Loch Leven showed that the proportion of young in the bag was much higher (approximately double) than the corresponding percentages found in observations of flocks (Wright & Boyd 1983) although this effect declined as the winter progressed. Similar results were obtained ten years later when Hearn & Mitchell (1995) found 60% young (n=84) in the bag sample at Loch Leven in October to December compared with 15% young in the field (n=5539).

Pink-footed Geese wintering in Britain tended to avoid the proximity of roads when feeding in agricultural land (Keller 1989, Gill 1996). Flocks were not found within 100 m of the nearest road (median distance 400 m) and fields with centres less than 100 m from a road were not visited.

4A.4 Protection and conservation

Hunting legislation: The Pink-footed Goose is listed on Annex II/2 of the European Union Birds Directive; Schedule 2, part 1 of Wildlife and Countryside Act (WCA) 1981 (may be shot outside the close season); Appendix III of the Berne Convention; Appendix II of the Bonn Convention. In Britain, the WCA permits an open season for Pink-footed Geese during 1 September - 1 February. An estimated 15,000-25,000 are shot each year, but no accurate bag statistics are available (Reynolds & Harradine 1994, 1996). Inland goose shooting, with the use of decoys, tends to be associated with larger organised parties, often from abroad, and involving a 'goose guide'. This type of shooting can provide an attractive source of income to some farmers - the current charge per gun per flight can be in the region of £35-£65. Whilst there are no reliable figures for wildfowling in Britain, an estimated 73,000 people participate in game, wildfowl and rough shooting, supporting an estimated 1220 full time job equivalents (excluding those linked to grouse shooting). Wildfowlers from the United Kingdom spent an estimated £5.7m in 1990 on their sport.

Site safeguard: The SPA network provides for a variety of different requirements, including roost sites and staging areas. The SPA network holds approximately 90% of the population (assessed using the November WWT goose census data). The national and international proportion of the population protected is difficult to calculate precisely owing to within-winter movements between different parts of the range. Sites are largely nocturnal roosts. Feeding areas (especially farmland) are not significantly represented within the SPA network and require complimentary measures such as designation as Environmentally Sensitive Areas (ESA). Of the 36 roost sites which support more than 1% of the population (Table 3.2), 18 are Ramsar sites (nine are proposed Ramsar sites) and 17 are SPAs (ten are proposed SPAs).

Agricultural conflict: In Britain, the main wintering habitat is thought to have been saltmarsh, but since late last century Pink-footed Geese have moved inland to feed on farmland. Although this change in habitat may have been forced on the geese, they have fared well on farmland. Pastures are heavily fertilised and provide palatable and digestible forage. It was probably not until the 1960s that Pink-footed Geese began to pose problems for farmers. On autumn stubbles, potato and waste sugar beet fields they do no harm, but they graze pastures throughout the winter, and on occasions, especially in spring, graze winter wheat and barley. In the latter part of April and in early May farm stock are being let out onto specially prepared 'spring bite' grassland, expensively managed and fertilised. Pink-footed Geese prefer this young grass to older leys and they congregate on these pastures, competing directly with stock for forage. Pink-footed Geese are frequently accused of damaging growing winter and spring-sown cereals, but clipping studies showed that the effect was slight (Kear 1970), although studies on other geese (cv Greylag Geese) do suggest that damage from grazing and puddling of the soil can occur in waterlogged conditions on heavy soils. Serious allegations of crop damage were made in Lancashire in 1973-74, when large numbers of Pink-footed Geese visited unharvested carrot fields and gouged out the tops of the roots to a depth of 3-4 cm, making the whole crop unmarketable. Damage to this high value crop has been alleviated by careful siting of the carrot fields and regular patrols by the farmer. On grass, Pink-footed Geese are more difficult to discourage, although small areas of high value spring bite can be protected by the intensive use of scaring devices.

Recent studies have revealed great variability in the effects of goose grazing (e.g. Patterson et al. 1989). The variability is so great because yield is affected by a complex interaction of factors which influence the response of the vegetation to grazing. These factors include time of year, type of crop, spring weather, crop growing conditions and management and grazing intensity. Spring is the most critical time of the year since goose grazing in April causes greatest losses in yield. As yet, there has been no attempt to assess the scale and distribution of alleged agricultural damage nationally.

5. DISCUSSION

Population status: At current population levels the Pink-footed Goose is considered to be of a *favourable conservation status* (a classification which is consistent with those used in international agreements). The Pink-footed Goose population has shown a period of expansion since the 1950s. Changes in legislation in Britain, beginning with the 1954 Protection of Birds Act, reduced the number of ways in which Pink-footed Geese could be taken or shot, and at the same time a national network of protected roosts was established. During the same period, Pink-footed Geese began to take advantage of the higher quality herbage available on improved grasslands and more recently, on autumn sown cereals. These changes occurred concurrently during the same decades and the net effect has been to reduce winter mortality, so increasing the population size. It is not possible to disentangle the relative importance of the different factors because of their complexity. For example, in different parts of Scotland geese may variously have switched to feeding on farmland either because traditional feeding areas (e.g saltmarsh) were reclaimed for agriculture, or they became less suitable for geese because of the cessation of traditional grazing by cattle and sheep; or moved inland because of shooting pressures; or moved simply because higher quality food was available.

Table 3.2. Mean winter maxima of Iceland/Greenland Pink-footed Geese, at principal resorts, based on counts from 1991/92 to 1995/96 (from Cranswick et al. 1997) and current site conservation status.

Site	Peak	Average	Ramsar	SPA
Dupplin Loch	Autumn	43,300	Yes[1]	Yes[1]
Loch of Strathbeg	Autumn	39,924	Yes	Yes
Snettisham	Winter	31,523	Yes[2]	Yes[2]
South West Lancashire	Autumn	31,215	(Yes[3])	(Yes[3])
Montrose Basin	Autumn	31,142	Yes	Yes
West Water Reservoir	Autumn	31,127	Yes	Yes
Loch Leven	Autumn	19,560	Yes	p
Holkham	Winter	17,288	Yes[4]	Yes[4]
Hule Moss	Autumn	16,416		
Cameron Reservoir	Autumn	16,233	Yes	Yes
Scolt Head	Winter	16,089	Yes[4]	Yes[4]
Solway Estuary	Spring	15,983	(Yes[5])	(Yes[5])
Slains Loch/Ythan Estuary	Autumn/Spring	14,825	p	p
Aberlady Bay	Autumn	12,013		
Carsebreck/Rhynd Lochs	Autumn	10,474	Yes[1]	Yes[1]
Fala Flow	Autumn	6719	Yes	Yes
Fylde/Morecambe Bay	Spring	6676	Yes	Yes
Loch of Kinnordy	Autumn	4760	Yes	Yes
Wigtown Bay	Spring	4698	p	p
Cowgill Reservoir	Autumn	4656		
Tay Estuary	Autumn	4016	p	p
Castle Loch/Lochmaben	Spring	3620	Yes	Yes
Glenfarg Reservoir	Autumn	3600		
Crombie Loch	Autumn	3583		
Loch Tullybelton	Autumn	3519		
Gladhouse Reservoir	Autumn	3068	Yes	Yes
Ardoch Loch	Autumn	2620		
Skinflats (Firth of Forth)	Autumn	2394	p	p
Tay/Isla Valley	Autumn	2345	p	p
Loch Eye/Cromarty Firth	Spring	2333	Yes	Yes
Hightae Loch	Autumn	2277		
Drummond Pond	Autumn	2272	p	p
Lake of Menteith	Autumn	2083	p	p
River Forth: Gargunnock	Autumn	2060	p	p
Upper Forth Estuary	Autumn	2001	p	p
Loch Mullion	Winter	1994		

Notes:

SPA	Site classified as Special Protection Area under EU Birds Directive
Ramsar	Site listed as wetland of international importance under the Ramsar Convention
p	Proposed (in Stroud et al. 1990)
1	South Tayside Goose Roosts SPA contains Dupplin Loch and Carsebreck/Rhynd Lochs
2	The Wash SPA contains Snettisham
3	Martin Mere SPA is within South West Lancashire
4	North Norfolk Coast SPA contains Holkham and Scolt Head
5	Upper Solway Flats SPA and Marss/Solway Mosses SPA are within the Solway Estuary

The proportion of young returning each winter to Britain fluctuates annually and, despite a general decline since the 1950s, appears not to be density-dependent. Whilst the population still increases there may be some check on recruitment which may limit the growth in the future. In two years (1992 and 1994), the autumn population estimate fell by c. 20%, compared to that in the previous year, indicating that some, as yet undetermined, factors may limit population growth.

Conservation issues: Conservation measures for Pink-footed Geese in Britain fall into two categories: the general species protection measures under the WCA (1981); the protection of suitable roosts using site based mechanisms (Sites of Special Scientific Interest (SSSI), SPA etc.) under the EU Birds Directive, and Ramsar sites under the Ramsar Convention on Wetlands of International Importance. Site protection in Iceland or Greenland is limited, however Þjórsárver is both a Ramsar site and is protected under the Nature Conservation Act and receives special protection (access is forbidden from 1 May to 10 June and no flying below 1000 m is allowed). Some important areas in Iceland (e.g. Eyjabakkar and Jökulsá) are under threat of flooding by hydro-power schemes. The population is also vulnerable to potential oil extraction in the vicinity of the moulting grounds in northeast Greenland (Madsen 1984). Its current reliance on farmland for feeding while in Britain means that very large areas of potential habitat are available. However, human disturbance at traditional roosting sites is a persistent problem.

Management options for Pink-footed Geese have recently been proposed for consideration by the Scottish Office (1996). These include traditional means of dealing with goose grazing, i.e. scaring and shooting; opportunities for offsetting any losses through income from organised hunting; extending the shooting season; easing of present restrictions on the sale of dead wild geese and actions by other countries and international cooperation including the restriction of breeding success by the destruction of eggs/chicks on the breeding grounds. However, the discussion document only discusses the impacts of wild geese on agriculture and provides suggestions for remedies, despite a paucity of data on the scale and distribution of alleged agricultural damage. The document did not develop wider issues, such as the economics of goose hunting, birdwatching, potential solutions under agricultural mechanisms etc., and falls short of a flyway management approach to the conservation of this population.

Agricultural conflict: While farmers have tolerated the geese for years, concern has been growing, particularly where numbers are high, with rising numbers of complaints of agriculture damage. There has been a number of complaints from farmers about loss of yield due to goose grazing on grass and cereal crops. In addition to reduced yields, there have been other agricultural effects of goose grazing such as reduced stocking densities, uneven ripening of crops, increased weediness of crops, puddling of ground and delays in turning out livestock. There is only one goose management scheme operated by Scottish Natural Heritage in Scotland specifically for Pink-footed Geese. The scheme, operated at farms close to the Loch of Strathbeg (Aberdeenshire) provides an alternative, non-lethal means of reducing, or compensating for, goose damage. The scheme had two objectives; to demonstrate that the feeding behaviour of Pink-footed Geese could be managed by the provision of refuge areas coupled with a coordinated scaring programme; and to demonstrate that farmers in those areas most heavily affected by goose grazing could be persuaded to enter into a management agreement which would help to resolve the conflict. The scheme was initiated in 1994 and was due to finish in spring 1996. Outwith the refuge area both active and passive scaring is encouraged and spring shooting of the geese under licence is allowed. Sport shooting during the open season is also permitted as this does not coincide with the operational period of the scheme. The payment rates depend on goose use, measured by the number of droppings per unit area. In 1996, the scheme operated with 12 farmers over a total of 300 hectares and payments ranged from £50 to £80 per hectare. The annual cost of the scheme varied slightly, and in 1996 was £27,000. The scheme has largely been welcomed by farmers.

There are increasing complaints in Iceland of agricultural damage as the population increases but there are no proposals for compensation. Discussions are underway in the Ministry for the Environment concerning these problems and ways to alleviate them (e.g. scaring techniques).

Future research needs: There is an urgent need to understand the population processes underlying the increase in numbers and distribution which have occurred in the last 40 years. Continued monitoring through census, especially in Iceland and Greenland, assessment of breeding success, and monitoring of movements and mortality patterns through individual marking are all basic requirements for the immediate future. There is an urgent need in Britain to quantify the distribution and scale of alleged agricultural damage.

International conservation: The world range of this population of Pink-footed Geese is restricted to three countries: Greenland, Iceland and Britain. This would enable the development of a flyway conservation plan for the population to guide national and international conservation and management actions, since this would involve relatively few governments and organisations.

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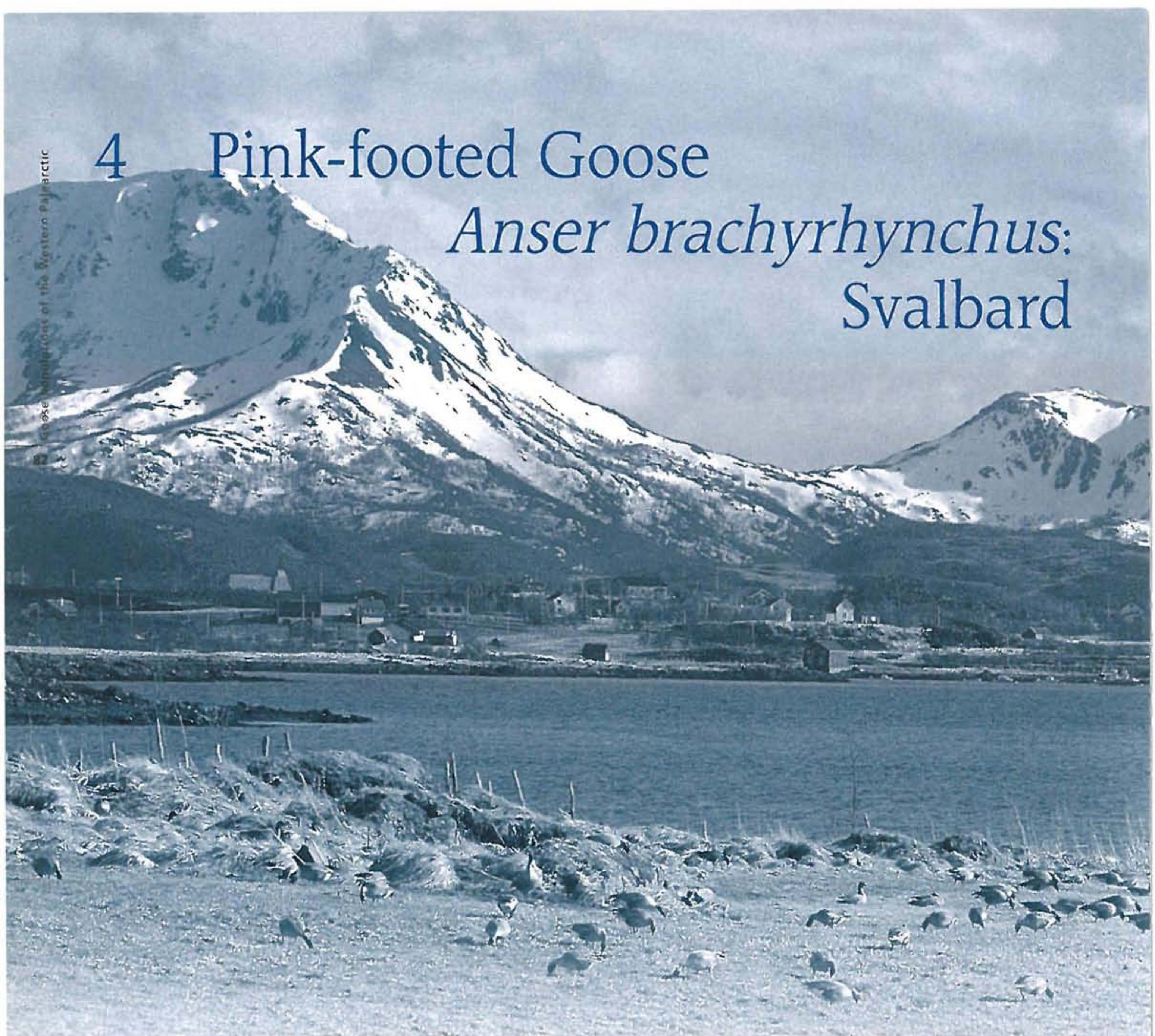

4 Pink-footed Goose *Anser brachyrhynchus*: Svalbard

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1. POPULATION REVIEW

1.1 Range

The Pink-footed Goose population breeding in Svalbard migrates southwards via Norway to autumn staging areas in Denmark and the Netherlands. The wintering grounds are divided between Belgium, the Netherlands and Denmark. In spring, the population is concentrated in western Denmark before migration to stopover sites in central and northern Norway and from there onwards to the breeding grounds (Fig. 4.1). In severe winters, some geese move to northwestern France (Holgersen 1960, J. Madsen unpubl.) and to the United Kingdom (UK) (see below). The status and management of the population was previously reviewed by Madsen (1987).

1.2 Delineation of flyways

The Svalbard breeding population is geographically separated from the Iceland/Greenland breeding population wintering in the British Isles (see Mitchell et al. this volume). On the basis of ring recoveries, it was estimated that in the 1970s there was an exchange between the two populations of a few hundred individuals per year (Ebbinge et al. 1984). In the 1990s, intensive neck-banding has been carried out in both populations. In the Svalbard population, a total of 645 geese have been ringed by the National Environmental Research Institute (NERI), Denmark, during 1990-1995. With an estimated annual adult survival rate of 0.84 (Madsen & Noer 1996), it can be estimated that these 645 individuals have lived a total of 1380 'goose years' during 1990-1997. Eight different neck-banded birds have been resighted in the UK, of which two have remained in the Icelandic/UK population. The average annual exchange of individuals is calculated at 0.7%. At the population level, this represents 246 individuals out of an average total population of 32,000 individuals. The majority of the exchange seems to take place in severe winters such as in 1995/96 and 1996/97 when three and four neck-banded Pinkfeet from the Svalbard population were observed in the UK, respectively, representing 443 and 663 individuals (J. Madsen & C. Mitchell unpubl.).

1.3 Population trends

Only since 1980 have coordinated population and age counts been carried out. Since 1991, annual population and age counts have been organised by NERI in October/November with synchronised counts in Denmark and the Netherlands.

In an attempt to reconstruct the population development in the 20th century, Madsen (1982) used the annual maximum figures recorded in Denmark in spring and autumn. With some reservations these figures are believed to reflect overall population trends. The population seems to have increased in three steps during this century: (1) from approximately 10,000-12,000 individuals in the 1930s-1950s to 15,000-18,000 in the 1960s-mid 1970s, (2) from 15,000-18,000 to 25,000-30,000 individuals in the 1980s and, (3) from 25,000-30,000 to 32,000-37,000 in the 1990s (Fig. 4.2).

1.4 Breeding success

The proportion of juveniles recorded in the autumn population since 1980 has varied between 6% and 30% annually without any significant trend (Fig. 4.2), with an average of 16.9%. Average brood size (recorded during 1980-83 and from 1991 onwards) was 2.03.

1.5 Mortality

Based on an analysis of ring recoveries, Ebbinge et al. (1984) calculated that the annual adult survival rate increased from 0.71 during 1955-1974 to 0.85 during 1975-1983. Based on capture/resightings of neck-banded individuals, Madsen & Noer (1996) estimated annual adult survival rate at 0.84 during 1990-1996. The two methods applied are not directly comparable.

A total of 344 Pinkfeet caught and neck-banded in Denmark during the springs of 1990-1992 were X-rayed before release to study the frequency with which shotgun pellets occurred in body tissue (outside the gizzard) and the possible effects on subsequent survival. In first-winter birds, which had experienced one hunting season, 25% of individuals were carrying shotgun pellets, whereas in older birds, 36% were carrying pellets. Based on an estimation of annual rates of infliction of shotgun pellets, it was calculated that for each goose killed by a hunter, one is hit by pellets and survives to at least the end of the winter (Noer & Madsen 1996). An analysis of survival of carriers of shotgun pellets versus non-carriers showed that carriers had a significantly lower survival rate (0.77) than non-carriers (0.87) (Madsen & Noer 1996). At present, however, it is not possible to conclude whether this is an effect of the pellets (injuries or contamination) or because some individuals in the population are for unknown reasons more exposed to hunting than others.

The annual hunting bag is estimated at c. 3000 individuals (shared between Svalbard, Norway and Denmark). Thus, shooting is a major contributor to annual mortality.

2. BREEDING GROUNDS AND BREEDING ECOLOGY

2.1 Distribution

Range: According to Løvenskiold (1963) and Norderhaug (1971), most Pinkfeet breed in western Svalbard (primarily Spitsbergen) (Fig. 4.3); searches for nesting geese in the eastern parts have only given negative results, despite the fact that suitable habitat is available (F. Mehlum, Norwegian Polar Institute unpubl.). The lack of Pinkfeet in the eastern parts is probably due to late snow melt. Pinkfeet nest on islets off the coast and

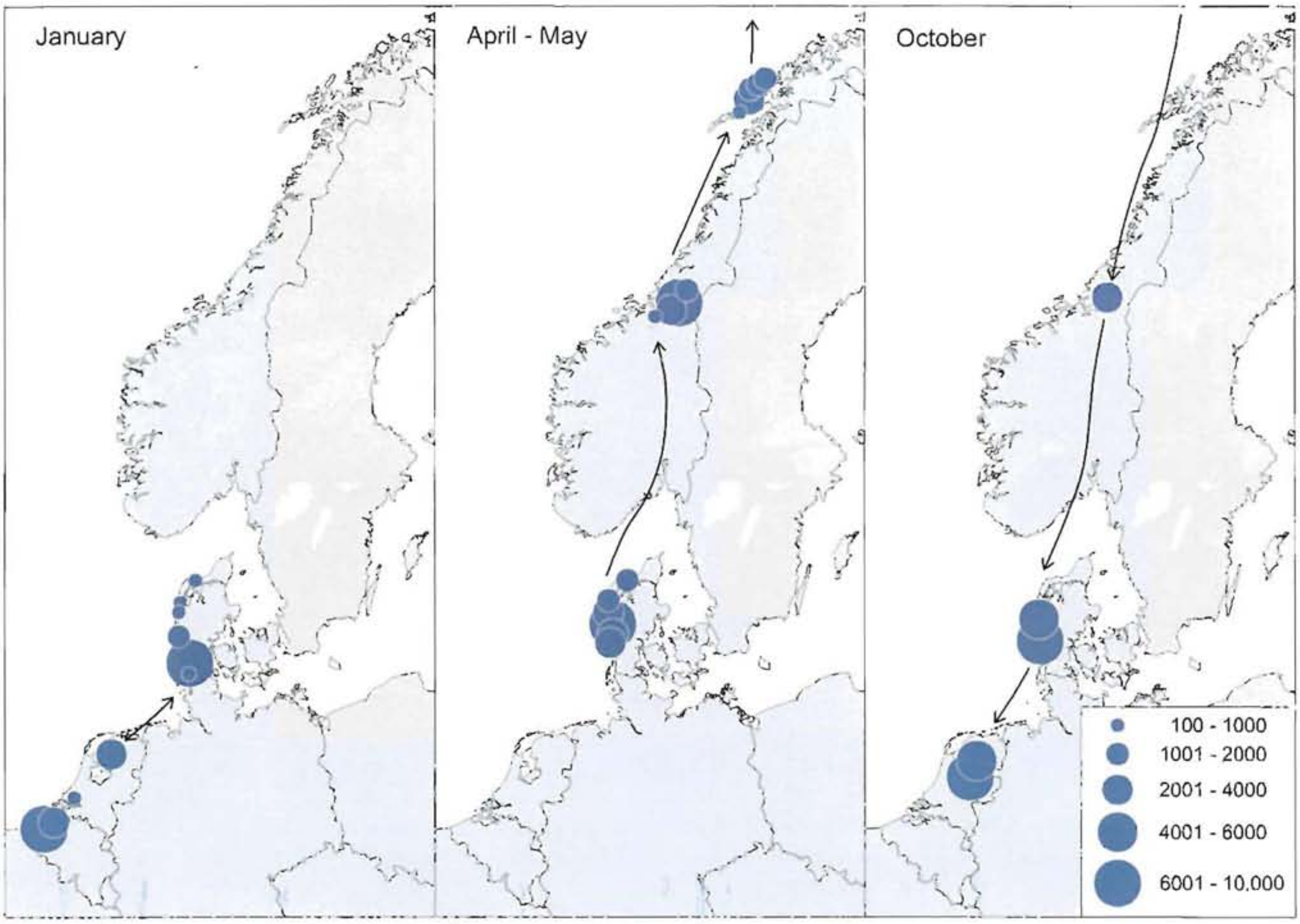

Fig. 4.1. Flyway distribution of the Svalbard-breeding population of the Pink-footed Goose during autumn, winter and spring. Arrows show migration routes. Dots show average numbers during 1994/95 and 1995/96.

on inland tundra; high nest concentrations are found on cliff sides beneath grassy slopes, especially close to seabird colonies (Nyholm 1965, Norderhaug et al. 1964, F. Mehlum unpubl.).

Breeding biology: The Pinkfeet usually arrive on Svalbard during the last 10 days of May when there is still extensive snow cover; egg laying commences from the first days of June (Løvenskiold 1963). During pre-nesting, females feed intensively (Frafjord 1993). Average clutch size is 4.0 eggs (Nyholm 1965).

Habitat and feeding ecology: Apart from some information about nesting densities (Norderhaug 1971, Prokosch 1984) there exists very little published information about the summer ecology of Pinkfeet on Svalbard.

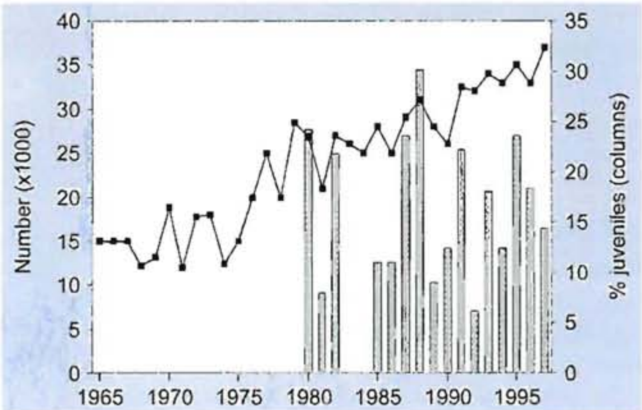

Fig. 4.2. Population trend of the Svalbard-breeding population of the Pink-footed Goose, 1965-1997 and the proportion of juveniles in autumn flocks, 1980-1997.

2.2 Moult migration and moulting areas

Non-breeding Pinkfeet aggregate to moult in flocks of hundreds of individuals, both within the breeding range and outside the reported breeding range, e.g. in the eastern and northern parts of Svalbard (Madsen et al. 1992, F. Mehlum unpubl., C. Mitchell unpubl.). However, the distribution of moulting grounds is not fully known.

2.3 Research

Apart from inventories of the distribution, very few studies have been carried out on the breeding biology and behaviour of Pinkfeet on Svalbard (e.g. Ekker 1981, Frafjord 1993). The Norwegian Polar Institute is compiling a map of the distribution of the species.

2.4 Protection and conservation

Hunting legislation: The open season starts 21 August, with a possibility of shortening the season in years with a late spring. No bag statistics exist but probably only a few hundred Pinkfeet are shot annually (F. Mehlum unpubl.).

Site safeguard: Small bird sanctuaries are situated on the west coast of Spitsbergen, but only few Pinkfeet nest there (Prestrud & Børset 1984). Human recreational activities (tourism) and physical development (road construction, oil and mineral exploration) have increased during recent decades; however, the potential impacts on breeding and moulting Pinkfeet are little studied (e.g. Frafjord 1993, Norwegian Polar Institute unpubl.).

3. STAGING AREAS

3A. NORWAY

3A.1 Distribution

Range: On spring migration, the Pinkfeet fly over southeastern Norway, through the central valleys to the Trondheimsfjord area. Traditionally, goose flocks flew past Trondheimsfjord or roosted there only briefly (Frengen 1977, Bollingmo 1981), continuing along the west coast to stopover sites in Lofoten and Vesterålen in Nordland. From there, the geese appear to fly non-stop to the Svalbard breeding gounds. Since the late 1980s, an increasing number of Pinkfeet have stopped in Trondheimsfjord as well. In autumn, the geese probably follow the same path although, until recently, no major stopover sites were known, except for some upland areas in Nordland where flocks of geese have been observed stopping briefly at lakes to drink and roost (E. Suglo pers. comm.). Some geese stop on Bear Island (M. Owen pers. comm.). Since the early 1990s, flocks of Pinkfeet have stopped in the Trondheimsfjord area.

Habitat and feeding ecology: In the 1970s, the majority of Pinkfeet staging in Lofoten and Vesterålen fed on saltmarshes fringing the sea (Rikardsen 1982, B. Røsshag pers. comm.). In the 1990s, most geese have been feeding on artificial grassland (*Phleum, Poa, Deschampsia* spp.) which has increased in area due to drainage and cultivation of lowland peat mires. Only in a few areas do the geese still feed on saltmarshes. In the Trondheimsfjord area, they feed on stubble or unharvested fields left from the previous autumn, artificial grassland and, as sowing of spring cereal commences in May, on newly sown fields (Madsen et al. 1997). They roost on the shores of the fjord or on lakes and fly up to 5-7 km inland to feed.

3A.2 Abundance

Phenology: In the 1970s, Pinkfeet were observed staging at Grunnfør, Lofoten and on Andøya in Vesterålen from c. 7-20 May and numbers peaked during a few days in the middle of the month (Rikardsen 1982). However, at least since the late 1980s, when systematic counts started, the first geese usually arrive during the first days of May, and numbers peak from c. 10-20 May (Fig. 4.4). In Trondheimsfjord, the majority of geese arrive c. 5-7 May and depart during 14-18 May; however, during the 1990s, the first arrrival has advanced from the first days of May to mid April.

In autumn, Pinkfeet pass through Norway from mid September to mid October. In the Trondheimsfjord area, staging flocks of geese are observed during the same period.

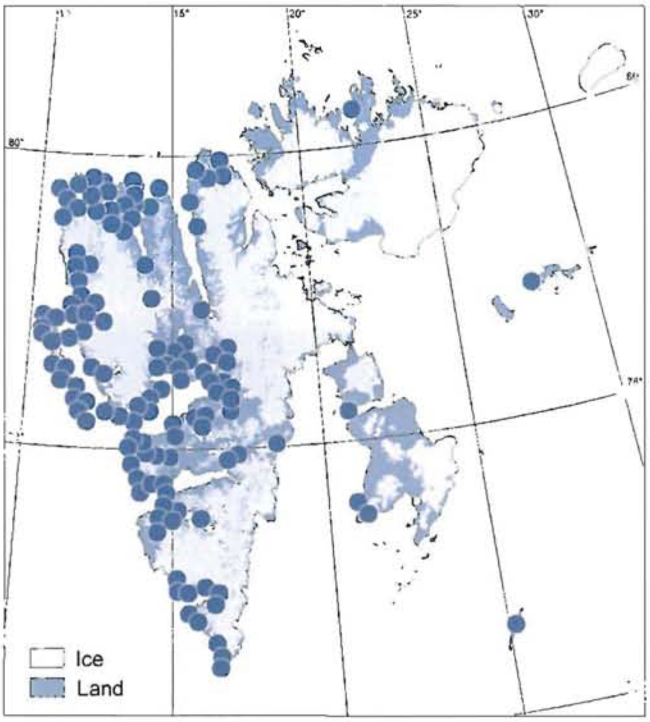

Fig. 4.3. Distribution of Pink-footed Geese during summer in Svalbard. Source: Norwegian Polar Institute database, 1962-1996.

Trends and numbers: The peak number of Pinkfeet observed at Lofoten and Vesterålen during the 1970s was c. 10,000 individuals (Rikardsen 1982). During the 1990s, peak numbers have not changed; based on resighting of neck-banded birds (ringed in Denmark) it is estimated that almost the entire population stops over; some marked individuals are only observed for 1-2 days, others for up to 14 days. The majority of geese are now found on Langøya and Andøya in Vesterålen, whereas geese only occur in relatively small numbers at Lofoten. In Trondheimsfjord, geese began to stopover during the late 1980s; during the 1990s, numbers have increased, peaking with up to 17,400 in May 1996. Based on resightings of neck-banded individuals, it is calculated that almost the entire population stops over there too before migrating to Vesterålen (Madsen et al. 1996). During the 1990s, the range of the staging area has expanded greatly, including coastal as well as inland sites in Nord-Trøndelag and Sør-Trøndelag.

The number of autumn-staging Pinkfeet in Trondheimsfjord has gradually increased during the 1990s, with up to 5000 observed during early October in 1997.

3A.3 Research

Census: In Vesterålen and Lofoten, coordinated counts of geese and reading of neck-bands have been carried out each spring since 1988 by local groups from the Norwegian Ornithological Society. In Trøndelag, such groups have also carried out counts and reading of neck-bands.

Other: During 1991-1996, studies of habitat exploitation, feeding ecology and energetics by spring-staging

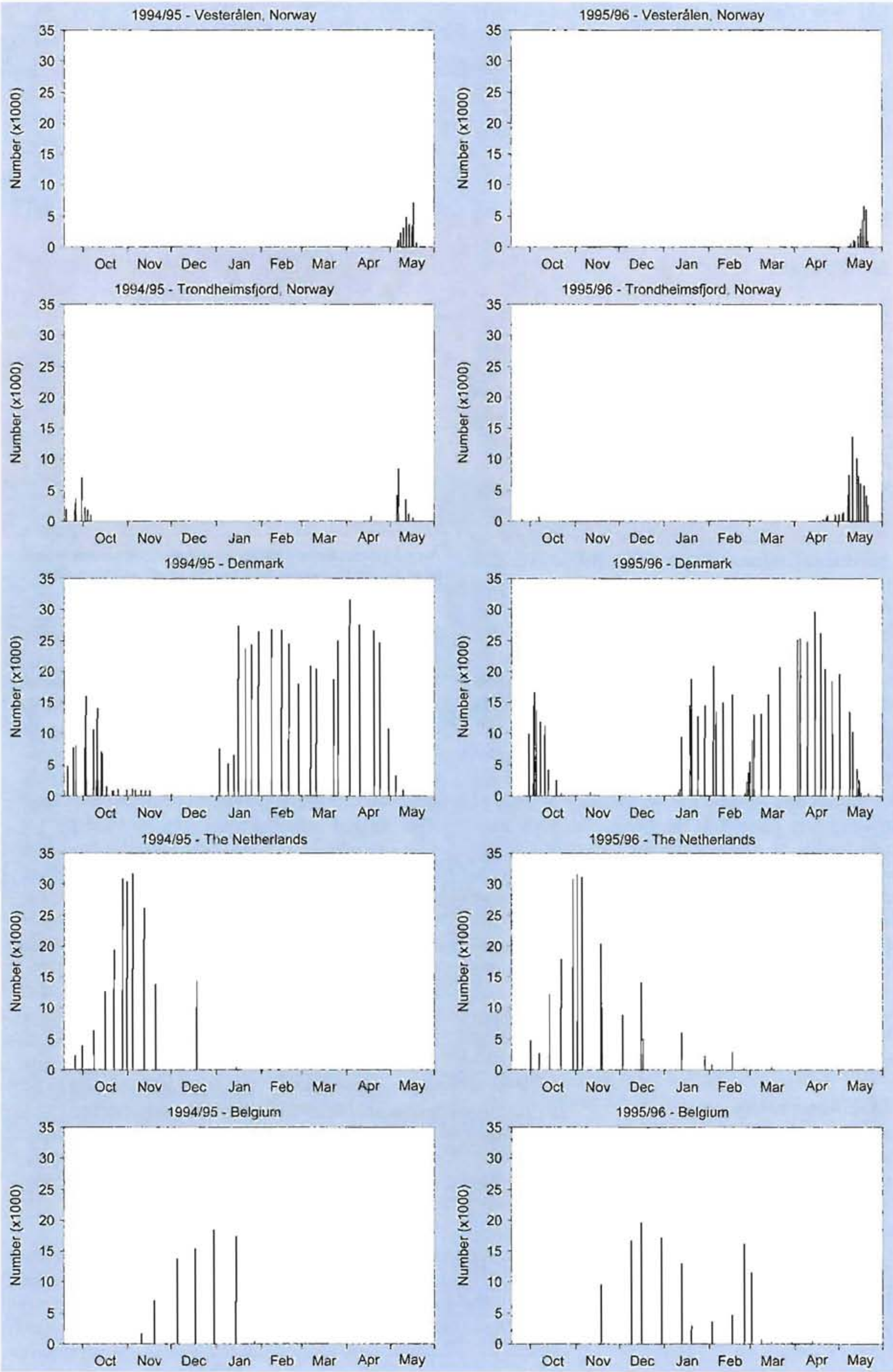

Fig. 4.4. Numbers of Pink-footed Geese in staging and wintering range states (in Norway two regions) in two contrasting winter seasons, 1994/95 (mild) and 1995/96 (severe). Data from Trondheimsfjord during spring 1995 are not complete.

Pinkfeet have been carried out by NERI, in collaboration with the Norwegian Directorate for Nature Management. Experiments to measure the effect of goose grazing on yields of grass and cereals have been carried out by 'Forsøksringen' under the Norwegian Ministry of Agriculture.

3A.4 Protection and conservation

Hunting legislation: The Pink-footed Goose has an open season ranging from 21 August to 23 December. Before the 1990s, probably less than 100 Pinkfeet were shot annually; however, since the establishment of the autumn staging area in the Trondheimsfjord in the early 1990s, between 600 and 1000 geese are estimated to be shot annually, although there is some uncertainty about the bag recording system (Norwegian Directorate for Nature Management 1996 & unpubl.). It is unknown to what extent hunting causes disturbance, preventing geese from feeding on available stubble; however, it has been observed that the geese mainly roost on the fjord during daytime, feeding primarily at night (P.I. Nicolaisen unpubl.).

Site safeguard: Some of the saltmarshes used by Pinkfeet in Lofoten and Vesterålen are designated as nature conservation areas.

Agricultural conflict: In Vesterålen, farmers have complained about damage caused by Pinkfeet to early grass in spring, especially in fields where sheep and lambs are released at the same time as the geese occur. In Trondheimsfjord, farmers complain about damage to grass and newly sown cereal fields. Due to the lack of response to these complaints by the authorities, farmers in Vesterålen organised a campaign in 1993-1994 (and continued in some areas since) to scare the geese off the fields. As a consequence, geese staging in areas with scaring stayed for a shorter period than geese in areas with no scaring (based on neck-banded individuals), and the geese remaining did not accumulate fat and nutrient stores as well as those in undisturbed areas. Subsequently, geese from areas with scaring did not breed as successfully as geese from undisturbed areas (revealed in the subsequent autumn when they returned to Denmark and the Netherlands)(Madsen 1994, unpubl.).

To alleviate the agricultural conflict, not only regarding Pinkfeet but all goose species occurring in Norway, the Norwegian Directorate for Nature Management (1996) has prepared a national management plan for geese. In both Vesterålen and Trøndelag, local management plans are currently being developed/implemented, including strategies for compensation payments and scaring.

4. STAGING/WINTERING AREAS

4A. DENMARK

4A.1 Distribution

Range: Pinkfeet stage in a narrow zone along the west coast of Jutland (Fig. 4.1). In spring, they make use of some 14 sites distributed from the Danish-German border in the Wadden Sea north to Vejlerne in Thy, whereas in autumn, they concentrate at only two sites because of disturbance from hunting at the other sites (Madsen 1982, 1984).

Habitat and feeding ecology: In autumn, the Pinkfeet primarily feed on waste grain in stubble fields, and to a small degree on winter sown cereals (Madsen 1984). In winter, they mainly feed on pastures but switch to winter cereal fields when temperatures drop below 0°C (J. Madsen unpubl.). As sowing of spring cereals and peas commences in western Jutland (from late March onwards), the geese progressively switch from the pastures to the energetically more profitable newly sown fields (Madsen 1984, 1985, 1996), taking the grain and pea seeds lying on the surface or in the top soil. To avoid agricultural conflict (see section 4A.4 below), the National Forest and Nature Agency spread grain bait in five areas where the Pinkfeet feed on newly sown fields (Jepsen 1992), and in April and May most of the Pinkfeet congregate in those areas, feeding partly on the bait, and partly on newly sown fields or pastures in the vicinity (Madsen 1996).

In late winter and spring in the early 1980s (and before), Pinkfeet also fed on saltmarshes in the Wadden Sea and on semi-natural grassland at Tipperne in Ringkjøbing Fjord (Madsen 1980, 1984). However, in the 1990s, the geese have almost completely given up using these habitats and now concentrate on improved grassland and arable land.

4A.2 Abundance

Phenology: In autumn, the first flocks of Pinkfeet arrive c. 20 September and numbers peak in October (Fig. 4.4). Before the mid 1980s, most of the population was concentrated in two areas in western Jutland (Vest Stadil Fjord and Fiil Sø) from early to late October; and by mid November most geese had migrated southwards (Madsen 1984). Since then, the pattern has changed dramatically. On the Fiil Sø farmland, the geese were making increasing use of winter cereals, and the farmer tried to reduced numbers by scaring. This resulted in an earlier southward departure (Madsen 1986). Furthermore, from the late 1980s, an increasing number of Greylag Geese *Anser anser* originating from Norway (see Nilsson et al. this volume) have occurred. In the early 1980s, only 1000-2000 Greylags occurred in western Jutland, but in the 1990s, more than 30,000 have concentrated at Fiil Sø and Vest Stadil Fjord from late August to mid September. The Greylags feed on waste grain in newly harvested fields and very quickly deplete the resource (J. Madsen unpubl.); by the time the Pinkfeet arrive, most of the waste grain has been eaten. Hence, in the 1990s, the Pinkfeet have only stopped for a very short period, and by 10 October most geese have migrated southwards (J. Madsen unpubl.).

In mild winters, i.e. temperatures above 0°C, flocks of Pinkfeet start returning from Belgium and the Netherlands from c. 20 December onwards (Madsen

1980) and by mid January, the majority of the population is concentrated in Denmark, with Ballum Enge as the most important site (up to 20,000 Pinkfeet in January-February). Before the 1990s, the Pinkfeet migrated southwards as soon as it started to freeze (Madsen 1980), but increasingly in the 1990s it has been observed that the geese remain despite the cold. Hence, in the severe winter of 1995/96, c. 15,000 Pinkfeet remained at Ballum Enge, despite the fact that effective ground temperatures were below -15°C (J. Madsen unpubl.). During the cold spell, the geese fed solely on winter cereal fields, moving away only during a short period with snow cover, after which they soon returned. This recent change may have been caused by the increasing area of winter cereals, although before the 1990s, winter cereal fields were also widely distributed in Ballum Enge, so this cannot be the only explanation. It seems that the geese must have 'learned' that they can survive on winter cereals even during severe cold. However, the energetics of the use of winter cereals and the thermoregulatory costs of remaining have yet to be studied.

In spring, the population is concentrated in Denmark from late February to mid April. Traditionally, i.e. before the mid 1980s, the Pinkfeet remained in western Jutland until 10-15 May, when northward migration started (Fog 1977, Madsen 1984). Since then, northward migration has started earlier: in the late 1980s, most Pinkfeet had left by 10 May, and in the 1990s, numbers start to decline from mid April onwards, and in most years, the majority of geese have left before 5 May (Fig. 4.4). The earlier departure in the 1980s was probably explained by geese being attracted to stopover at improved pastures in northern Norway, where grass growth started earlier than in the past (Boyd & Madsen 1997). The most recent change has been caused by the 'discovery' of Trondheimsfjord as a spring staging area (see above), attracting an increasing number of geese.

Trends and numbers: In autumn, numbers have, as explained above, decreased. During the 1970s and early 1980s, up to 25,000-29,000 Pinkfeet were counted in western Jutland. In the 1990s, peak numbers have been 10,000-15,000, despite the general population increase. In winter and spring, numbers have mirrored the increasing population trend. In the 1990s, up to 31,000 Pinkfeet have been recorded in western Jutland.

4A.3 Research

Census: Synchronised counts, organised by NERI, covering all sites are carried out in October, mid January and several times during spring. In some years, aerial spring counts have been conducted to cover the entire coastline in one day, and on occasion photographs have been taken of each flock for subsequent counting on a screen.

Ringing: In spring 1988, NERI started a ringing programme to study population dynamics and migration strategies in the population. In the first two years, darvic leg-rings were used but because of poor resighting rates, blue neck-bands with white engraving have been used since 1990. Up to 1996, a total of 610 Pinkfeet have been neck-banded.

Other: Studies of habitat exploitation, feeding ecology and energetics have been carried out since the 1970s, including studies of interspecific interactions between Pinkfeet and other goose species (Lorenzen & Madsen 1985, Madsen 1985a,b,c, J. Madsen unpubl.). Damage caused by Pinkfeet to spring barley has been studied by Lorenzen & Madsen (1986). Seasonal body nutrient dynamics, with special focus on the effect of winter stress and spring migration, is studied by observing individual abdominal profiles through the season and by collection of birds and dissection/carcass analysis (J. Madsen unpubl.).

4A.4 Protection and conservation

Hunting legislation: The open season is from 1 September to 31 December (on fishing territory until 15 January). Since 1994, shooting of geese has only been permitted from 1.5 h before sunrise to 1000 h (since 1997 until 1100 h). The effect of this regulation is being studied by NERI and the National Forest and Nature Agency .

The annual hunting bag in the 1960s was estimated at c. 1400 Pinkfeet; in the early 1990s, it has increased to c. 2100 individuals, which is in line with the general population increase (Madsen et al. 1996).

Site safeguard: Most of the areas where Pinkfeet occur are designated as Ramsar sites or EU Special Protection Areas (SPAs) (Madsen 1986). These designations prevent major land use developments, but not changes in agricultural uses which may greatly affect goose numbers and the perception of geese by farmers. In autumn, shooting takes place in most areas, and only because of local voluntary shooting regulations, are the geese able to stage at Vest Stadil Fjord and Fiil Sø. In autumn 1996, the State purchased agricultural land at Skjernå (in preparation for a major nature restoration project). In this area, Pinkfeet do not usually occur in autumn because of hunting disturbance. However, in 1996, there was no shooting in the State-owned area, and this became the most important autumn staging area for Pinkfeet in Denmark, with up to 4000 geese during October-mid November (J. Madsen unpubl.).

Agricultural conflict: In Denmark, no compensation is paid for goose damage to crops. The National Forest and Nature Agency gives advice on and helps with the use of scaring devices.

In autumn, there is local damage conflict when Pinkfeet feed on winter cereals. In winter, there are also local complaints of damage to winter cereals but the amount of damage has never been documented. In spring, the use of newly sown cereal and pea fields has given rise to increasing conflict (Jepsen & Madsen 1992), although the damage caused to the yield is minor (Lorenzen & Madsen 1986). The National Forest and Nature Agency has organised the baiting of Pinkfeet with grain at five sites and this has solved most of the conflicts.

By feeding on newly sown cereals and peas, the

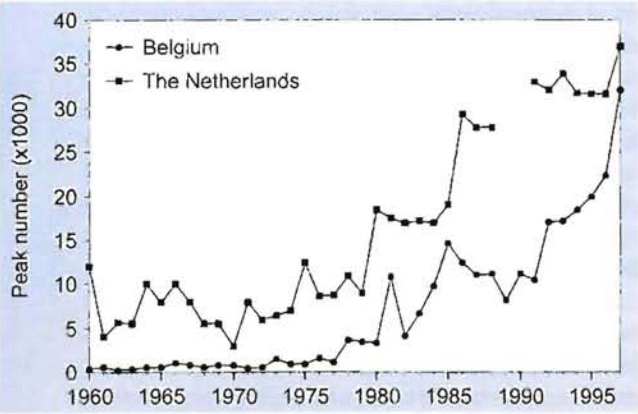

Fig. 4.5. Peak numbers of Pink-footed Geese recorded during winter in Belgium and the Netherlands, 1960-1997.

geese are exposed to pesticides used as seed dressings. Seeds of barley and wheat are treated with the fungacide Imazalil (Fungazil is the active ingredient) and pea seeds with Thiram. In a study of the daily intake rates of pesticides, it was found that the intake of Imazalil was not critical to the geese because of relatively low intake rates, low toxicity and high mobility of the compound. Thiram, however, can easily be ingested in an amount which could have sub-lethal effects on reproductive parameters (Madsen 1996). Even though the geese only used newly sown pea fields occasionally, exposure of geese to Thiram should be prevented.

4B. THE NETHERLANDS

4B.1 Distribution

Range: The main distribution in the Netherlands is limited to the southwestern part of the province of Friesland. Nearly the whole population is present in this area during a short period of time in autumn (Fig. 4.1). The only other area of some importance is Midden Delfland (Zuid-Holland Province) where peak counts of several hundreds of birds have occurred in recent years. In normal winters, Pinkfeet are seen in extremely low numbers outside these two areas (maximum of some tens of birds). In severe winters more geese occur outside the traditional areas, but numbers seldom exceed some hundreds of birds.

Habitat and feeding ecology: In Friesland, Pinkfeet only feed on grassland which is also intensively used by farmers. Only in some areas outside Friesland does feeding occur on winter cereals or in tidal areas.

4B.2 Abundance

Phenology: The first small flocks of Pinkfeet arrive c. 15-20 September (Fig. 4.4), and numbers reach a few thousand birds by end September. In the early part of the season they mainly concentrate in two areas near the coast of the IJsselmeer, at and near the Workumerwaard and the Steile Bank. In October there is a steady increase in numbers, peaking in the last 10 days of the month. In October, the Pinkfeet use feeding sites and night roosts in the inland areas of southwestern Friesland. Important night roosts are the Zwarte & Witte Brekken and Oudegaasterbrekken. In recent years, numbers have decreased rapidly after early November when the geese migrate to wintering areas in Belgium. Usually, only a few hundred or thousands of birds remain in Friesland after January, depending on the weather conditions, and only low numbers visit Friesland during the return migration from Belgium to Denmark. Also, depending on weather conditions, the majority of the remaining wintering birds from the Netherlands migrate to Denmark already in January, although some birds stay until the end of March or even the first days of April. It has been observed that during severe weather conditions in Denmark in the second half of winter, the majority of the population returns to Friesland for a short period.

Trends and numbers: Until recently, peak numbers of Pinkfeet were present during November and December, when the whole Svalbard population used to occur in Friesland. However, the trend in recent years has been that peak numbers only occur during a period of some two weeks during late October-early November. There is a stable wintering population with a maximum of a few thousand birds. Peak numbers counted have increased three-fold during 1960-1979 to the 1990s (Fig. 4.5).

4B.3 Research

Census: Mid monthly counts with extra counts between are carried out to obtain good information on arrival, numbers and staging patterns.

Ringing: Birds are occasionally ringed (metal rings only) during catches of White-fronted Geese *Anser albifrons,* the target species.

Other: Since 1990, NERI has made annual visits to Friesland in October-November to assess population size and breeding success overall and the status of neck-banded individuals in particular.

4B.4 Protection and conservation

Hunting legislation: Protected since 1976.

Site safeguard: Night roosts at Workumerwaard, Steile Bank and Witte & Zwarte Brekken are nature reserves. Agricultural areas used for feeding are not protected.

Agricultural conflict: The early arrival of Pinkfeet in autumn may cause some local conflicts with farmers. However, later in the season, when tens of thousands of geese of other species (White-fronted Geese, Barnacle Geese *Branta leucopsis*) arrive, problems are less focussed on Pinkfeet.

4C. BELGIUM

4C.1 Distribution

Range: Pinkfeet in Belgium traditionally winter almost exclusively in the Flemish coastal Polder area a short distance from the North Sea (maximum 10 km) (Fig.

4.1). Most important wintering grounds are situated in the Oostkustpolders, the triangle between Brugge, Knokke and Oostende. Here, the core areas are grassland complexes at Damme, Brugge, Uitkerke, Zuienkerke, Meetkerke, Houtave, Stalhille, Vlissegem, Klemskerke, Oudenburg and Oostende. In some seasons since the 1980s, a westward shift has occurred with smaller numbers occasionally occurring in the valley of the IJzer River, and some polder complexes west of Oostende. Single birds are very rarely reported further inland during hard winters only.

Habitat and feeding ecology: During the whole wintering period, Pinkfeet (and Whitefronts, mostly in mixed flocks) prefer permanent old grassland with distinct micro-relief as feeding grounds. These habitats are typically on low-lying clay-soils, overlying peat layers from before the Dunkerque transgressions. Main vegetation types are *Lolio-Cynosuretum, Poa-Lolietum, Agropyro-Rumicion crispi* and some brackish depressions with *Puccinellion* relicts. Many grassland areas are improved by fertilising and sown cultivar grass species (*Alopecurus, Lolium* and others). The typical landscape is relatively open with scattered farms and small roads, the slightly higher parts of polders are mainly arable in contrast to the above mentioned wet grassland in the depressions. There are many linear landscape elements: ditches, some canals (often with *Phragmites* fringes), remains of hedges (*Crataegus monogyna* and *Prunus spinosa*) and rows of trees along main canals, roads and former dikes.

As grassland complexes are increasingly divided into smaller field units and ploughed (especially for potatoes, winter cereals, *Lolium multiflorum* for silage grass and recently also maize), the mosaic pattern of land-use has resulted in a slight increase in goose feeding on arable land. Many farmers succesfully avoid goose damage by putting up simple scaring devices (e.g. plastic bags moving in the wind), and only 5-10% of geese feed outside permanent grassland.

As snow cover normally only occurs during short periods (and not every winter), problems with geese moving to higher crops such as turnips are limited. Other crops, such as maize and beet, are almost completely harvested before the arrival of the geese. There is no clear shift in feeding preference between grass and arable land during the season nor in relation to weather conditions (except during heavy snow cover, which splits up large concentrations of feeding geese into small flocks dispersing over the whole polder area).

There are no lakes or ponds within the Oostkustpolders, except some small artificial sandpits, and the geese depend on temporary inundated depressions, cattle ponds and ditches for water; exceptionally, harbour docks (Zeebrugge) and larger canals are used for drinking and bathing. The brackish ponds and saltmarshes of the Zwin Nature Reserve (Knokke) are used fairly frequently as nocturnal roosts by Pinkfeet in the area, although most geese stay on the feeding grounds at night. Intensive feeding occurs during moonlit periods, when the birds rest the following morning.

4C.2 Abundance

Phenology: First geese arrive in the last week of October or early November (Pinkfeet normally before Whitefronts), with a tendency for earlier arrival since the mid 1980s. Timing of first arrival does not appear to depend on regional weather conditions, although prevailing northeasterly winds in northwestern Europe speed up the influx of larger numbers from the Netherlands and Denmark.

Pinkfeet normally reach winter peak numbers between mid December and early January, and most birds have migrated back to Denmark before mid February, except in very severe winters, when larger numbers remain until early March. In recent years, Pinkfeet have wintered in large flocks from the end of November onwards, thus increasing the number of goose days spent at the southernmost border of their normal wintering range.

In contrast to autumn arrival, spring departure clearly depends on regional climatic conditions, starting already early in January. Neck-band records (1990-97) indicate that most Pinkfeet move non-stop to Denmark, with only limited use of the traditional feeding grounds in southwestern Friesland. Kuijken (1969, 1976) showed a significant relationship between departure of both Pinkfeet and Whitefronts and the date when the January temperature sum of 200°C is reached. The geese do not usually return to Belgium once spring migration has started, even when sudden cold spells occur during late winter. Detailed monitoring since 1959 shows that severe cold spells after mid/end January are rare in Belgium. However, the winter of 1995-96 was exceptional, and almost half the population returned south from Denmark and Friesland to Flanders during late winter (Kuijken et al. 1997); these movements were well documented by records of neck-banded birds (see Fig. 4.4).

Trends and numbers: In the early 1960s, a maximum of 250-500 Pinkfeet were discovered wintering in Belgium. During the extremely severe winter of 1962/63, all northwest European goose populations were driven into France and thus became familiar with coastal wintering grounds in Belgium. Since that winter, Pinkfoot numbers in Belgium increased slightly. During the period 1965-1978, maximum numbers of Pinkfeet fluctuated between 500-1500 birds and goose shooting at the traditional wintering grounds near Damme ceased (see section 4C.4 below). The extremely severe winter of 1978/79 again pushed most goose populations southwest over Belgium to France. A sudden increase in Pinkfeet maxima (c. 3500) was again recorded. The series of cold winters in the early 1980s caused further upward trends, with peaks of 10,000-15,000 Pinkfeet. Since 1992-93, more than 17,000 or almost 75% of the Svalbard population reached Belgium, with a unique peak of 32,000 at the end of December 1997 (Fig. 4.5).

Analysis of this long term trend indicates that severe cold weather movements from northwestern Europe to areas far beyond the southernmost distribution limit of the species repeatedly caused increases in numbers in

Belgium, possibly because new and attractive wintering grounds were explored.

At a regional scale, Pinkfeet have expanded their feeding grounds from the traditional site at Damme to a much larger area in the Oostkustpolders (see Kuijken & Meire 1987, 1996, Meire & Kuijken 1991, Meire et al. 1988). A positive effect on wintering numbers and distribution has also resulted from the shooting ban covering all wintering geese throughout Belgium which came into force in 1981 (see section 4C.4 below). This ban has enabled geese freely to explore a much larger area than before, for example, large feeding flocks have occasionally shifted slightly west to the IJzer valley. Furthermore, the significant increase in numbers of wintering geese also forces the birds to expand their range.

4C.3 Research

Census: For the greater part of the last 40 years, geese in the Oostkustpolders have been counted on a weekly basis, and, since 1993, fortnightly synchronous counts covering the whole area have been carried out. All goose flocks are mapped in detail and habitat use noted. Mid monthly synchronised counts in Belgium, the Netherlands and Denmark have been conducted at intervals to record distribution and numbers and compare results with estimated numbers for the entire Svalbard population in November (when the geese are mainly concentrated in Friesland) and April (mainly in Denmark).

Ringing: No specific ringing programmes for wintering Pinkfeet exist in Belgium, but resighting of neck-banded Pinkfeet has been carried out by numerous observers. Results are coordinated by E. Kuijken & C. Verscheure (see e.g. Kuijken et al. 1997) and entered in the Danish database (at NERI, Denmark).

When, as in recent winters, 75% or more of the Svalbard Pinkfeet occur in Flanders for some weeks, the ratio between individually marked birds recorded and the total contingency ringed and still alive provides a good control of winter counts, mortality rates, reproduction etc. throughout the migration route.

Other: The wintering geese in the Oostkustpolders (mainly Pinkfeet and Whitefronts) have been continuously studied since 1959. Kuijken (1969, 1976) investigated aspects such as population trends, population dynamics, analysis of phenology in relation to weather conditions, regional distribution, carrying capacity and feeding ecology. Further results have been summarised in Meire & Kuijken (1991), Kuijken & Meire (1996) and a number of other publications.

Long-term monitoring of movements, regional distribution and increases in number is supplemented by information from records of neck-banded Pinkfeet. Site and partner fidelity, mechanisms triggering shifts in feeding areas, effects of disturbance etc. are the subject of detailed observations.

4C.4 Protection and conservation

Hunting legislation: Following the discovery of wintering geese in 1958, local hunters agreed to respect a shooting free zone (500 ha) at the traditional wintering grounds at Damme as of 1960. In 1968, the Ministry of Agriculture issued an official but local goose shooting ban (1500 ha), which was expanded in area (3750 ha) in 1971. Finally, since 1981 a national ban on the shooting of geese has been in place (maintained by the Flemish, Walloon and Brussels regional governments), with one local exception for Greylag Geese (see Nilsson et al. this volume).

As most geese remain on the feeding grounds at night, some disturbance by farmers including illegal shooting may occur, but is of minor importance (birds are only very occasionally killed and temporarily shift to other haunts within short distances). Lessened disturbance through the absence of hunting leads to more efficient habitat use, less use of nocturnal roosts and greater efficiency during feeding (even at night) and metabolism (less energy expenditure) by geese; this may be a major reason for the very early departure of Pinkfeet in spring.

Site safeguard: The importance of permanent wet grassland for waterbirds was highlighted when goose numbers increased as described above, and this habitat has recently been given specific protection measures according to the recent (Flemish) Decree on Nature Conservation of October 1997.

In the mid 1970s, most of the traditional wintering grounds (mainly large grassland complexes in the polders of Damme, Oostkerke, Knokke, Bruges, Meetkerke and Uitkerke) were protected through land use planning "nature zones", and in 1988 were designated as SPAs under the EU Birds Directive 79/409. Since the mid 1980s, many similar polder areas (extending to the Oostende region: Houtave, Klemskerke, Vlissegem, Jabbeke, Oudenburg, Zandvoorde etc.) have been discovered and taken into use by large goose flocks. These sites are of international importance but have no legal protection status at all.

Belgium has an outstanding responsibility for the survival of the Svalbard Pink-footed Goose population, and it is strongly recommended that new sites be added to the existing list of 23 SPAs under the EU Birds Directive in Flanders and that further steps be taken in designating core goose wintering grounds as Ramsar sites. The new Decree on Nature Conservation, and new planning procedures for "Structuurplan Vlaanderen" must ensure the sustainable safeguard or restoration of the most important coastal polder grasslands as an integrated part of a pan-European ecological network. This could be suitably developed as part of the flyway reserve concept to be established under the African-Eurasian Migratory Waterbird Agreement (AEWA) under the Bonn Convention.

Behavioural adaptations to reduced disturbance following the shooting ban have increased regional carrying capacity by at least 30% because the birds are less wary, approaching roads and farms more closely and thereby gaining a potential feeding zone of at least 50 m.

Agricultural conflict: There are several reasons why goose grazing in general remains within the limits of the regional carrying capacity and why serious damage does not occur: relatively short stay of large flocks, with early spring departure when vegetation regrowth starts; preference for permanent grassland (with lower risk of damage and only some overlap with cattle grazing in November); high flock mobility with shifts to adjacent parcels in case of disturbance; more efficient or complete grazing of parcels closer to farms, borders and roads (see above). Farmers are advised to tie plastic bags on sticks to scare geese from vulnerable crops, this method of scaring seems to be quite efficient.

Although farmers in general do not like large concentrations of geese on their land, the number of official complaints is very low indeed. Damage has mainly been recorded on winter wheat where scaring has been absent or inefficient. If damage occurs, farmers are allowed a lower taxation rate for agricultural products from the damaged fields.

No direct compensation is paid and management agreements according EU regulations have not yet been drafted. A small number of farmers work with private nature conservation associations which own or manage grassland reserves for botanical and/or ornithological interests.

5. DISCUSSION

Population status: The Svalbard population of the Pink-footed Goose has shown an increasing trend since the 1950s. The increase has been stepwise and most probably related to improved protection and decreased shooting pressure in the staging and wintering quarters, of which the most important events were: the ban of spring shooting in Denmark in 1955, the ban on spring shooting in Svalbard in 1975, the ban on shooting in the Netherlands in 1976 and in Germany in 1977. In Belgium, Pinkfeet were locally protected in 1960, and from 1981/82 onwards there has been a general ban on the shooting of geese. The period when the survival rate improved (from 1955-74 to 1975-83) matches the period of conservation initiatives, which supports the hypothesis that the increases were primarily caused by the relaxation of shooting pressure.

It does not seem that improved feeding conditions in spring (baiting in Denmark, improved feeding conditions in Norway) have resulted in improved breeding output of the population in general (as observed by the proportion of juveniles in the autumn population). If baiting had had an effect, it would have been manifest from the mid 1980s when the large baiting scheme was launched. The recent scaring of Pinkfeet by farmers in Vesterålen in northern Norway during spring has been shown to impact individual breeding performance but it is difficult to assess the impact at the population level. Although the majority of geese in the population stopover in the area, they do so for varying lengths of time and, concurrently, the stopover sites in central Norway have gained more importance.

The recent upsurge in numbers cannot yet be fully explained. One possible reason is that the population increasingly by-passes western Jutland - the core shooting area - in autumn, and that this has improved survival. At the same time, however, more geese stage in central Norway during autumn, and shooting pressure there has increased.

Conservation issues: Reporting of the high rate of shotgun pellets in body tissues of Pinkfeet for which especially Danish hunters are responsible has given rise to a national Action Plan to improve the situation (also for Danish game in general).

The potential poisoning of Pinkfeet through intake of Thiram-treated pea seeds has been addressed. Because of its negative environmental impacts, the use of Thiram has now been banned in Denmark.

Agricultural conflict: The earlier departure of Pinkfeet from Denmark to the Netherlands in autumn has caused an increase in crop damage in the Netherlands. Likewise, the earlier departure from Denmark in spring has given rise to increased damage in central Norway, whilst giving a relief to the problems in Denmark. This is an example of how national management policies and natural phenomena in one country may have an effect in other range states (Madsen & Jepsen 1992).

In Norway, a national management plan to reduce damage conflict caused by geese is now being implemented. At the time of writing, a plan for solving the conflicts in Vesterålen is being negotiated. There is, however, increasing conflict in central Norway which has still to be addressed.

Future research needs: Whilst much research has been carried out on the ecology of wintering and staging Pinkfeet, little is known about their breeding ecology. The Norwegian spring staging areas have been shown to be an energetic bottleneck which may have a density-dependent regulating effect on reproduction. However, the parameters limiting the population are still unknown (see Madsen 1987 for a discussion). We are now in a position to evaluate the effects of factors operating on the staging and wintering grounds, but have no information at all from the breeding grounds. Hence, it is vital to establish a field study on the breeding grounds in Svalbard.

High priority should be given to studying the causes of increased mortality in Pinkfeet carrying shotgun pellets in their tissues. What are the reasons, and is this a problem specific to the Pinkfeet or is it general problem for quarry waterfowl?

International conservation: The issues concerning shooting and agricultural conflict are management problems requiring international cooperation. National action plans for solving agricultural conflict have been implemented or are currently in the implementation phase, but international coordination of initiatives is essential to ensure that national strategies do not jeopardise each other. The AEWA under the Bonn Convention offers an obvious platform for the development of an operational international flyway plan.

6. BIBLIOGRAPHY

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5 White-fronted Goose *Anser albifrons albifrons*

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1. POPULATION REVIEW

1.1 Range

The White-fronted Goose breeds in the tundra zone of Eurasia and North America. The majority of Eurasian Whitefronts belong to the subspecies *Anser albifrons albifrons* breeding in the Russian tundra from the Kanin Peninsula (44°E) to the Kolyma River (155°E) between latitudes 66° and 77°N. Their breeding range is situated between the 4° and 10°C July isotherms (Fig. 5.1; Bauer & Glutz von Blotzheim 1968, Cramp & Simmons 1977, Flint et al. 1984, Johnsgard 1978, Philippona 1972, Rutschke 1987, Voous 1960). Alphéraky (1904) reported breeding Whitefronts from Finland and the Kola Peninsula during the 19th century, but there are no records of breeding Whitefronts west of the Kanin Peninsula this century.

Eurasian Whitefronts can be divided into two populations: a Western Palearctic population breeding west of Chatanga River and migrating west and southwest to winter in Europe and southwest Asia; and an Eastern Palearctic population breeding between the Chatanga and Kolyma Rivers and migrating southeast to winter in southeast and east Asia (e.g. Cramp & Simmons 1977, Rogacheva 1992). At present the southern border of the wintering range is about 35°N in Europe and about 23°N in Asia.

1.2 Delineation of flyways

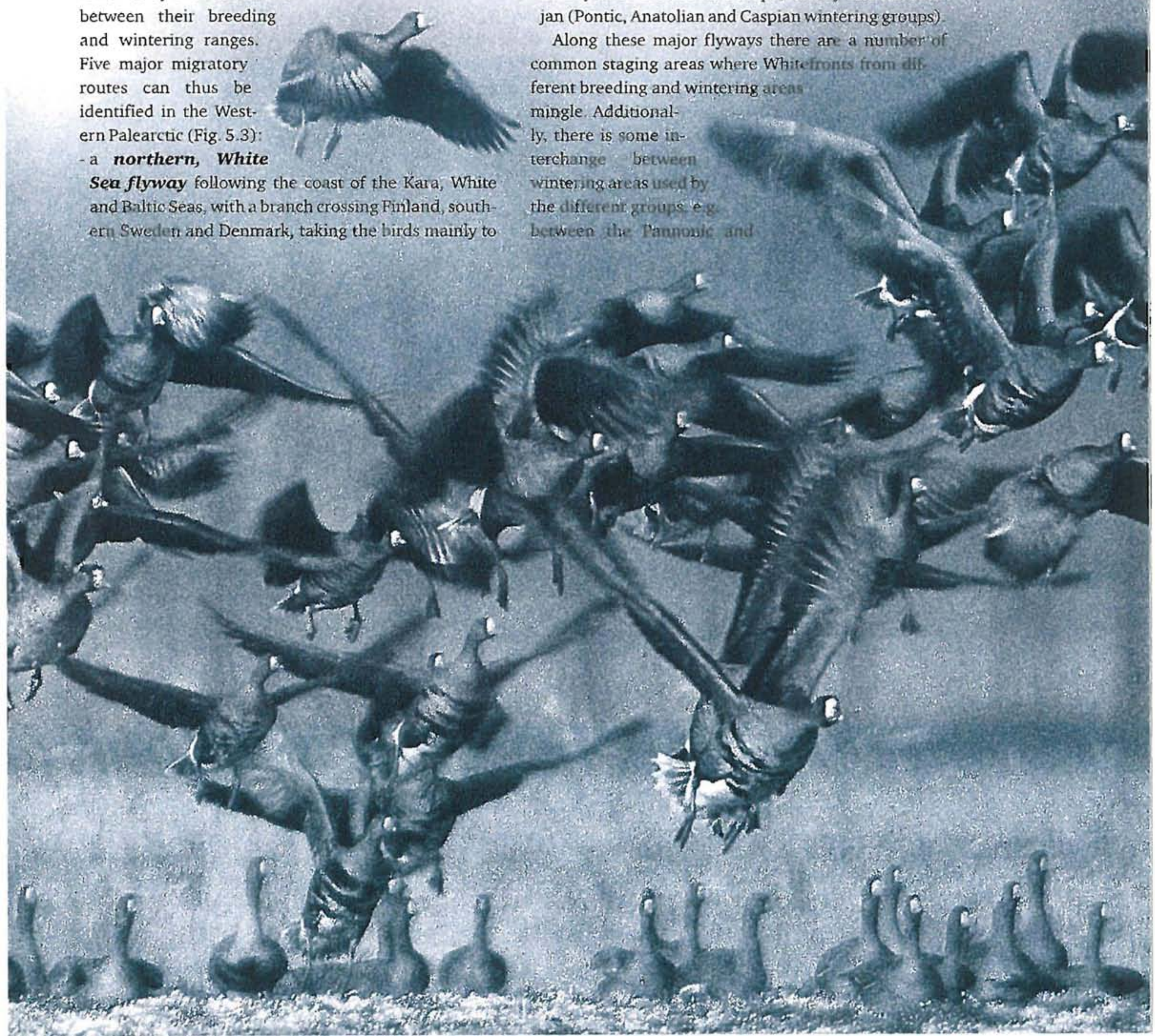
White-fronted Geese wintering in the Western Palearctic have traditionally been sub-divided into five groups according to wintering distribution: the Baltic-North Sea, Pannonic, Pontic, Anatolian and Caspian sub-populations (Fig. 5.1; Bauer & Glutz von Blotzheim 1968, Cramp & Simmons 1977, Lebret et al. 1976, Philippona 1972, Rutschke 1987, Timmerman 1976, Timmerman et al. 1976). However, analysis of recoveries of ringed Whitefronts suggests that this model of more or less separate wintering populations is no longer tenable. There is much more interchange between Western

Palearctic wintering groups than was previously assumed, and Whitefronts from any one breeding area are distributed over several sites in winter (Fig. 5.2; Mooij 1996a, b, 1997, Mooij et al. 1996, Mooij & Kostin 1997).

Recent analyses from ringing programmes at wintering sites in the Netherlands and on the Taimyr Peninsula (Borzhonov 1975, Drobovtsev 1979, Mooij 1996a, 1997, Mooij et al. 1996, Mooij & Kostin 1997), together with observations of migration in several countries along the migratory routes (e.g. Bauer & Glutz von Blotzheim 1968, Hudec & Simec 1994, 1995, Dick et al. 1994, Drobovtsev 1979, Engel 1991, Faragó 1995, Handrinos 1991, Kozulin et al. 1995, Krivenko 1996, Leito 1996a, Lysenko 1990, Michev et al. 1991, Mikuska & Kutuzovic 1982, Mineyev 1995, Mooij 1991a, b, J. Mooij & I.O. Kostin unpubl., Munteanu et al. 1991, Philippona 1972, Raudonikis & Svazas 1991, Rogacheva 1992, Rutschke 1987, V. Serebryakov & A. Poluda unpubl., E. Tkachenko unpubl., Vinokurov 1982, Yakimenko 1995, Zhmud 1996), give an impression of the main routes followed by the Whitefronts between their breeding and wintering ranges. Five major migratory routes can thus be identified in the Western Palearctic (Fig. 5.3):

- a ***northern, White Sea flyway*** following the coast of the Kara, White and Baltic Seas, with a branch crossing Finland, southern Sweden and Denmark, taking the birds mainly to western, central and southern Europe (Baltic-North Sea and Pannonic wintering groups);
- a ***central, Russian flyway*** from northwestern Kazakhstan, passing through central Russia and Belarus, taking the birds mainly to western, central and southeastern Europe (Baltic-North Sea, Pannonic and Pontic wintering groups);
- a ***southern, Caspian/Black Sea flyway*** crossing Siberia along the Ob River to Turgayskaya Region in Kazakhstan, from there crossing the Volga delta to the northern Black Sea coast, taking the birds mainly to southeastern Europe, Turkey and Azerbaijan (Pontic, Anatolian and Caspian wintering groups);
- a ***western, Ukrainian flyway*** from the western breeding areas, crossing western parts of European Russia and the Ukraine, taking the birds mainly to southeastern Europe and Turkey (Pontic and Anatolian wintering groups);
- an ***eastern, Volga flyway*** west of the Ural Mountains, following the Volga valley and taking the birds mainly to southeastern Europe, Turkey and Azerbaijan (Pontic, Anatolian and Caspian wintering groups).

Along these major flyways there are a number of common staging areas where Whitefronts from different breeding and wintering areas mingle. Additionally, there is some interchange between wintering areas used by the different groups, e.g. between the Pannonic and



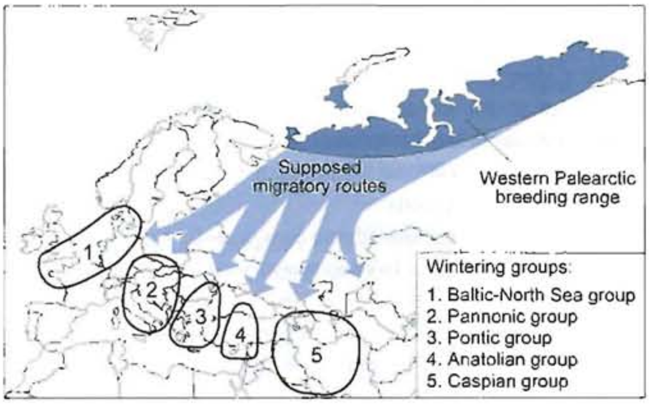


Fig. 5.1. Breeding range, supposed migratory routes and wintering groups of Western Palearctic White-fronted Geese according to Cramp & Simmons (1977), Lebret et al. (1976), Philippona (1972), Rutschke (1987), Timmerman (1976) and Timmerman et al. (1976).

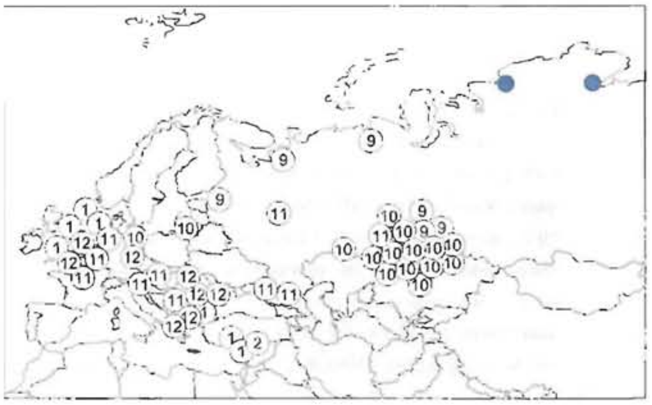


Fig. 5.2. Autumn and winter recoveries of shot White-fronted Geese ringed on the Taimyr Peninsula between 1966 and 1970 (Borzhonov 1975) and between 1989 and 1992 (Mooij et al. 1996). Filled circles show ringing sites. Numbers refer to month of recovery.

Pontic wintering groups along the Danube valley at the Romanian-Bulgarian border, in Thrace crossing the Greek-Turkish border, and between the Pontic and Anatolian wintering groups in western Anatolia (J. Mooij & I.O. Kostin unpubl.). This winter mixing of regional breeding populations and the formation of new pairs on the wintering grounds (van Impe 1978, Johnsgard 1978, Rutschke 1987) enhances the possibility of genetic exchange between breeding stocks and helps explain why no subspecies have been formed in this part of the range (Mooij et al. 1996).

1.3 Population trends

Since the early 1960s, more or less regular counts of wintering Whitefronts have taken place in most west European countries (e.g. Belgium, Germany, Great Britain, the Netherlands). From estimates of Whitefront numbers at the most important wintering sites since the 1950s, it is possible to make conservative estimates of the population size (Table 5.1). Available data suggest that whilst there were increasing improvements in count coverage at wintering sites, there may have been no real increase in Whitefront numbers in the Western Palearctic since the 1950s. Estimates based on mid winter counts from the 1980s record a Western Palearctic population of about 850,000 individuals ±150,000, of which 450,000-600,000 now regularly winter in western Europe (Madsen 1991, Mooij 1995a, b, Rose 1995, Rose & Scott 1994, Scott & Rose 1996). A similar population size was estimated for the 1960s and 1970s. Regular count data were not available until the end of the 1980s for a number of eastern European countries (e.g. Bulgaria, Romania and the Ukraine) supporting considerable numbers of Whitefronts each winter. Since these countries started contributing regular count data to the Wetlands International Goose Database, the number of Whitefronts counted annually in the Western Palearctic has increased to about 1.2-1.4 million birds. Given annual fluctuations in reproductive and mortality rates, the number of Western Palearctic Whitefronts may therefore have fluctuated between 1.0 and 1.5 million birds since the 1950s (Mooij 1996a, b, 1997, 1998).

Based on surveys in the breeding areas, Flint & Krivenko (1990) estimated the Eurasian population of the White-fronted Goose (*A.a.albifrons* and *A.a.frontalis*) during the 1980s at about 1.3 million, and Krivenko (1996) arrived at a total of about one million individuals for the early 1990s. Rogacheva (1996) estimated the total number of White-fronted Geese in the Western Palearctic during the early 1990s to be at least 700,000 birds. Flint & Krivenko (1990) and Rogacheva (1992)

Table 5.1. Estimated population size of Western Palearctic White-fronted Geese since the 1950s according to estimates from the wintering grounds.

Period	Baltic-North Sea	Pannonic	Pontic-Anatolian	Population size	Source
1950-60	10,000-50,000	400,000-500,000	?	-[1]	1, 14
1960-70	50,000-100,000	100,000-150,000	500,000-600,000	650,000-850,000	1, 2, 13, 6
1970-80	200,000-300,000	100,000-175,000	250,000-300,000[2]	550,000-775,000	3, 7, 12, 11
1980-90	c. 400,000	c. 100,000	c. 250,000[2]	c. 750,000	4, 5
1990-93	400,000-600,000	10,000-40,000	350,000-700,000[3]	760,000-1,340,000	9, 10, 8

Notes: [1] incomplete count; [2] total does not include counts from the Ukraine where annually 200,000-500,000 geese have been counted since the 1990s; [3] includes c. 330,000 unidentified geese.

Sources: 1. Bauer & Glutz von Blotzheim (1968); 2. Cramp & Simmons (1977); 3. Lysenko (1990); 4. Madsen (1991); 5. Madsen (1992); 6. Philippona (1972); 7. Pirot & Fox (1990); 8. Rose (1995); 9. Rose & Taylor (1993); 10. Rose & Scott (1994); 11. Rutschke (1987); 12. Scott (1980); 13. Timmerman et al. (1976); 14. Uspenski (1965).

state that Eurasian White-fronted Goose populations decreased sharply since the 1940s but at present seem to have stabilised at a considerably lower level. Recently, in some parts of the breeding areas, increasing numbers of local breeding/moulting Whitefronts were found by Mineyev (1995) on the northern Russian tundra and by Tomkovich et al. (1994) on part of the northern Taimyr Peninsula, as well as stable or increasing numbers on the Yamal and Gydan Peninsulas by Molochaev & Kalyakin (1990) and Ryabitsev (1995). All studies show a sharp decrease in numbers of the Eastern Palearctic population of White-fronted Geese (*A.a.albifrons* and *A.a.frontalis*) (Degtyarev 1995, Flint & Krivenko 1990, Madsen et al. 1996a, Rogacheva 1996, Syroechkovsky Sr. 1995, Syroechkovsky Jr. 1995).

Russian estimates from the Western Palearctic breeding grounds record about 100,000-180,000 Whitefronts on the north Russian tundra, about 200,000-250,000 on the Yamal and Gydan Peninsulas and about 400,000-450,000 on the Taimyr Peninsula, giving a total population of 700,000-980,000 Western Palearctic Whitefronts (Krivenko 1996, Mineyev 1995, Mooij 1996a, b, Rogacheva 1992, 1996, Table 5.2).

According to these population estimates, numbers of Western Palearctic White-fronted Geese may have remained more or less stable in recent decades, both in the wintering and breeding areas, whereas the Eastern Palearctic population has decreased. This may explain the overall decreasing trend for the total Eurasian population found by Flint & Krivenko (1990) and Krivenko (1996).

1.4 Breeding success

Since 1957, the percentage of first-winter birds has been recorded in Whitefront flocks wintering in Western Europe. Figure 5.4 shows that the percentage of juveniles varies widely from winter to winter and has decreased over the last 30 years, from about 34% at the end of the 1950s to about 27% in the first half of the 1990s. Years with poor reproductive success follow one year after peak lemming years in eight out of 12 cases (Fig. 5.4; Mooij 1997, Mooij & Kostin 1997, Mooij et al. 1995).

1.5 Mortality

Literature estimates of annual mortality rates of White-fronted Geese give a broad range between 16 and 36% (Bauer & Glutz von Blotzheim 1968, Boyd in Kuijken 1975, Rutschke 1987, Doude van Troostwijk 1966, 1974,

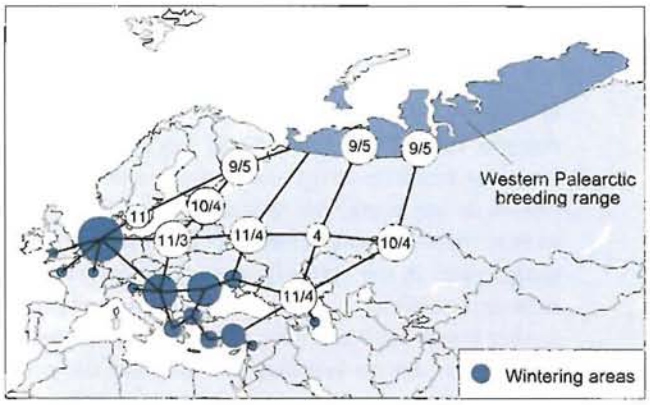


Fig. 5.3. Migratory routes of Western Palearctic White-fronted Geese according to Mooij & Kostin (1997). Numbers refer to the month of major goose concentrations.

Ebbinge 1991, Kuijken 1975, Mooij 1995a, b, 1996a, 1997, Mooij et al. 1995), although most authors estimate an annual mortality of between 25 and 30%. The mortality rate of first-year birds seems almost double the mortality of older birds (Bauer & Glutz von Blotzheim 1968, Boyd in Kuijken 1975, Cooke et al. 1995, Mooij 1997, Rutschke 1987). At present, man-induced mortality caused by hunting is the most important mortality factor, responsible for about 80-95% of annual mortality (Ebbinge 1991, Mooij 1997, Mooij & Kostin 1997).

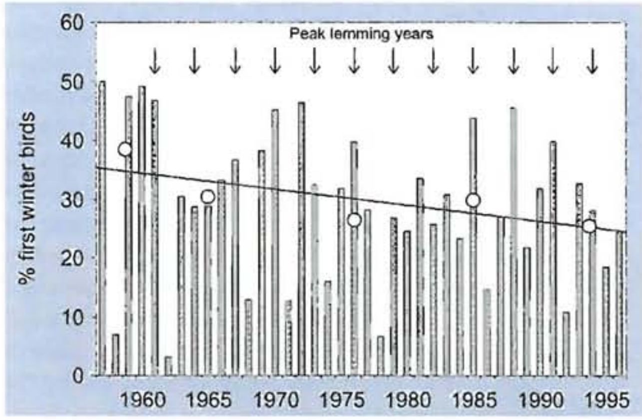


Fig. 5.4. Sampled proportion of first-winter White-fronted Geese on western European wintering sites (Ganzenwerkgroep 1976-1992, Lebret et al. 1976, Mooij 1993, 1995, pers. obs., J. Philippona & L. van den Bergh pers. comm.). Circles show mean values for the 1950s, 1960s, 1970s, 1980s and 1990s. Line shows long-term trend. Arrows show peak lemming years on the Taimyr Peninsula according to Kostin & Mooij (1995), Kuksov (1979), Mooij et al. (1995) and Rykhlikova & Popov (1995).

Table 5.2. Estimated population size and distribution of Western Palearctic White-fronted Geese in the breeding area during the 1980s.

Breeding area	Estimated size of breeding area (km^2)	Estimated number of White-fronted Geese	Source	Breeding density (nests/km^2)
Kanin-Vaygach Island	120,000	100,000-180,000	Mineyev (1995)	0.18
Yamal-Gydan	250,000	250,000-300,000	Mooij (1996a, 1997)	0.17
Taimyr	400,000	400,000-450,000	Rogacheva (1992)	0.16
Western Palearctic	770,000	750,000-930,000		0.17

2. BREEDING GROUNDS AND BREEDING ECOLOGY

2.1 Distribution

Range: The White-fronted Goose has an almost circumpolar breeding range and is characteristic of the tundra. In the south, the species is common in some parts of the shrub-tundra but is not found in the forest-tundra zone. In the northern part of the arctic tundra subzone, the White-fronted Goose is less common than further south, but is the most numerous goose species there. There are no breeding records from the polar desert zone. The breeding area of the Western Palearctic population of *A.a.albifrons* covers an area of about 770,000 km². The breeding range is situated approximately between the 4° and 10° July isotherms and includes a broad zone along the northern coast of Eurasia as well as several arctic islands, e.g. Kolguyev, Vaygach and Nova Zemlya (Mineyev 1995, Rogacheva 1992, Voous 1960). South of the Taimyr Peninsula, White-fronted Geese have been found breeding in the northwestern Putorana mountains up to 1000 m above sea level. White-fronted Geese breeding to the east of the Kolyma River belong to the sub-species *A.a.frontalis* (Fig. 5.1; Bauer & Glutz von Blotzheim 1968, Cramp & Simmons 1977, Flint et al. 1984, Johnsgard 1978, Philippona 1972, Rutschke 1987, Voous 1960).

Habitat and feeding ecology: Whitefronts are generally found in a range of wetland habitats with an abundance of grass and sedge vegetation. In general, they arrive in the breeding areas about one week after mean daily temperatures exceed 0°C; in western breeding areas this is in the second half of May and further east (e.g. the Taimyr Peninsula) in early June (Mineyev 1995, Mooij et al. 1995). At this time, most areas are still snow-covered and, on arrival, Whitefronts feed on dead leaves of grass and sedge species. As soon as the upper soil layer has melted, the geese start uprooting grass and sedge plants to feed on the rhizomes and stolons. After vegetation growth has started, geese switch to feeding exclusively on fresh leaves. Although in some years many plants may be uprooted by the geese at favoured feeding sites, the vegetation is restored very soon after the geese shift to feeding on fresh leaves (Mooij et al. 1995, V. Zyrianov pers. comm.). Main feeding plants on the tundra are Cotton grass *Eriophorum angustifolium* and *E. scheuchzeri, Horsetail Equisetum* spp., several grass species (e.g. *Alopecurus alpinus, Arctofila fulva* and *Poa* spp.), herbs (*Atropis angustata, Oxytropis* spp, *Pleuropogon sabinii*), sedges (*Carex stans*), moss species, berries (e.g. *Empetrum nigrum*) as well as *Polemonium acutiflorum, Polygonum viviparum* and *Saxifraga cernua* (Bauer & Glutz von Blotzheim 1968, Cramp & Simmons 1977, Johnsgard 1978, Mooij et al. 1995, Uspenski 1965, Walter & Breckle 1986).

Foraging Whitefronts can have a considerable local influence on tundra vegetation, especially early season uprooting and late summer concentrated foraging by moulting groups and pre-migratory gatherings (Mooij et al. 1995, Remmert 1980 a, b, Walter & Breckle 1986). Serious damage to tundra vegetation caused by goose foraging as found in northern America by Cooke et al. (1995) and Kerbes et al. (1990) has never been documented in Eurasia.

Breeding biology: Based on European breeding population estimates by Mineyev (1995) and on the Taimyr Peninsula by Rogacheva (1992), size of breeding areas and a mean recruitment rate of 30%, mean breeding density can be estimated at 0.17 nests/km² (Table 5.2, Mooij 1996a, 1997). Within breeding areas, nesting density shows considerable variation: e.g. in European breeding areas 0.01-12.7 nests/km² (Mineyev 1995, unpubl.,) and 0.2-1.7 nests/km² from Taimyr (Kokorev 1985, Rogacheva 1992). Although normally solitary, aggregations of Whitefronts can be found in association with gull colonies on islands or Peregrine Falcon *Falco peregrinus* nests on cliffs (up to 3 nests/ha, J. Mooij unpubl., V. Zyrianov pers. comm.). Breeding densities also vary annually according to weather conditions and predation pressure. If the birds cannot start breeding within 14 days after arrival at the breeding site (because of late snow cover), they leave and move to the moulting sites (Kostin 1985, Mooij et al. 1995). In years with high predation pressure and/or bad weather conditions, only some of the potentially breeding pairs will attempt to nest. Of these attempts, up to 50% of clutches and 25% of goslings will be lost, i.e. an overall loss of up to 40% (Kokorev 1985, Mooij et al. 1995, unpubl, V. Zyrianov pers. comm.).

2.2 Moult migration and moulting areas

In July, non-breeding Whitefronts move to moulting sites in sedge-gramineous lowland areas with an abundance of rivers and lakes. In Taimyr, flightless geese feed along river banks and around lakes most of the day, often far from water. Moulting geese may cover considerable distances on foot during moult (e.g. Seebohm 1901). Geese seek safety on water and gather in concentrations of several thousands along sections of the Pyassina and Taimyra Rivers, and several hundreds on smaller rivers and lakes. In the European part of the moulting areas, concentrations of more than a thousand birds are rare and most moulting Whitefront groups contain 20-250 birds. Moult takes about one month and most birds finish primary moult in mid August. Families moult close to the breeding site, whereas non-breeders may fly considerable distances to moult (Mineyev 1995, Mooij 1996, Mooij et al. 1995, Y. Kokorev & V. Zyrianov pers. comm.). There are still major gaps in the information about moult migration, the composition of local moult concentrations and the number and importance of moulting areas throughout Eurasia.

2.3 Research

Whitefronts have been studied and ringed on the European wintering sites, especially in the Netherlands and the United Kingdom, since the early 1950s and Soviet scientists have studied and ringed Whitefronts on the breeding areas since the 1960s (Borzhonov 1975, Rogacheva 1992). In 1989, joint Russian-western European research programmes started in the breeding areas. This range-wide research cooperation has resulted in considerable exchange of information and the joint ringing programmes have increased our knowledge of migration, although there remain major gaps in the understanding of breeding ecology and migration.

2.4 Protection and conservation

Hunting legislation: The White-fronted Goose has long been a quarry species through most of its range. In the breeding areas, eggs were traditionally gathered and moulting geese caught by both the Russian inhabitants and local people (e.g. Alphéraky 1904, Seebohm 1901, Nowak 1995, Rogacheva 1992). From the 1930s, this harvest (by traditional means as well as shooting) reached high levels as a result of a planned use of natural resources in the breeding areas by settlers and prison camp inhabitants. The influence of these hunting practices could have had a profound effect on local goose populations. However, the solitary habit of Whitefronts and their habits during moult would have made them difficult to catch in large numbers. For the White-fronted Goose, the influence of spring and autumn shooting seems to be more important (Kostin 1981) since illegal hunting occurs in all seasons on a large scale in spite of official hunting seasons and bag limits. Spring hunting in the breeding areas may disproportionally affect breeding pairs as well as affecting the breeding condition of surviving arriving birds (Kostin 1981, 1996, Rogacheva 1992).

Goose hunting on staging and wintering areas has a long tradition. Geese were caught with nets (Alphéraky 1904, Lebret 1952) and hunted with trained birds of prey as well as bow and arrow (Kaiser Friedrich II von Hohenstaufen 1969, Gesner 1669). In more recent times, these waterfowl hunting methods have been replaced by shooting and, during this century, most countries have replaced rifle shooting (bullets) with shotguns (pellets).

At present, the White-fronted Goose is the most hunted goose species in the Western Palearctic, being quarry on the breeding areas, on migration and throughout most of the wintering range. Conservative estimates of annual goose bags in the Western Palearctic (Table 5.3) suggest about 300,000 geese (mainly of the genus *Anser*) were killed by hunters annually in the 1960s, 1970s and 1980s. For most countries, there are no official data on the species composition of goose bags but, based on the numbers of geese and the numbers of White-fronts in each country, perhaps 165,000 of these geese (50-60%) were White-fronted Geese (Mooij 1997). This would equate to c. 20% of the White-front population being killed every year, excluding crippled birds or those dying of lead poisoning, which may add another 5% dying from the indirect effects of shooting (Ebbinge 1991, Kalchreuter 1994, Mooij 1990, 1991c, Morehouse 1992).

Site safeguard: Only a few traditional Whitefront sites are protected (van Roomen 1989). Within the breeding areas there are a number of protected sites, both Zapovedniks: the highest level of state nature reserve where economic activity affecting the development of natural processes is prohibited, and Zakazniks: state nature reserves where land use is partially restricted to preserve natural ecosystems (Wilson & Moser 1994). These protected areas, although covering vast areas, only protect a relatively small part of the population. Most of the breeding range lacks protec-

Table 5.3. Estimated annual goose bags in the Western Palearctic during the 1960s, 1970s and 1980s.

	1960s	Source	1970s	Source	1980s	Source	Estimated annual Whitefront bag 1980s
Former USSR (west)	c. 230,000	13, 12	c. 210,000	12	c. 180,000	12	c. 120,000
Poland	c. 6300	13	c. 12,000	8	c. 12,600	2, 8, 17	c. 2500
Denmark	c. 10,000	13	c. 11,000	8	12,000-13,000	7	c. 300
Sweden	c. 2000	13	c. 5000	14	c. 7500	6	0
Germany	c. 6000	13	c. 7500	9	c. 10,000	9, 18	c. 6000
The Netherlands	c. 7000	3, 4	c. 10,000	4, 9, 14	35,000-50,000	11, 18	c. 30,000
Hungary	c. 7500	13	c. 5000	14	c. 7300	5	c. 2000
former Czechoslovakia	c. 1500	13	c. 2000	14	> 1500	16	c. 100
Austria	c. 1700	13	c. 2000	14	c. 2000	1	c. 400
Romania	c. 5000	10	c. 3000	15	3000-5000	-	c. 1500
former Yugoslavia	unknown	-	c. 4000	15	unknown	-	unknown
Bulgaria	c. 7000	13	c. 14,000	14	7000-14,000	-	c. 3500
Greece	unknown	-	unknown	-	unknown	-	unknown
Turkey	unknown	-	unknown	-	unknown	-	unknown
Total	c. 285,000		285,000		290,000		c. 165,000

Sources: 1. Dick (1992); 2. Dmowski (1996); 3. Doude van Trooswijk (1974); 4. Ebbinge (1991); 5. Faragó (1992); 6. Hedlund (1992); 7. Jepsen & Madsen (1992); 8. Landry (1990); 9. Mooij (1995b, 1997), Mooij & Kostin (1997); 10. Munteanu (1992); 11. Van Oosterbrugge et al. (1992); 12. Priklonski & Sapetina (1990); 13. Rutschke (1973); 14. Rutschke (1978); 15. Scott (1982); 16. Urbanek (1992); 17. Wieloch (1992); 18. Wiese (1991).

tion, although the difficulties of penetrating the tundra and high transportation costs offer a certain degree of protection. In September 1994, the Russian Federation increased the number of wetland sites protected under the Ramsar Convention from three to thirty-five (I.O. Kostin pers. comm.), some of which are important for White-fronted Geese.

Public awareness: Because of the regionally large wintering concentrations and the relatively large population, public awareness of the need to protect White-fronted Geese is generally low. However, considering the annual fluctuations in reproductive rate, high annual mortality rates and long migratory routes, the population should be viewed as more vulnerable than is currently perceived.

3. STAGING AREAS

On migration from breeding to wintering areas, White-fronted Geese fly 3000-5000 km within two months and cross several countries which were formerly republics of the USSR. This region (except the Ukraine) does not support large Whitefront numbers during winter and is treated collectively here.

3A. COUNTRIES ON THE TERRITORY OF THE FORMER USSR

3A.1 Distribution

Range: Analysis of ringing recoveries resulted in the description of five major flyways of White-fronted Geese through the countries formerly comprising the USSR (see section 1.2 above, Fig. 5.3) which are used in both spring and autumn. In autumn, the central flyway seems less important and in early spring few geese use the northern flyway. Autumn migration may occur more rapidly than spring migration. There are many important staging sites along the flyways (Fig. 5.5).

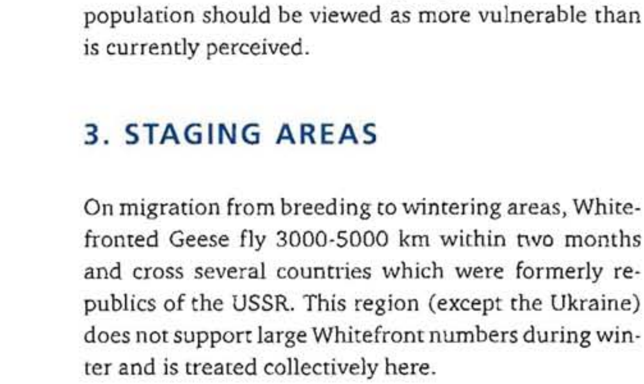


Fig. 5.5. Important staging sites of Western Palearctic White-fronted Geese in Europe and western Asia. Sites: 1. Inner delta of Upper Taimyra; 2. Lower Pyassina basin; 3. Tanama River basin; 4. Mouth of Ob River; 5. Lower Ob basin; 6. Upper Petchora basin; 7. Lower Petchora basin; 8. Southern coast of the White Sea; 9. Ob basin around Chanty-Mansijsk; 10. South-Karelian lake area and Kargopol region; 11. Basins of Lower Tobol and Ishim; 12. Turgayskaya Region; 13. Basins of Volga and Kama; 14. Oka River basin; 15. Area southwest of St. Petersburg; 16. West coast of Estonia (Matsalu Bay); 17. Bogs of eastern Latvia; 18. Nemunas river delta in Lithuania; 19. Marshes of Zuvintas reserve; 20. Lower Volga basin; 21. Propyat River basin; 22. Biebrza basin; 23. Lower Odra basin; 24. Volga delta; 25. Manych-Gudilo area; 26. East coast of Sea of Asov; 27. Crimea; 28. Basins of the Lower Dnestr and Dnepr; 29. Danube delta; 30. Kirov Bay.

Habitat and feeding ecology: On migration, White-fronts feed on agricultural land such as cereals, peas and grassland, as well as on semi-natural and natural wetland habitats such as marshes, bogs, lakes and floodplains (Cramp & Simmons 1977, Kozulin et al. 1995). During autumn migration they gradually shift from natural to agricultural sites and the reverse in spring.

3A.2 Abundance

Phenology: Analysis of ringing recoveries (Borzhonov 1975, J. Mooij unpubl.) and regional observations (Drobovtsev 1979, Kozulin et al. 1995, Luigujõe & Kuresoo 1996, Lysenko 1990, Mineyev 1995, Raudonikis & Svazas 1991, Rogacheva 1992, Vinokurov 1982, Yakimenko 1995, Y. Kokorev, V. Krivenko, R. Sagitov pers. comm.) show that the majority of White-fronted Geese leave breeding areas during September and early October. During the 1980s, it was estimated that up to 200,000 Whitefronts migrated annually through Estonia in autumn (Leito 1996b, Luigujõe & Kuresoo 1996). Large numbers of Whitefronts reach Poland, Sweden and Germany in October, and peak numbers are recorded in southern Russia and the Ukraine in October and southeastern Europe and Turkey in November.

In spring, the majority of Whitefronts pass through Belarus in March and April, and large concentrations are reported from eastern Poland, Belarus and central Russia to mid-western Siberia in April (all flyways). In May, most Whitefronts have arrived on the western breeding grounds, whilst birds from the southern flyways are in central Russia, Turgayskaya Region and Chanty-Mansijsk in the Ob River valley. By June, almost all Whitefronts are on the breeding areas.

Trends and numbers: In the Russian literature there is no clear picture of changes in numbers of White-fronted Geese on migratory routes and staging areas. Alphéraki (1904) quotes Menzbier, who stated that White-fronted Geese in Russia do not use the same migratory routes each year, but that "Something causes them to leave their old favourite road for a new one, and then, together with the alteration in direction of the migratory route, the halting-places are also changed. It is indeed possible that it is precisely the alteration in the conditions of the halting-places and the facilities for getting food that compel the white-fronted geese to vary their minor lines of migration". Alphéraky further quotes Eversmann who stated that Whitefronts "abandon the known track and select a new one far northwards or southwards, and then pass annually over the newly chosen route." Niethammer (1938) also reports periodical shifts of migratory routes, wintering sites and regional wintering populations of White-fronted Geese. Numbers of staging Whitefronts have decreased since the 1970s in the southwestern Caspian (E. Tkachenko unpubl.), varied widely between years in the north Caspian (Krivonosov & Rusanov 1990) and lower Ob region (Molochaev 1990), have steadily increased along the Baltic (Leito 1996b, Luigujõe & Kuresoo 1996) and northern Black Sea coasts (Ardamatskaya 1994, Ardamatskaya & Sabinevsky 1990, Zhmud 1996) as well as in the Turgayskaya region of Kazakhstan (Vinogradov & Auezov 1990), and, in the Moscow region (Michenko & Suchanova 1990, Panchenko & Priklonsky 1972, Zykov & Priklonsky 1991), increased again since the mid 1980s to numbers recorded in the mid 1970s. The number of geese using any one of the migratory route apparently changes but the data do not provide a clear picture of the changes in recent decades.

3A.3 Research

In Russia and the former Soviet Union there is a long tradition of goose research. From a number of faunistic expeditions during the 19th century, several Russian explorers brought the first information about breeding geese in the Russian arctic (e.g. Buturlin, Menzbier, Middendorff). Alphéraky (1904) reviewed all knowledge then available about geese. Since the 1930s, the former Soviet Union has intensified its efforts to develop and exploit the natural resources of Siberia and research in the arctic has thereby increased since that time. Research on waterfowl and opportunities for exploitation became a high priority and the development of management strategies for waterfowl populations has been ongoing in the USSR, initiated in the mid 1960s by Isakov. Most research was published in Russian as internal reports or in regional journals and was consequently almost inaccessable to western scientists. Since the fall of the iron curtain, several research programmes have ceased due to lack of money. In recent years, research on the breeding biology of White-fronted Geese has been carried out in several parts of arctic Russia: in the Russian breeding area (e.g. Krivenko 1996, Mineyev 1995); in western Siberia (e.g. Kalyakin 1995, Molochaev 1990, Molochaev & Kalyakin 1990, Syroechkovsky et al. 1991, Uspenski & Kischinski 1972); on the Yamal Peninsula (e.g. Ryabitsev 1995); on the Taimyr Peninsula (e.g. Ebbinge & Boere 1991, Kokorev 1983, 1985, 1989 & unpubl., Kokorev et al. 1990, Kostin 1981, Krivenko et al. 1984, Matyushenkov 1980, Mooij 1997, Mooij et al. 1995, Mooij & Kostin 1997, Pavlov et al. 1983, Rogacheva 1992, Spaans 1992, Syroechkovsky 1995, Tomkovich et al. 1994, Zyrianov & Kokorev 1983, Zyrianov 1990 & unpubl.). In addition, the size of the breeding population was estimated during several waterfowl survey programmes (Flint & Krivenko 1990, Krivenko 1996, Rogacheva 1996). Since 1989, 848 Whitefronts have been individually marked with coloured leg-rings or white neck-collars with a three digit code. Satellite transmitters have also been fitted to birds on the Taimyr Peninsula to obtain information on migratory routes (Ebbinge & Boere 1991, Mooij 1993, 1996a, b, Mooij et al. 1996, Spaans 1992).

3A.4 Protection and conservation

Hunting legislation: There is little information about changes in hunting regulations since the break up of the former USSR. In the Russian Federation, there is a traditional spring hunting season, using decoys, for a maximum of 10 days with a daily bag limit of two geese per hunter. The opening and closing dates vary according to region and goose concentrations. The autumn season begins on the second Saturday in August or first Saturday in September, ending no later than 30 September. Details of hunting seasons are set by special decree of the regional committees of the Hunting Board. Since 1988, native arctic peoples have been allowed subsistence hunting of all waterfowl species, excluding those in the Red Data Book, without a permit, although the harvest cannot be sold or bartered. This is valid for people for whom hunting is an integral lifestyle component, e.g. professional fishermen, hunters and reindeer breeders (Gusakov 1990, Kostin 1996). Marked Whitefronts have been recovered as shot from Khazakhstan and southern Russia in October and November, so the open season must be later there. In Estonia, a new Game Act was accepted by Parliament in 1994 retaining the White-fronted Goose as a huntable species between 20 August and 31 October on the coast and until 30 November inland (Luigujõe & Kuresoo 1996). In Latvia, Whitefronts are a huntable species and the open season for waterfowl hunting is from 1 August to 15 November (Baumanis & Krusts 1996). There is no spring hunting season in either Estonia or Latvia (Baumanis & Krusts 1996, Luigujõe & Kuresoo 1996).

The annual goose bag in the western part of the former USSR was estimated at about 230,000 geese during the 1960s, about 210,000 in the 1970s and about 180,000 during the 1980s (Priklonski & Sapetina 1990, Mooij 1997a, Rutschke 1973). There is no recent information on goose bags in the various independent countries since the break up of the USSR, although in Estonia goose bags fluctuated widely between years with a marked increasing trend during the last 20 years (L. Luigujõe unpubl., Luigujõe & Kuresoo 1996). The goose bag in Latvia is estimated to be stable at about 400 birds annually over the last 20 years (Baumanis & Krusts 1996, Rutschke 1978).

Control of illegal hunting activities was always difficult in the former USSR (Gusakov 1990, Lampio 1983, Nowak 1995, Rogacheva 1992, Rusanov & Khakin 1990, A.M. Amirchanov & I.O. Kostin pers. comm.) and, according to several Russian experts, official estimates of the annual goose bag in the former USSR (Table 5.3) are definitely too low (e.g. A.M. Amirchanov, V. Flint, I.O. Kostin & V. Krivenko pers. comm., Mooij 1996a, 1997, Rogacheva 1992).

Site safeguard: There are several protected areas along the migratory routes (e.g. Chanty-Mansijsk, Manych-Gudilo, Volga delta, Oka Valley, Lake Vyalye, plus several sites in the Baltic countries). Some have not only national protection status (Zapovednik or Zakaznik) but also international status as Ramsar sites or Biosphere Reserves. In spite of the large size of these protected sites, the geese are unprotected along most of the flyway.

Agricultural conflict: Although migrating Whitefronts feed partly on agricultural sites, especially in the European part of the former USSR, there are almost no records of conflict with agricultural interests. However, because of continuing privatisation throughout the area resulting in increased quality of grassland and crops, more and more geese are likely to be attracted to agricultural areas. Goose damage and agricultural conflict could become a major problem in years to come. Svazas et al. (1997) report a new and serious conflict between migratory waterfowl, especially geese, in parts of Lithuania. More reports of goose damage can be expected in the future.

4. WINTERING AREAS

Most important wintering sites for White-fronted Geese are located between the 0°C and 10°C January isotherms, stretching from southeastern England to southwestern Turkey but avoiding highland areas (Fig. 5.6). Most wintering sites are situated in river valleys, estuaries or deltas.

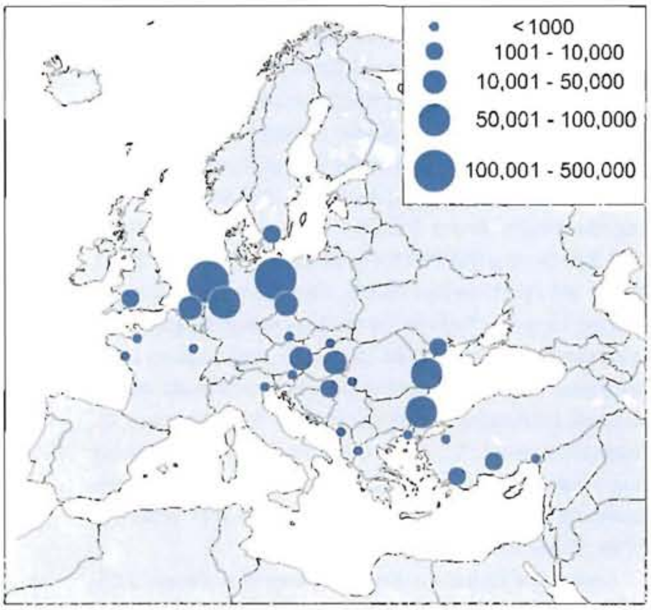


Fig. 5.6. Important wintering sites of Western Palearctic White-fronted Geese in Europe.

4A. ALBANIA

4A.1 Distribution

Range: In Albania, wintering White-fronted Geese occur in the north of the country near Liqen Shkodrës (Lake Shkodra) on the border with Yugoslavia (Skadarsko Jezero) and in the southwest near Liqen i Prespa (Lake Megali Prespa) on the border with Macedonia (Prespansko Jezero) and Greece (Limni Megali Prespa) and Liqen i Prespes (Lake Mikri Prespa) on the border with Greece (Limni Mikri Prespa) and occasionally in coastal areas (Grimmett & Jones 1989, Peja & Bino 1996, Philippona 1972).

Habitat and feeding ecology: No data exist on habitat selection of White-fronted Geese in Albania. Most of lowland Albania was drained and reclaimed for agriculture after the Second World War to increase agricultural productivity and exterminate malaria (Grimmett & Jones 1989).

4A.2 Abundance

Phenology: No data. However, because Albanian haunts lie close to wintering sites in Yugoslavia, Macedonia and Greece, Whitefronts can be expected from December to February.

Trends and numbers: The political isolation of Albania has meant that virtually nothing is known about former numbers of Whitefronts wintering in the country. In recent years, data on waterfowl abundance in Albania have improved and it seems that generally less than 100 Whitefronts winter there at present, with more in severe winters (Peja & Bino 1996, Philippona 1972, Wetlands International Goose Database unpubl.).

4A.3 Research

No information.

4A.4 Protection and conservation

Hunting legislation: No information, Scott (1982) estimated the Albanian goose bag during the 1970s at about 2000 geese.

Site safeguard: No information. Data in Grimmett & Jones (1989) suggest that Whitefront haunts in Albania are unprotected.

Agricultural conflict: No information.

4B. AUSTRIA

4B.1 Distribution

Range: In Austria, there is one important wintering area for White-fronted Geese in the border area with Hungary around Neusiedler See, where they winter in mixed groups with Bean Geese *Anser fabalis*. Whitefronts roost on a number of shallow lakes in the plains east of Neusiedler See (e.g. Lange Lacke, St. Andräer Zicksee, Fuchslochlacke, Illmitzer Zicksee) as well as in Hungary and feed in the surrounding area, on both sides of the border (Dick et al. 1994).

Habitat and feeding ecology: In the 19th century, Whitefronts fed almost exclusively on semi-natural grassland and marshland. Since then, especially in the last 50 years, most of the area around Neusiedler See was claimed for intensive agriculture and now they feed almost exclusively on arable land; in autumn c. 60% cereals, c. 30% maize and c. 10% rape, and in spring only on cereals (Dick et al. 1994).

4B.2 Abundance

Phenology: The first Whitefronts reach Austria in October. Numbers increase from November and spring migration peaks in February. By April, most Whitefronts have left Austria. In cold, dry winters, numbers can drop considerably and in severe winters all geese leave the area (Fig. 5.7).

Trends and numbers: In the 1940s and 1950s, c. 45,000 Whitefronts were counted in the Austrian part of the Neusiedler area each winter. Occasional larger counts of 60,000-120,000 Whitefronts were reported at that time. In the 1960s, numbers decreased and by the mid 1960s only about 8000-10,000 Whitefronts remained. By the 1970s, the number of Whitefronts was estimated at 3000-10,000 birds and joint simultaneous Austrian-Hungarian goose counts since the early 1980s found c. 15,000 Whitefronts in the Austrian-Hungarian Neusiedler region. An average of about 1200 Whitefronts was reported from Austria during January counts in the 1980s, increasing to c. 4800 in the early 1990s (Dick 1986, 1987, 1990, 1992, Dick et al. 1994, Parz-Gollner et al. 1993, Timmerman et al. 1976, Wetlands International Goose Database unpubl. data).

4B.3 Research

With the creation of the Neusiedler See-Seewinkel National Park, a waterfowl research programme was started focussing on waterfowl ecology, the influence of hunting and necessary measures for protection. Dick et al. (1994) concluded that there is still a considerable need for ecological research on waterfowl, especially relating to habitat use in the light of the planned restoration of natural and semi-natural habitats. A waterfowl census programme is carried out (Dick et al. 1994, Parz-Gollner et al. 1993).

4B.4 Protection and conservation

Hunting legislation: There is an open season in Austria, although the length of the hunting season varies between states. In Burgenland, where most Whitefronts winter, the open season is from 1 August to 31 January with no bag limit. Geese are hunted using shotguns from hides close to the roost during morning or evening flights or lured to feeding areas with food or decoys. The national annual goose bag in the 1960s and 1970s

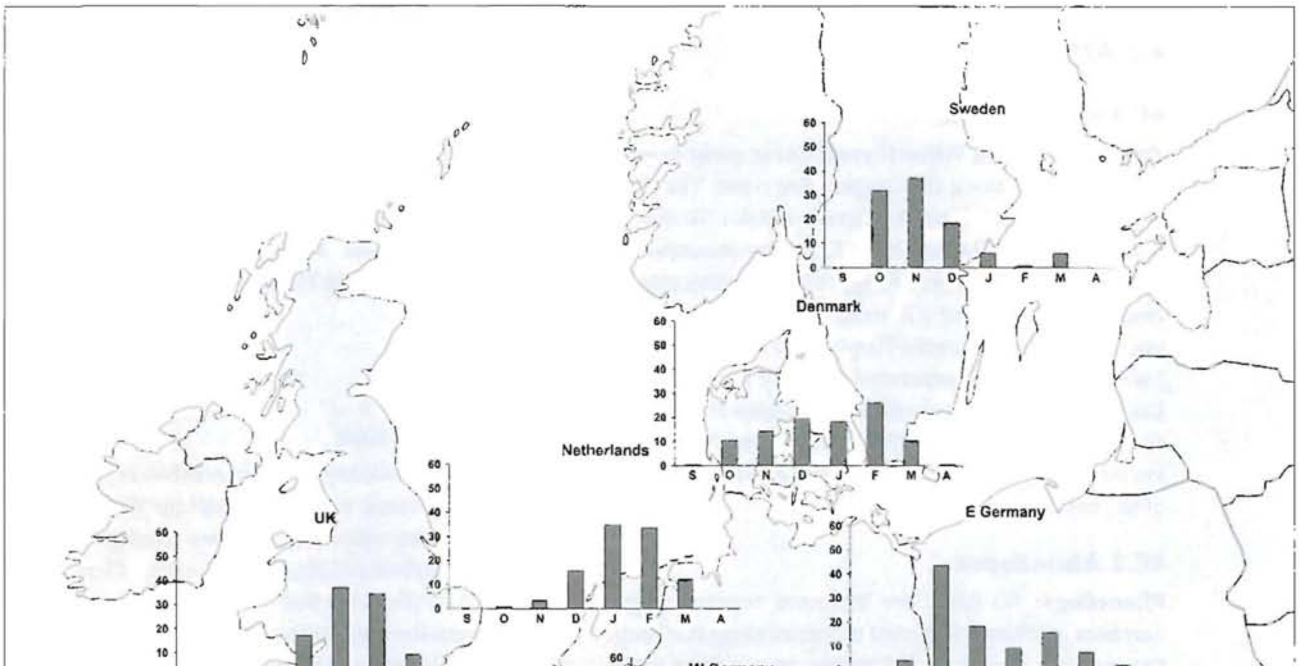


Fig. 5.7. Phenology of White-fronted Geese in Europe shown as percentage occurrence in each month for various countries. Source data: Austria, Dick et al. (1994); Belgium, Meire & Kuijken (1991); Denmark, Jørgensen et al. (1994); Germany, Zentrale für Wasservogelforschung und Feuchtgebietsschutz in Deutschland (unpubl. data); Hungary, Faragó (1995); the Netherlands, Lebret et al. (1976), Ebbinge et al. (1987), Mooij (1991a), SOVON (1995); Sweden, Nilsson & Persson (1989); UK, Owen (1972b), The Wildfowl & Wetlands Trust (unpubl.).

was c. 2000 geese, about 3000 during the 1980s, and in the early 1990s about 1500 geese, 82% of which are shot in Burgenland. Species are not identified in the annual goose bag (Dick et al. 1994).

Site safeguard: The area around Neusiedler See has been a Ramsar site since 1982 and a National Park since 1992. Hunting is restricted in some areas (e.g. the southern part of Neusiedler See) and some areas were taken out of intensive agricultural use to restore former semi-natural grassland habitat with extensive cattle grazing. A management plan is being developed for the entire area and a total hunting ban is proposed (Dick et al. 1994).

Agricultural conflict: Because of the intensive agricultural use of most of the area, conflict between agriculture and geese has been long standing, although most of the conflict is focussed on the Greylag Goose *Anser anser*. Whitefronts damage winter cereals during periods of cold weather. Between 1977 and 1992, the Burgenland federal government annually paid an average of ÖS 173,000 (c. US$ 16,000) for goose damage to some 165 ha (Dick 1992, Dick et al. 1994).

4C. AZERBAIJAN

4C.1 Distribution

Range: Wintering White-fronted Geese occur in eastern Azerbaijan along the Caspian Sea coast. The most important haunt is Kirov Bay, south of Baku (Grimmett & Jones 1989, Philippona 1972, E. Tkachenko unpubl.).

Habitat and feeding ecology: The Kirov Bay area includes two important sub-units: Kyzyl-Agach Bay, an open bay connected to the Caspian Sea and Maly Kyzyl-Agach Bay, which is separated from the sea by an artificial dam. Emergent vegetation includes *Phragmites, Scirpus* and *Juncus* beds. Most Whitefronts in Azerbaijan feed on agricultural land and roost in shallow parts of the bays.

4C.2 Abundance

Phenology: No data. The literature suggests larger numbers of Whitefronts used to winter along the south Caspian Sea coast but mid winter counts have never found high numbers (Perennou et al. 1990, Philippona 1972, Scott & Rose 1989, van der Ven 1987, 1988). In severe winters, most Whitefronts may fly to more southerly haunts, but at present it seems that Azerbaijan is the most important wintering site in the Caspian during normal winters from December to February.

Trends and numbers: Surveys in the 1960s found c. 8000 Whitefronts during mid winter counts. In the 1970s and 1980s, 8000-40,000 White-fronted and Greylag Geese (combined) were counted in Kirov Bay. During the 1980s, numbers of White-fronted and Lesser White-fronted Geese declined from 17,000-25,000 to 5000-6000 birds, whereas Greylag Geese increased in wet years (Grimmett & Jones 1989, Philippona 1972, E. Tkachenko unpubl.).

4C.3 Research

Regular waterfowl counts have been carried out for more than 10 years. No other information.

4C.4 Protection and conservation

Hunting legislation: No information, although there are few indications that regulations differ greatly from those in the former USSR (hunting season in autumn). High rates of disturbance and poaching occur in Kirov Bay (Grimmett & Jones 1989). Azerbaijan has a high density of waterfowl hunters and although there are no data on the annual Whitefront bag it seems that the species suffers considerable hunting pressure.

Site safeguard: Whitefront haunts in the Kirov Bay area in Azerbaijan are protected partly under the Kyzyl-Agach Bay Zapovednik and partly under the Maly Kyzyl-Agach Zakaznik. The entire area is also a Ramsar Site. However, the protected area excludes Whitefront feeding sites, where conditions become less and less favourable for feeding geese. The water areas are subject to ecological changes because of human activities in coastal areas (Grimmett & Jones 1989).

Agricultural conflict: Agricultural changes (from rice and grain to vegetables and especially grapes and cotton) have affected the availability of food for geese. Changes in water quality (e.g. extraction of water for irrigation, release of large quanties of fresh water into Kyzyl-Agach from fishponds, eutrophication and use of pesticides, especially in the cotton fields, have made the site less attractive to waterfowl in recent decades (Grimmett & Jones 1989, E. Tkachenko unpubl., Tkachenko & Litvinova 1990).

4D. BELGIUM

4D.1 Distribution

Range: The Oostkustpolders in northwest Flanders is the most important wintering haunt for White-fronted Geese. The core wintering areas are Damme, Knokke, Brugge, Meetkerke-Houtave, Uitkerke, Klemskerke, Vlissegem, Oudenburg and Zuienkerke, including the Zwin Nature Reserve on the Belgian-Dutch border and reserves at Damme and Uitkerke Polders (Kuijken 1975, 1978, Meire et al. 1988a, b, Meire & Kuijken 1991, Kuijken & Meire 1996). The western part of the coastal Polder area including the IJzer valley has developed from a refuge area, used during extreme cold periods, into an area of increasing importance for Whitefronts which now remain for several weeks (K. Devos pers. comm.). Goose flocks feed regularly in the Creeck area along the Dutch border in northeast Flanders, depending on occurrence in Zeeuws Vlaanderen, south of the Westerschelde river on the Dutch side of the border. Whitefronts also winter in the Polders along the Lower Schelde river north and northwest of Antwerp, although numbers are decreasing as a result of industrial development. Increasing observations of small Whitefront flocks have also been reported along the Grensmaas (Border Meuse) eastern Limburg Province.

Whitefronts are rarely observed in the Walloon part of Belgium (Central Ornithologique Aves pers. comm.).

Habitat and feeding ecology: In Flanders, Whitefronts feed almost exclusively on improved grasslands, although the area of these has been reduced by ploughing for other crops in recent years. From the early 1960s, when the traditional wintering grounds at Damme were protected, until recently, Whitefronts arrived first in traditional haunts around Damme, later dispersing over the entire polder area as grass stocks became depleted. A fairly consistant cyclic pattern of habitat use was observed from year to year. In recent years, however, Whitefronts have started using several core areas simultaneously, early in the season and dispersing from these. Cyclic consumption of the available food supply is probably a successful strategy. As the grass sward is grazed, the foraging benefit eventually drops below a profitable harvest threshold (sward height 3 cm) and the geese leave the area; during normal winters, the sward recovers and becomes profitable for goose grazing again after some months (Kuijken 1969, Meire & Kuijken 1991, Tys et al. 1992). In the second half of winter, some increased use of winter wheat fields has been observed.

The national goose shooting ban, introduced in 1981, resulted in the birds becoming less shy and they started to feed closer to roads and farms. This increased the area of available feeding grounds by c. 30-45% (Kuijken & Meire 1996). Furthermore, the geese also remain on the feeding grounds during the night, thus saving energy previously spent on morning and evening flights of over 30 km. Only in the Zwin area do the Whitefronts return to the Reserve to roost at night. In the Creeck area and the Schelde Polders, Whitefronts forage on a mosaic of shallow brackish waters, wet permanent grasslands in depressions and large ploughed fields. Nocturnal roosts are situated close-by at Saeftinge and Westerschelde in the Netherlands.

4D.2 Abundance

Phenology: Whitefronts migrating southwest pass through from late September. The first wintering birds arrive in early November. Numbers rapidly increase in December, usually peaking in mid January. Birds on spring migration are recorded in February and by the second half of March, most Whitefronts have left the area (Fig. 5.7) (Meire & Kuijken 1991, Kuijken & Meire 1996). Following severe winters, some birds exceptionally stay until April (e.g. Kuijken et al. 1997). Kuijken (1969) illustrated a clear relationship between the departure of White-fronted Geese and the date when the temperature sum of 200°C is reached, indicating the start of vegetation growth in spring.

Trends and numbers: In the early 1960s, only 2500-3000 Whitefronts occurred, but between the mid 1960s and the mid 1970s numbers reached 6000. In the severe winter of 1978/79, well over 100,000 Whitefronts occurred in lowland Belgium (Kuijken 1979, unpubl.), although peak numbers were otherwise stable at c. 10,000. From the late 1980s until the present, mid winter maxima have ranged between 15,000-30,000 (Kuijken 1975, Meire & Kuijken 1991, Tys et al. 1992).

In recent years, peak numbers of 20,000-35,000 occur mainly in the Oostkustpolders (Meire et al. 1989, Kuijken & Meire 1996, Kuijken et al. 1997). In the other areas, the picture is less regular, depending largely on the weather, food availability and disturbance in the Netherlands, and overflow from the Oostkustpolders. Numbers can reach several hundreds (thousands in cold spells) in the IJzer valley during short periods in mid winter (K. Devos pers. comm.). In the Creeck area between Watervliet and Assenede, an exceptional peak of 20,000 occurred in 1995/96 (De Smet 1997). The lower Schelde polder area hosted some 3000 Whitefronts in early 1996, and 2000 were observed along the border Meuse. Thus total numbers in Flanders for January-February 1996 reached almost 50,000 (Meire & Kuijken 1997).

4D.3 Research

Changes in numbers and the ecology of wintering geese at Flemish goose haunts have been studied by E. Kuijken and others at the University of Gent and the Instituut voor Natuurbehoud for 30 years. Between 1959 and 1975, counts were made twice a week, from 1976-1993 almost weekly, and fortnightly since then. All goose groups are mapped and habitat types are recorded. Observations on the behaviour of geese were made, and dropping densities, feeding behaviour and sward height were recorded before and after goose feeding (e.g. Kuijken 1969, 1975, 1983, Kuijken & Meire 1987, Lievrouw 1985, Meire & Kuijken 1991, Meire et al. 1988a, b, Ysebaert et al. 1988, Tys et al. 1992). In other parts of Belgium, geese are counted as part of the mid-monthly waterbird counts. Kuijken (1975) analysed Whitefront population dynamics (family composition, mortality, recruitment) and found a three year cycle of increase, this was before the discovery of the relationship with the lemming cycle.

4D.4 Protection and conservation

Hunting legislation: A voluntary ban on goose shooting from December onwards was established in 450 ha of goose habitat around Damme in 1960. In the winter of 1968/69, an official goose hunting ban was declared in an area of 3000 ha around Damme, extended to an area of 6230 ha in 1971/72. A national goose shooting ban has been in place since 1981/82 (see map in Kuijken & Meire 1987, Kuijken & Meire 1996).

Site safeguard: Large parts of the Flemish polder area have international importance for geese. Some of the traditional core areas were designated as Special Protection Areas under the EC Birds Directive in 1988 and up to 5% of wintering northwest European Whitefronts occur there. The Zwin Reserve, the IJzer valley and Blankaart Lake, and the brackish tidal marshes of the Lower Schelde have Ramsar status. Through Flemish land use planning instruments, some grassland complexes have Green Area or Nature Reserve status.

However, a number of important sites which have only recently been taken into use by geese have no protection status at all. The new Decree on Nature Conservation in Flanders (1997) will enable further steps for grassland preservation.

Agricultural conflict: Crop damage caused by waterfowl only occurs locally and is of minor importance. When significant damage is proven, tax relief on income from affected fields is allowed, although this is applied only exceptionally.

4E. BOSNIA-HERZEGOVINA

4E.1 Distribution

Range: In northern Bosnia-Herzegovina along the Sava River bordering Croatia, small groups of staging Whitefronts are regularly recorded.

Habitat and feeding ecology: No information.

4E.2 Abundance

Phenology: Large numbers of White-fronted Geese are recorded mainly from late autumn and early winter, especially in severe winters, when birds from eastern Croatia and northern Yugoslavia migrate to the Dalmatian coast in Croatia (Mikuska & Kutuzovic 1982, Philippona 1972).

Trends and numbers: Goose count coverage in Bosnia-Herzegovina has never been good, but was especially poor during the war following the collapse of the former Yugoslavia. Only one record of about 50 Whitefronts exists from the 1980s. (Wetlands International Goose Database unpubl.). Until political problems are resolved, reliable count data cannot be expected from this country.

4E.3 Research

No information.

4E.4 Protection and conservation

Hunting legislation: In the former Yugoslavia, White-fronted Geese had an open season between 1 September and the end of February, except in Slovenia (Lampio 1983). There is no information to suggest that the situation has changed since the formation of new countries on the territory of the former Yugoslavia. There is no information about the size of the annual goose bag.

Site safeguard: No information.

Agricultural conflict: No information.

4F. BULGARIA

4F.1 Distribution

Range: White-fronted Goose haunts are located along the Danube River and the Black Sea coast. Since the late 1970s, the north Black Sea coast Whitefront haunts have become the most important in Bulgaria; the southern Black Sea coast has gained importance for Whitefronts although to a lesser extent, whereas the Danube has lost much of its former importance. Focal points for wintering Whitefronts are the natural Lakes Shabla and Durankulak, the artificial lakes Ovcharitza and Pyasachnik in eastern Bulgaria, the areas around the natural Lake Mandra, the Malko Sharkovo Reservoir in southeastern Bulgaria and the area around Lake Srebarna in the Danube River valley (Grimmett & Jones 1989, Michev et al. 1991).

Habitat and feeding ecology: The Bulgarian lowlands have been largely converted to agricultural land and therefore most Whitefronts feed almost exclusively on arable land, mainly on winter cereals (Grimmett & Jones 1989, Michev et al. 1991).

4F.2 Abundance

Phenology: The first Whitefronts reach Bulgaria in October from Romania. In severe winters, a number of geese normally wintering in Romania move to eastern Bulgaria, resulting in exceptionally high numbers in some years. The winter peak occurs in January and flocks depart by the end of February. Most Whitefronts have left Bulgaria by the end of March (Michev et al. 1991).

Trends and numbers: In the late 1970s, the average number of Whitefronts wintering in Bulgaria was c. 66,000 birds. Since then, the average peak number has increased to about 145,000 birds during the 1980s (not mid winter counts) and seems to have stabilised at 100,000-190,000 in the early 1990s. In severe winters, peak numbers of up to 316,000 Whitefronts have been counted (January 1995). The average mid winter count in January was 50,000 during the 1980s and 187,000 in the 1990s (Michev et al. 1991, Wetlands International Goose Database unpubl.).

4F.3 Research

Since the 1970s, distribution and numbers of wintering Greylag, White-fronted and Red-breasted Geese have been studied for both conservation and wildfowl management purposes (Michev et al. 1991).

4F.4 Protection and conservation

Hunting legislation: The Whitefront is the only goose species which may be hunted in Bulgaria. The annual goose bag in Bulgaria was c. 6800 in the 1960s and c. 14,000 during the 1970s. There was and is considerable hunting pressure, especially in the vicinity of roost sites, which suggests that hunting pressure has not lessened since the 1970s (P. Simeonov pers. comm.). More recent data are not available (Michev et al. 1991, Rutschke 1973, 1978).

Site safeguard: A number of Bulgarian goose haunts have legal protection status. Lakes Srebarna and Durankulak have been listed as Wetlands of International Importance under the Ramsar Convention. Lake Srebarna is also a Biosphere Reserve. Lake Shabla has recently been protected and declared a Ramsar site; hunting is prohibited on the lake. White-fronted Geese also benefit from a protection plan established for Red-breasted Geese whereby land around the lake is rented by certain nature conservation organisations (Grimmett & Jones 1989, Michev et al. 1991).

Agricultural conflict: There is no information on agricultural conflict but experts assume considerable local crop damage caused by geese. Economic change in Bulgaria may trigger major changes in agricultural tenure in years to come and this could result in increased goose damage conflict.

4G. CROATIA

4G.1 Distribution

Range: The most important site for White-fronted Geese in Croatia is Kopacki Rit in the southeast at the junction of the Drava and Danube Rivers. At the centre is Lake Kopac, which is connected with both rivers and several swamps by a number of natural channels. Most parts of the area are natural or semi-natural and little influenced by human activities. The site is flooded every year, most frequently in spring and early summer. Even in dry years, large areas retain their wetland character and numerous channels, oxbows and Lake Kopac remain. In some years, small flocks of Whitefronts are observed passing through the Sava valley and in severe winters some flocks reach the Dalmatian coast, especially Lake Vrana. In winter, when waters freeze and snow covers most Whitefront haunts, they migrate south to Montenegro, Macedonia and Greece (Grimmett & Jones 1989, Mikuska 1982, Mikuska & Kutuzovic 1982).

Habitat and feeding ecology: The geese at Kopacki Rit feed on natural and semi-natural grasslands as well as surrounding arable land (Philippona 1972).

4G.2 Abundance

Phenology: Whitefronts arrive in November and leave in March. They are less abundant in autumn than in spring, reaching peak numbers in March (Mikuska & Kutuzovic 1982).

Trends and numbers: Whitefronts were almost unknown here in the 19th century, becoming more frequent this century. Highest numbers were recorded between the two World Wars, especially on the Great Hungarian Plain. Since then, numbers have decreased and, during the 1970s, spring peak numbers of 10,000-18,000 Whitefronts were recorded. January peak numbers averaged c. 1750 in the 1980s and 320 in the 1990s (Mikuska & Kutuzovic 1982, Wetlands International Goose Database unpubl.).

4G.3 Research

Despite the war in the former Yugoslavia, Croatia has contributed count data more or less regularly to the Wetlands International Goose Database since the middle of the 1980s, although coverage has been incomplete in a number of years.

4G.4 Protection and conservation

Hunting legislation: See section 4E.4 above for information on countries comprising the former Yugoslavia. Hunting pressure is high in Croatia, particularly in the Mediterranean areas. Prior to the war, hunting by tourists - especially from Italy - was considerable, but has now stopped. Legislation concerning the protection and hunting of Anatidae is adequate, but its implementation is poor. This situation is likely to improve now the war has ended. There is no information about the size of the annual goose bag (J. Mikuska & T. Mikuska unpubl.).

Site safeguard: Kopacki Rit was a protected site in the former Yugoslavia: an area of 6234 ha was strictly protected, 10,000 ha comprised a National Park and a further 23,000 ha was proposed as a nature reserve. The site is silting up and is affected by eutrophication and human disturbance from illegal fishing and frog-collecting activities (Grimmett & Jones 1989, Mikuska 1982). It was also a battle field in the recent war which had a major impact on the site. The present ecological and protection situation is unclear.

Agricultural conflict: No information.

4H. CZECH REPUBLIC

4H.1 Distribution

Range: The main goose haunt in the Czech Republic is the Nové Mlyny Reservoir in the Dyje (Thaya) Valley in southern Moravia, near the Austrian border. Bean Geese and Greylag Geese predominate but recently the White-fronted Goose also occurs. The geese roost on the reservoir and disperse over the surrounding arable land to feed (Grimmett & Jones 1989, Hudec & Simec 1994, 1995). Recently, the Velky a Maly Tisy National Nature Reserve in southern Bohemia has become more important as a staging area for Whitefronts.

Habitat and feeding ecology: Geese wintering in the Czech Republic feed mainly on arable land (winter cereals and maize) close to the roost (Hudec & Simec 1994, 1995, Urbanek 1992).

4H.2 Abundance

Phenology: During the mid 1980s, geese used to arrive in the Czech Republic in mid February and depart in early March. Nowadays, Whitefronts can be observed throughout October-April. Highest numbers occur in November and February, indicating the area is a staging as well as wintering area for Whitefronts. Peak counts are in February (Hudec & Simec 1994, 1995, Urbanek 1992).

Trends and numbers: In the 1970s, average peak counts of up to 500 occurred, but during the late 1980s, c. 1800 Whitefronts were counted in the Czech Republic. During the mid winter goose counts an average of c. 500 Whitefronts was recorded in the 1980s, compared with c. 4400 in the 1990s (Hudec & Simec 1994, 1995, Timmerman et al. 1976, Urbanek 1992, Wetlands International Goose Database unpubl.).

4H.3 Research

Goose numbers are regularly monitored as part of the International Waterfowl Census.

4H.4 Protection and conservation

Hunting legislation: In the Czech Republic only *Anser* species are huntable. In the 1980s and 1990s, goose hunting was permitted from 1 September to 15 December on Saturdays only. Under the 1996 Hunting Law, the season now lasts from 1 September to the end of February. Hunting is not limited to specific days, but is only allowed by groups of at least three hunters. Goose hunting is only permitted with pellet shot or birds of prey. In some nature reserves shooting is prohibited, in others only restricted (Urbanek 1992). The annual goose bag in the former Czechoslovakia was c. 1500 in the 1960s and c. 2000 in the 1970s (Rutschke 1973, 1978, Scott 1982). In the 1980s, the annual goose bag in the Czech Republic alone was estimated at c. 1500 geese and showing signs of an increase (Urbanek 1992), which may indicate a general increase in the hunting bag for the territory of former Czechoslovakia.
Site safeguard: The main Czech Whitefront goose haunts are protected, parts of the Nové Mlyny Reservoir, the Vestonice Reservoir and the Lednice Fishponds are nature reserves and the Velky a Maly Tisy National Nature Reserve recently gained importance as a staging area for White-fronted Geese.
Agricultural conflict: Crop damage by waterfowl is locally an important issue in the Czech Republic. The Hunting Law stipulates that the owner has to take measures to avoid damage to his property by game without endangering the health of the game. Where he can prove the damage was unavoidable, compensation will be paid. In practice no compensation for reported damage has been paid to date.

Major changes in the economy and agricultural structure of the Czech Republic, both now and in the near future, will probably increase agricultural conflict as big agricultural collectives are split up and privatised. Increased disturbance to geese and growing numbers of complaints about goose damage will probably ensue (Urbanek 1992).

4I. DENMARK

4I.1 Distribution

Range: In Denmark, small numbers of White-fronted Geese occur on the islands of Fyn, Langeland, Sjælland, Lolland and Falster. The most important is in northern Fyn and supports annually more than half the total number of Whitefronts wintering in Denmark.
Habitat and feeding ecology: White-fronted Geese staging in Denmark mainly feed on artificial grasslands and winter cereals (Madsen 1986).

4I.2 Abundance

Phenology: The first Whitefront flocks reach Denmark in October and most are recorded on Fyn and Lolland. In the 1960s, winter peaks occurred in January, in February in the 1970s and in March in the 1980s (Fig. 5.7). At most Danish sites, Whitefronts only occur in February and March although in some years they depart in April (Fog 1971, 1976, 1977, Jørgensen et al. 1994).
Trends and numbers: Although there are no major Whitefront haunts in Denmark, there is a long tradition of wintering Whitefronts, however, numbers are very variable. The traditional haunt on Fyn supported up to 1000 Whitefronts in the 1950s, decreasing to a maximum of 650 (average: 300-400) in the 1960s and in the 1970s, c. 200. Since the 1980s, the average number on Fyn seems to have stabilised at about 100 birds, whilst total Danish wintering numbers for 1988-94 were c. 180 birds annually. During the mid winter counts, less than 100 Whitefronts were counted in the 1980s and c. 150 in the 1990s (Madsen 1986, Jørgensen et al. 1994, Wetlands International Goose Database unpubl.).

4I.3 Research

In Denmark, there is a long tradition of research on the status, ecology and management of goose populations as well as on goose damage. Because of the small numbers wintering in the country, research on Whitefronts has not had a high priority.

4I.4 Protection and conservation

Hunting legislation: In Denmark, the White-fronted Goose has an open season from 1 September to 31 December. Before 1994, goose hunting could take place between 1½ hours before sunrise and 1½ hours after sunset, since then it is only allowed in the morning until 1000 h. All persons with a valid game licence can shoot geese and in Denmark about 170,000 game licences are issued every year. In the 1960s, the annual bag of Whitefronts was c. 150 and in the early 1990s, 300 (Madsen et al. 1996b).
Site safeguard: Reserves can be established in accordance with the Danish Hunting and Wildlife Management Act and the Danish Nature Protection Act. To date, about 50 reserves have been established in important waterfowl areas, including aproximately 50% of the most important areas for geese (Jepsen & Madsen 1992). The most important Whitefront haunt in Denmark on Fyn (on the Gyldensten Estate) is a Ramsar site as well as an EU Bird Protection Area with a ban on shooting to protect staging White-fronted Geese (Jepsen et al. 1993).
Agricultural conflict: Whitefronts play no role in the goose damage problem in Denmark (Jepsen & Madsen 1992).

4J. FRANCE

4J.1 Distribution

Range: White-fronted Geese mainly occur in northwestern France, mostly in Brittany and Normandy. Traditional haunts are in the coastal area near Mont-Saint-

Michel and Marais du Dol, the mouth of the Vilaine River and Marais de Redon. More recently wintering Whitefronts have been reported from Champagne, east of Paris (Yésou 1991, Philippona 1972).

Habitat and feeding ecology: In coastal haunts, Whitefronts roost on flat areas (e.g. mud flats) and feed mainly on nearby semi-natural, artificial grasslands and arable land. In Champagne, they feed mainly on arable land.

4J.2 Abundance

Phenology: The first Whitefronts arrive in November, increasing until mid January. Most Whitefronts have left by March.

Trends and numbers: Thousands of White-fronted Geese wintered in the early 1950s. Since then, numbers have declined and, by the mid 1960s, the species was only regular near Mont Saint-Michel, although in smaller numbers. During the 1980s, it was an irregular winter visitor there (0-140, average 40 in mid January 1980-1986), but wintering has since become regular in Champagne (30-120, average 80 in mid January) and occasional at other sites. Mid January counts in France during the 1980s have totalled 90-380 Whitefronts (average 220). In severe winters, several thousand Whitefronts have been recorded (e.g. 9500 in February 1979 and 1200 at the end of January 1985). January counts in the 1990s have registered 80-270 (average 154) Whitefronts (Yésou 1991, Wetlands International Goose Database unpubl.).

4J.3 Research

Goose numbers are regularly monitored under the International Waterfowl Census.

4J.4 Protection and conservation

Hunting legislation: All grey geese are huntable and White-fronted Geese have an open season from October to February (Lampio 1983). Although there are no data about total numbers shot each year, ringing recoveries show that when Whitefronts from the Netherlands and Belgium move further south to France in severe winters, large numbers are shot there (Ebbinge 1991).

Site safeguard: White-fronted Goose haunts in France are unprotected.

Agricultural conflict: No information.

4K. GERMANY

4K.1 Distribution

Range: All the important White-fronted Goose haunts in Germany are situated in the states of Brandenburg, Mecklenburg-Vorpommern, Niedersachsen, Nordrhein-Westfalen, Sachsen, Sachsen-Anhalt and Schleswig-Holstein. Most important haunts occur in the valley of the Lower Odra River, the lowlands along the Baltic coast, the Elbe River basin, the mouth of Ems River and the Lower Rhine area. The geese roost on shallow parts and banks of lakes and old river oxbows and disperse by day over the surrounding farmland to feed (Bauer & Glutz von Blotzheim 1968, Gerdes 1994, Gerdes et al. 1978, 1983, Hummel 1976, 1977a, b, 1978, 1980, 1981, 1982, 1983, 1984, Klafs & Stübs 1977, Mooij 1991a, 1993, 1995a, b, 1996a, Mooij & Naacke 1997, Naacke 1971, 1978, 1993, Naacke et al. 1988, Rutschke 1983a, b, 1986, 1987, 1990, Rutschke & Wessel 1987, Wernicke 1993, Wernicke & Naacke 1989).

Habitat and feeding ecology: In Germany, White-fronted Geese feed almost exclusively on agricultural land. In eastern Germany they feed about equally on arable and grassland and in western Germany, about 60-80% on grasslands. Most grasslands used by Whitefronts are improved for dairy farming and on arable land the most important crops are winter cereals (barley and wheat), maize, fodder grass, rape and sugar beet remnants after harvest. The proportion of Whitefronts feeding on arable land increases during cold weather.

4K.2 Abundance

Phenology: During the early 20th century, Whitefronts only migrated through Germany in autumn (September-November) and spring (March-May). Since the 1930s, wintering Whitefronts have been recorded (Niethammer 1938). At present, the first Whitefronts reach eastern Germany in mid September and numbers increase rapidly during October, to peak during November, when the first Whitefronts reach western Germany. Subsequently, numbers decrease in eastern and increase in western Germany, where maximum numbers occur during early January. After this, numbers in western Germany drop, increasing again in eastern Germany, especially in Brandenburg, Sachsen-Anhalt and Sachsen, where numbers peak during February-March, although numbers are lower than in autumn. In late March, most Whitefronts have left western Germany and in early May eastern Germany (Fig. 5.7). In severe winters, all Whitefronts leave eastern Germany and numbers also drop in western Germany.

In the 1970s, hardly any wintered in eastern Germany and the winter peak in western Germany occurred in February. In the 1980s, increasing numbers of Whitefronts wintered in eastern Germany and the winter peak in western Germany occurred progressively earlier and currently occurs in early January.

Trends and numbers: Since the 1930s, increasing numbers of wintering Whitefronts have been reported from northern Germany, mostly in small numbers associated with Bean Geese (Niethammer 1938), and by the early 1960s the first wintering Whitefronts were reported from the Lower Rhine area in western Germany (Möller 1972, Mooij 1996a).

November counts in the 1960s recorded an average of c. 50,000 Whitefronts in Germany. The average number increased from c. 200,000 in the 1970s, to c. 370,000 in the 1980s and stabilised at c. 300,000 in the early 1990s. Since the 1960s, 50-90% of the total number of Whitefronts using the Baltic-North Sea flyway have been recorded in Germany every year in November. This suggests that almost all Whitefronts in the Baltic-North Sea flyway stage in Germany in autumn. The annual count of Whitefronts varies considerably because Whitefronts move in response to weather conditions.

January counts of Whitefronts increased from c. 4000 in the 1960s to c. 9500 in the 1970s, c. 70,000 in the 1980s, and c. 250,000 in the 1990s. Most remain in western Germany but numbers in eastern Germany have increased since 1985 (Bauer & Glutz von Blotzheim 1968, Gerdes 1994, Gerdes et al. 1978, Gerdes & Reepmeyer 1983, Hummel 1976, 1977a, b, 1978, 1980, 1981, 1982, 1983, 1984, Klafs & Stübs 1977, Mooij 1991a, 1993, 1995a, b, 1996a, Mooij & Naacke 1997, Naacke 1971, 1978, 1993, Naacke et al. 1988, Rutschke 1983a, b, 1986, 1987, 1990, Rutschke & Wessel 1987, Wernicke 1993, Wernicke & Naacke 1989, Zentrale für Wasservogelforschung und Feuchtgebietsschutz in Deutschland (ZWFD) Database unpubl.).

4K.3 Research

In Germany, there is a long tradition of research on the status, ecology and management of goose populations as well as on goose damage. Regular goose counts have been carried out since the mid 1960s; until 1989 with two coordination centres, one in the former GDR and one in the former FRG, and since 1989 coordinated by the ZWFD, a voluntary union of the former coordinators for eastern and western Germany. A number of ecological and goose damage studies have been carried out in the Lower Rhine area (Eberhardt 1966, 1971, Ernst 1991, Mildenberger 1971, Mooij 1979, 1982, 1984, 1991, 1993, 1994, 1996a, Mooij & Ernst 1988), in the Dollart region (Gerdes 1994, Gerdes et al. 1978, Gerdes & Reepmeyer 1983) and in the Lower Havel area (Kalbe 1982, Rutschke 1973, 1987, Rutschke & Naake 1995, Rutschke & Schiele 1978/79). Several research programmes concerning goose damage and local goose management are currently running.

4K.4 Protection and conservation

Hunting legislation: In Germany, the White-fronted Goose is a game species, with a maximum hunting season set by Federal Hunting Law from 1 November to 15 January. According to this Law, federal states can shorten or close the hunting season for all game species or extend the hunting season for particular species in specific regions under specific conditions. There is no hunting season for Whitefronts in Baden-Württemberg, Hessen, Niedersachsen, Nordrhein-Westfalen and Rheinland-Pfalz. The annual goose bag has increased considerably, especially in the last five years since the unification of Germany, from c. 6000 in the 1960s to c. 30,000-40,000 in the 1990s. The increase of the annual goose bag is most pronounced in Brandenburg, Mecklenburg-Vorpommern and Sachsen-Anhalt. The Whitefront comprises 50-60% of the annual German goose bag (Mooij 1992, 1995b, 1997).

Site safeguard: A number of important Whitefront haunts are protected. Some are hunting-free zones (in most cases only the roosts), nature reserves, Ramsar sites or national parks. Of the states with the highest Whitefront numbers (Brandenburg, Mecklenburg-Vorpommern and Nordrhein-Westfalen), Whitefronts are afforded greatest protection in Nordrhein-Westfalen (non-huntable species, Ramsar sites and partly nature reserve) (Mooij 1995a, 1996a, Mooij & Naacke 1997).

Agricultural conflict: Crop damage occurs in Brandenburg, Mecklenburg-Vorpommern, Niedersachsen, Nordrhein-Westfalen and Schleswig-Holstein. There is no general concensus about the extent of goose damage in Germany because crop damage by waterfowl is the responsibility of federal states with no central registration. Crop damage by Whitefronts occurs mainly in Brandenburg, Mecklenburg-Vorpommern, Niedersachsen and Nordrhein-Westfalen, but in most areas damage is caused by mixed flocks of Bean and White-fronted Geese. Crop damage is reported from grasslands, cereals, rape and fodder grass. In the late 1980s, waterfowl damage in Germany was estimated to be 2-3 million DM (c. US$ 1.3-1.9 million) per year, of which up to 75% was caused by White-fronted and Bean Geese. In the early 1990s, waterfowl damage was estimated to be 5-6 million DM (c. US$ 3.2-3.9 million) annually. Compensation for reported goose damage or for nature/goose management contracts is paid in Brandenburg, Mecklenburg-Vorpommern, Niedersachsen and Nordrhein-Westfalen, totalling 4-5 million DM (c. US$ 2.6-3.2 million).

There is no federal policy or coordination of measures to regulate or reduce crop damage problems in Germany. Several states have developed solutions to reduce crop damage problems. Measures vary from increased hunting pressure (e.g. Mecklenburg-Vorpommern, Brandenburg, Sachsen-Anhalt), to the use of sacrificial crops (Niedersachsen), to total protection and financial compensation for all reported goose damage (Nordrhein-Westfalen). These differences in approach to goose damage probably influences the distribution of the geese in Germany and it is, therefore, desirable to coordinate regional responses (Mooij 1992, Wille 1995).

4L. GREECE

4L.1 Distribution

Range: Important Whitefront haunts occur in northeastern Greece in Macedonia and Thrace, especially at the mouth of the Axios, Nestos, Kourou and Evros Rivers as well as Lakes Kerkini, Mitrikou, Mikri Prespa and Megali Prespa. The last lake straddles three countries: Albania, Greece and Macedonia (Grimmett & Jones 1989, Handrinos 1991).

Habitat and feeding ecology: White-fronted Geese feed mainly on natural and semi-natural habitats, mainly marshy grasslands. They are facing serious problems posed by destruction of habitats and intense hunting pressure. In the Greek province of Macedonia alone, 40% of inland lakes have been drained and 95% of marshland reclaimed for agriculture in recent decades (Grimmett & Jones 1989). Falling water-levels have opened up the traditional wintering goose feeding sites to grazing cattle, which have degraded the vegetation. Although the geese do feed on these agricultural habitats, continued habitat loss through groundwater loss and increased salinisation of the remaining areas is a problem (Grimmett & Jones 1989, Handrinos 1991).

4L.2 Abundance

Phenology: Significant Whitefront numbers are recorded in Greece from December to February, with peak numbers in January. In severe and early winters in the Balkan region, the geese arrive earlier and stay until March (Bauer & Glutz von Blotzheim 1968, Handrinos 1991).

Trends and numbers: The White-fronted Goose is the most numerous goose species in Greece and, although numbers fluctuate strongly between years, there has been a clear decline in numbers since the 1960s. Maximum numbers fell from c. 15,700 in the 1960s, to 1000 in the 1970s, c. 4000 in the 1980s, and c. 2500 in the early 1990s. In severe winters (1968/69, 1984/85) up to 35,000 White-fronted Geese have been recorded. The White-fronted Goose remains the most numerous goose species in Greece. January counts recorded an average of c. 290 Whitefronts in the 1980s, increasing to c. 2500 in the 1990s (Handrinos 1991, Johnson & Hafner 1970, Wetlands International Goose Database unpubl.).

4L.3 Research

Goose numbers are regularly monitored under the International Waterfowl Census.

4L.4 Protection and conservation

Hunting legislation: In Greece, Whitefronts suffer intense shooting pressure during the open season from 15 August to 10 February. There are no data about the size of the annual goose bag, but hunting results in a considerable annual kill. However, hunting disturbance may be an even more serious factor affecting numbers (Handrinos 1991).

Site safeguard: Most Whitefront haunts are at least partly protected as Ramsar sites. In Nestos, there are two non-hunting zones, but on other sites waterfowl hunting is allowed. The geese disperse during the day, due to heavy shooting pressure and human disturbance. In spite of Ramsar status, most haunts suffer from drainage which affects groundwater levels and salinity (Handrinos 1991).

Agricultural conflict: No information.

4M. HUNGARY

4M.1 Distribution

Range: The White-fronted Goose is confined to the Great Hungarian Plain in eastern Hungary. Thirteen Whitefront sites meet the criteria for international importance when related to Whitefront numbers wintering in central Europe (in numerical order): Hortobágy, Lake Fehér at Kardoskút, Fishponds at Biharugra-Begécs, Kiskunság salt lakes, Lake Fehér at Szeged, Lake Velence-Dinnyés marshland, Balaton East, Fertö-tó, Fishponds at Soponya, River Tisza II (Reservoir at Kisköre), River Danube at Gemenc, River Danube (BédaKarapancsa), Lake Csaj at Tömörkény.

Habitat and feeding ecology: The most important Whitefront haunts in Hungary are salt lakes and fresh water habitats (lakes, fishponds, banks of rivers). During the day they feed mainly on natural and artificial grasslands and pastures but also on arable land; mainly maize, sunflower and sugar beet stubble, winter cereals and rape in autumn and winter, and rape, winter cereals and sometimes alfalfa in spring (Faragó 1994).

Based on analysis of Whitefront stomach contents sampled between 1952 and 1976, the species fed mainly on maize seed, *Festuca pseudovina* leaves, and leaves and grains of winter wheat and rice (Sterbetz 1979a). Since then, agriculture has shifted to increasing large-scale production of monocultural crops (Sterbetz 1979b) and reanalysis in the early 1990s, showed food selection was somewhat more restricted (Faragó 1994). Maize was the commonest food, followed by the leaves of winter wheat and wheat and barley grains. Rape and Gramineae leaves were also eaten. The industrial production of maize feed for animal husbandry provides a rich, high energy food for geese. Following privatisation in Hungary, food availability has again changed.

4M.2 Abundance

Phenology: Between 1972 and 1982, the first Whitefronts reached Hungary in October and peak numbers were recorded in November, followed by a steady decrease until the last geese left in March (Fig. 5.7, Sterbetz 1983 in Faragó 1995). Nowadays, highest numbers are recorded during spring staging: first individuals arrive in October, the autumn peak is usually in November but there is a higher spring peak in February or March (Fig. 5.7). In winter, Whitefronts disappear from many wetlands and in severe winters most birds leave southward. Whitefronts use two separate migration routes through Hungary, one through the western and one through the eastern part of the country. In autumn geese arrive from either the north-northwest or the northeast then migrate south in winter. In spring, more birds use the eastern route than the western one (Faragó 1995).

Trends and numbers: Goose numbers were high in Hungary during the late 19th and early 20th centuries. Until the 1950s, peak numbers of more than 500,000 Whitefronts on Hungarian sites were not unusual. Since then, numbers have declined (Bauer & Glutz von

Blotzheim 1968, Philippona 1972). Between 1972 and 1982, average numbers of Whitefronts were c. 88,000 in November, c. 21,000 in January and c. 17,000 in February (Sterbetz 1983 in Faragó 1995). During 1984/85-1990/91, average Whitefront numbers were 32,600 in November, 11,800 in January and 11,900 in February. During 1991/92-1994/95 average numbers were c. 47,000 in November, c. 46,000 in January and c. 85,000 in February. In some years exceptional numbers were recorded: c. 57,000 in November 1986, c. 71,400 in November 1994 and c. 165,800 in February 1992 (Faragó 1995, Faragó et al. 1991). In severe winters, numbers are as low as 1000-3000, whereas in mild winter 21,000-38,000 birds were counted.

Based on monthly counts in Transdanubia on the Great Hungarian Plain, large decreases in Whitefront numbers occurred until winter 1989/90, when only about 15,000 were recorded in November, less than 5000 in January and about 7000 in February. Since then, Whitefront numbers have increased again, although their phenology has changed considerably, with the highest numbers recorded in February instead of November as formerly. The changes in migration patterns and use of wintering areas that have occurred throughout Europe are reflected in Hungary, since some of the Whitefronts that formerly wintered in the Pannonic region have shifted to other wintering sites.

The increase in Whitefront numbers in Hungary in recent years could indicate further changes in migratory patterns. In March 1992, the numbers of White-fronted Geese migrating through eastern Hungary were much higher than in several previous years, and this pattern has continued in subsequent years.

4M.3 Research

Since 1984, goose research has been coordinated by the Department of Wildlife Management at Sopron University under which the Hungarian Waterfowl Research Group organises goose monitoring at 24 sites in the country, including ecological study of wintering behaviour, habitat use, feeding and hunting of the White-fronted Goose.

4M.4 Protection and conservation

Hunting legislation: During 1970-1982 White-fronted Geese were huntable in Hungary between 1 October and 15 January. Since 1988, the open season for White-fronted Geese was prolongued to 31 January. The average annual goose bag in Hungary was c. 7500 geese in the late 1960s (Rutschke 1973), c. 5000 geese in the 1970s and c. 7300 geese during the 1980s (Farago 1992, 1995). The present hunting pressure appears to be acceptable and would not cause problems if shooting took place on the feeding areas or as geese fly from roosts. However, in most cases, hunters shoot geese at or near to roosts causing heavy disturbance. This is incompatible with wise wildlife management and it has become necessary to revise the laws that regulate hunting. To this end, the Hungarian Waterfowl Management Plan was established in 1993. A key focus of this plan is the strict regulation of waterfowl hunting (Faragó 1995). The Ministry of Agriculture, which is responsible for wildlife management, acted on the recommendations of the Plan by restricting the hunting of White-fronted Geese to the use of shotguns and only flying birds can be shot. The use of electro-acoustic devices (e.g. tape-recorders) to attract birds is banned and shooting at night is prohibited. Shooting may begin one hour before sunrise and must not continue beyond one hour after sunset. Shooting from powered boats is prohibited. Prolongation of the open season is also possible. Land-owners and game managers can apply for a permit from the County Office of Agriculture under which a hunter may shoot up to four geese per day. This should reduce the tendency for hunters to try to achieve record size bags. Hunting of geese and other waterfowl is banned at important winter roosts and sites along migration routes, including all Ramsar sites. Hunting is banned at the following sites: Fertö-tó (Neusiedler See), Lake Balaton, Kisbalaton, Lake Öreg-tó at Tata, Lake Velence and Dinnyés Fertõ, Fishponds at Rétszilas, Kiskunság salt lakes, Lake Csaj-tó at Tömörkény, Lake Fehér-tó at Szeged, Büdös-szék, Hortobágy (all Ramsar sites), Lake Fehér-tó at Kardoskút.

Site safeguard: Part of the Whitefront haunts at Hortobágy, Kiskunság salt lakes, Lake Fehér at Szeged, Lake Velence-Dinnyés marshland, Balaton East, Fertö-tó, Lake Csaj at Tömörkény are Ramsar sites with hunting free zones.

Agricultural conflict: Crop damage caused by waterfowl occurs in Hungary, but until the early 1990s this did not result in conflict. Since privatisation of agriculture, it is likely that in the future private farmers will feel the damage more acutely and crop damage problems may become an issue.

4N. ITALY

4N.1 Distribution

Range: Italy lies on the southwestern border of the wintering range of the White-fronted Goose. In the past, Italy had high numbers of wintering geese and historical sources indicate that the most important haunts were in the south of the country. Since the middle of this century the geese shifted to the north and since the 1970s the most important Whitefront haunts are situated along the coast of the upper Adriatic Sea, in the Po River Delta and the surrounding area (Boldreghini & Montanari 1991, Perco 1991).

Habitat and feeding ecology: The main roosts are lakes and lagoons along the Adriatic coast. The main feeding areas are winter wheat and barley fields, available from late November and sometimes later. At present there are no grasslands in the area suitable for goose feeding, except on the edges of canals. The wetlands (c. 100,000 ha within four lagoons and the Po Delta), have *Scirpus* grasslands which seem to be underused by geese, due to high disturbance levels. If the disturbance level is high, the geese may forage during the night and rest in protected areas during the day. In years with high goose numbers, flocks often feed far from the coast and the wetlands on surrounding arable land. Usually the Whitefronts are found in mixed groups with Bean Geese (Boldreghini & Montanari 1991, Perco 1991).

4N.2 Abundance

Phenology: The White-fronted Goose can be observed in Italy between December and March. Most birds arrive during the first half of January and peak numbers are usually counted between mid January and mid February. By early March, most Whitefronts have left Italy (Boldreghini & Montanari 1991, Perco 1991).

Trends and numbers: Prior to 1955, the important Whitefront haunt near Manfredonia in southern Italy held 40,000-50,000 geese, mainly Whitefronts. Since then, numbers decreased rapidly and during the 1970s between 500 and 2500 Whitefronts were counted here. In the 1980s this site was deserted and the main Whitefront haunts have shifted to northeastern Italy, where the average peak number was about 3500. During the 1980s and 1990s, the average number of Whitefronts counted there in January was 150-175 (Boldreghini & Montanari 1991, Perco 1991, Philippona 1972, Timmerman et al. 1976, Wetlands International Goose Database unpubl.).

4N.3 Research

Goose numbers are regularly monitored under the International Waterfowl Census.

4N.4 Protection and conservation

Hunting legislation: In Italy, goose shooting is prohibited, yet shooting is the most serious factor influencing goose distribution, with geese concentrating in the few hunting-free sites. A shooting ban has little or no effect when hunting of other species is still allowed on the same site. The disturbance caused by hunting makes large areas unsuitable for goose feeding and staging and forces the geese to leave the wetlands to feed on the nearby arable land (Boldreghini & Montanari 1991, Perco 1991).

Site safeguard: Most of the Italian Whitefront haunts are protected and some of them are Ramsar sites. At some sites, the disturbance level from human activities is high, e.g. hunting of other species.

Agricultural conflict: No information.

4O. MACEDONIA

4O.1 Distribution

Range: The only significant haunt for White-fronted Geese in Macedonia is situated around the Prespansko Jezero (Lake Prespa) in the southwestern part of the country. This very large inland lake is surrounded by mountains and divided between three countries: Albania, Greece and Macedonia (Grimmett & Jones 1989, Mikuska & Kutuzovic 1982).

Habitat and feeding ecology: Prespansko Jezero is a large inland freshwater lake surrounded by mountains and agricultural land. The geese feed on natural, semi-natural and agricultural land (Grimmett & Jones 1989).

4O.2 Abundance

Phenology: Whitefronts are recorded in Macedonia from December until February, with peak numbers in winter. In severe and early winters in the Balkan region the geese arrive earlier (Bauer & Glutz von Blotzheim 1968).

Trends and numbers: There were hardly any records of White-fronted Geese from the former Yugoslavia last century. Since then, records have increased with maximum numbers between the two World Wars. Although numbers in Macedonia fluctuated widely between years as a result of weather conditions, there is some evidence of a decline in numbers since the 1950s, but there are no recent data (Makatsch 1950, Philippona 1972).

4O.3 Research

No information.

4O.4 Protection and conservation

Hunting legislation: In the former Yugoslavia, White-fronted Geese had an open season between 1 September and the end of February, except in Slovenia (Lampio 1983). There is no information that the situation changed after Macedonia became independant, nor about the size of the annual goose bag.

Site safeguard: There are no protected Whitefront haunts in Macedonia.

Agricultural conflict: No information.

4P. THE NETHERLANDS

4P.1 Distribution

Range: In the 1960s and 1970s, the distribution of White-fronted Geese in the Netherlands was dominated by the northern province of Friesland, the reclaimed polders in Flevoland and the northwestern part of the province Overijssel (Lebret et al. 1976). As a result of the increase in goose numbers wintering in the Netherlands, White-fronted Geese are now widespread throughout the low-lying parts of the country in autumn and winter. Some main haunts are still in Friesland, Flevoland (Noordoostpolder) and Overijssel but, in past decades, especially the main river district along the rivers IJssel, Nederrijn and Waal, and the southern part of the delta in the province of Zeeland have become important. Recently, smaller numbers have also been observed in the province of Noord-Holland, in the northwest (for a review see Koffijberg et al. 1997). During severe winters, many of the staging areas situated in the north (e.g.. Friesland) are almost abandoned, whereas numbers sharply increased in the main river district and the southwestern part of the country (e.g.

Lok et al. 1992). Large numbers may also leave the Netherlands for Flanders in Belgium.

Habitat and feeding ecology: White-fronted Geese feed almost exclusively on agricultural land, mainly artificial grasslands where about 80% feed. Most are improved grasslands for dairy farming. On arable land the most important crops are winter cereals (barley and wheat), maize, fodder grass, rape and sugar beet remnants after harvest. In the first half of the winter, the proportion of Whitefronts feeding on arable land is higher than in the second half. In November-December, the main food resource on arable land is the remains of sugar beet and rape seed after the harvest, whereas in mid winter and early spring, Whitefronts shift to winter cereals (Koffijberg et al. 1997, van Oostenbrugge et al. 1992, Osieck & de Vries 1987).

4P.2 Abundance

Phenology: First Whitefronts usually reach the Netherlands in October and steadily increase to a winter peak in January. As spring migration in normal winters starts in February, especially the second half of the month, numbers counted in mid February are slightly lower compared to January. By the end of March, most Whitefronts have left the country (Fig. 5.7). In severe winters, spring migration starts as late as March and last flocks leave early in April. During the mid 1960s, the winter peak in the Netherlands was usually in February but this shifted to January during the 1970s, although in most winters February numbers were only a little lower than those in January. Recently there has been a tendency for large numbers of Whitefronts to arrive in November (e.g. 300,000 in November 1996) (Anon. 1990, Ebbinge et al. 1987, Koffijberg et al. 1997, Lebret et al. 1976, Mooij 1991a, Philippona 1972, SOVON Ganzen- en Zwanenwerkgroep 1995).

Trends and numbers: The Netherlands is a traditional winter haunt for White-fronted Geese although former numbers were considerably lower than today (Bos 1889, Brouwer 1943, 1953, Schlegel 1877). In the 1950s, an average peak number of 40,000 Whitefronts was recorded compared to an average maximum of 55,000 in the 1960s. Average peak numbers reached c. 150,000 in the 1970s, c. 350,000 in the 1980s and c. 450,000 in the 1990s (winter peak during January count). Since winter 1989/90, Whitefront numbers in the Netherlands have been more or less stable.

Since the 1950s, 70-85% of the estimated numbers on the Baltic-North Sea flyway and 40-50% of the entire Western Palearctic population have been recorded in the Netherlands every winter, indicating that the Netherlands is the most important Whitefront winter haunt in western Europe and has a key role to play in the protection of Western Palearctic Whitefronts (Anon. 1990, Ebbinge et al. 1987, Koffijberg et al. 1997, Lebret et al. 1976, Mooij 1991a, Philippona 1972, SOVON Ganzen- en Zwanenwerkgroep 1995, Wetlands International Goose Database unpubl.).

4P.3 Research

There is a long tradition of research on the status, ecology and management of wintering geese in the Netherlands. Since the 1950s, almost 20,000 White-fronted Geese have been caught and ringed in the study of migration patterns (Ebbinge 1991, Mooij et al. 1996) and several research programmes on goose feeding and damage were started (Ebbinge & Boudewijn 1984, Ebbinge et al. 1975, De Jong & Smook 1981, Drent et al. 1978/79, Groot Bruinderink 1987, 1989, Teunissen 1996, van Dobben 1953, van Eerden 1990). Reliable census data are available from the mid 1960s; at present, monthly censuses are carried out from October to March.

4P.4 Protection and conservation

Hunting legislation: In the Netherlands, all waterfowl species are protected, but some species can be shot by persons with valid game licences. Whitefronts have an open season between 1 September and 31 January, between half an hour before sunrise and 1000 h. In a number of nature reserves owned by the state or nature conservation organisations, shooting is prohibited or restricted. The annual goose bag in the Netherlands has increased from c. 7000 in the 1960s and c. 10,000 in the 1970s, to at least 35,000-50,000 in the 1980s and 60,000-70,000 in the 1990s. It is estimated that during the late 1970s about 60% were Whitefronts. This proportion increased to c. 70% in the 1980s and reached c. 80% in the early 1990s (Anon. 1990, Doude van Troostwijk 1966, Ebbinge 1991, Mooij 1995b, 1996a, van Oostenbrugge et al. 1992, Wiese 1988-1995).

Site safeguard: Most roosts are protected and on most, shooting is prohibited by either the owner or the Government. Most Whitefronts feed in unprotected agricultural areas. A small number of feeding areas are protected as reserves, although there is no special protection programme for White-fronted Geese.

Agricultural conflict: Crop damage caused by waterfowl is an important issue in the Netherlands. Compensation for crop damage caused by swans, geese and ducks is paid every year to an annual average of more than 2 million Hfl. (c. US$ 1.2 million) since the mid 1980s.

Goose damage to crops is mainly reported from artificial grasslands, winter cereals and grass seed. Since 1977, an average of c. Hfl. 825,000 (c. US$ 480,000) on grasslands and c. Hfl. 461,000 (c. US$ 270,000) on arable land was paid every year as compensation for reported goose damage. An estimated 40% of grassland damage and 18% of the damage on arable land is caused by White-fronted Geese.

In 1991, a goose policy for the Netherlands was accepted by Parliament (Anon. 1990). The policy is aimed at preferably accommodating geese on natural areas and land where less vulnerable crops are grown, through the encouragement of coordinated and planned activities for scaring geese from damage-sensitive land (e.g. newly sown arable crops and, in late spring, pastures) to less damage-sensitive land (such as pastures, green crops, natural areas and contract areas for grassland conservation). Damage caused by migratory geese is, in principle, fully compensated. Game licencees will have to contribute 25 Hfl. each towards financing the policy, providing about one third of the budget needed to compensate for the waterfowl damage reported annually. The other two thirds comes from the Government (Anon. 1990, van Oostenbrugge et al. 1992).

4Q. POLAND

4Q.1 Distribution

Range: White-fronted Geese migrate through the entire northern lowlands in autumn and spring. In autumn they pass fairly rapidly through eastern Poland and the main concentrations occur in northwest Poland, especially in the Szczecin and Elblag Provinces. The main roosts are the Slonsk Reserve, the Lower Odra Valley between Kostryn and Cedynia, and near Gryfino and Lake Miedwie. In mild winters, small numbers remain in the west during December and January but in severe winters, numbers are very low. The main winter haunts are situated in the Lower Odra River Valley. In spring, Whitefronts gather in the flooded areas of the Lower Odra Valley and the Slonsk Reserve, later shifting to eastern Poland in Bialystok and Lomza Provinces along the borders with the Russian Federation, Lithuania and Belarus. The main haunts in eastern Poland are the valleys of the central Narew and lower Biebrza Rivers as well as parts of the Baltic coast, especially the Vistula Bay and Lake Druzno (Engel 1991).

Habitat and feeding ecology: White-fronted Geese roost in natural and semi-natural areas and most disperse over the surrounding arable land to feed by day. They feed on natural and artificial grasslands as well as on arable land (particularly cereals), which is the most important feeding habitat for Whitefronts in Poland (Wieloch 1992).

4Q.2 Abundance

Phenology: The first Whitefront flocks arrive in September and migration occurs until late November. Peak numbers occur in October. Numbers drop until February, almost all Whitefronts leave in severe winters. Spring migration starts in March, peaking in late March or early April at up to 60% of the autumn peak. Most Whitefronts have left Poland by late April (Engel 1991, Wieloch 1992).

Trends and numbers: Whitefront trends in Poland reflect those in the Baltic-North Sea flyway as a whole. Since the late 1970s, numbers wintering in Poland have increased and have numbered 15,000 birds, although numbers vary considerably between years as a result of weather conditions. During the 1990s, January numbers varied between 400 and 8500 (Dmowski 1996, Engel 1991, Wetlands International Goose Database unpubl.).

4Q.3 Research

Regionally there are good goose count data but national count networks remained incomplete until the late 1980s. Since the early 1990s, national waterfowl census coverage has greatly improved and Poland delivers regular count data to the Wetlands International Goose Database (Engel 1991, Wetlands International Goose Database unpubl.).

4Q.4 Protection and conservation

Hunting legislation: All goose species are protected under Polish law, but may be hunted by licensed hunters. The level of biological knowledge of hunters in Poland is generally very low. The number of game licencees has increased three-fold during recent years. The goose hunting season is between 15 August and 15 February. The annual goose bag in Poland was estimated at c. 6300 in the 1960s, c. 12,000 in the 1970s and c. 12,600 in the 1980s (Dmowski 1996, Landry 1990, Wieloch 1992, Rutschke 1973).

Site safeguard: Some White-fronted Goose roosts are protected (e.g. large parts of the Lower Odra Valley and Biebrza Valley as well as the Slonsk Reserve) and at protected sites, shooting is prohibited or restricted (Engel 1991, Grimmett & Jones 1989, Wieloch 1992).

Agricultural conflict: There is a crop damage problem in Poland but it seems to have assumed only marginal importance until now. Farmers receive no compensation for damage caused by waterfowl and, for this reason, there is no assessment of crop damage and the conflict is not recognised by government. The Polish Government has no policy on the subject. The recent changes in the economic and political situation will influence this issue, as private and state owners have increasingly to compete in the free market (Wieloch 1992).

4R. ROMANIA

4R.1 Distribution

Range: White-fronted Geese are regular, common migrants and winter visitors to Romania. In autumn and spring, the species passes in large numbers through the eastern part of the country, between the Carpathians and the Black Sea. Most migrants are recorded in Dobrodja, especially in the lagoon complex Razelm-Sinoe. Roost sites are also found on the lakes of the eastern part of the Romanian Plain and on the lakes and wetlands along the Danube. Considerably smaller numbers of Whitefronts migrate over western Romania along the Hungarian border, which is in fact the eastern border of the migratory route through the Great Hungarian or Pannonian Plain in Hungary to the Danube and Tisa valleys in Croatia and Yugoslavia. In northern Romania, low numbers of Whitefronts migrate in autumn in an east-west direction from Moldavia to the Pannonian Plain. Earlier this century, there was also a Whitefront migration in a north-south direction in the vicinity of Sibiu, central Romania, but in the last three decades hardly any migrating geese have been recorded in this region.

In normal winters, large numbers of Whitefronts remain in Dobrodja and a few also in the Romanian part of the Pannonian Plain and in the Danube valley (Klemm & Kohl 1988, D. Munteanu pers. obs., Munteanu et al. 1991, Salmen 1980).

Habitat and feeding ecology: In Romania, Whitefronts feed on natural and artificial grasslands as well as on arable land (mainly winter wheat, barley and maize). At night they roost on lakes, old river oxbows and lagoons and a significant proportion of the geese disperse over the surrounding or more distant arable land to feed by day (Munteanu 1992).

4R.2 Abundance

Phenology: In eastern Romania, autumn passage begins in the second half of September (usually in October) and can last until mid November in severe winters and until the end of December in mild winters. Peak numbers are recorded in October. In western Romania, the main autumn passage occurs between mid October and mid November. Spring passage in both areas occurs between late February and mid May, with peak numbers in late March (western) and mid March (eastern Romania). The number of Whitefronts passing in spring is rather small compared to autumn numbers although the proportion of spring migrants in western Romania is higher than in the eastern part of the country (Klemm & Kohl 1988, Munteanu et al. 1991, Salmen 1980).

Trends and numbers: According to Niethammer (1938), considerable concentrations of Whitefronts have been reported from central and southeastern Europe since the beginning of the 20th century. During the 1960s, variable numbers of Whitefronts (20,000-100,000) were counted in different years, with 500,000 in November-December 1968 (Bauer & Glutz von Blotzheim 1968, Johnson & Hafner 1970, Klemm & Kohl 1988, Munteanu et al. 1991, Philippona 1972). During the 1980s, an average of 80,000-150,000 Whitefronts occurred in Dobrodja during the peak of autumn migration. Numbers migrating through the Romanian part of the Pannonian Plain have decreased in recent decades and nowadays Whitefront numbers never exceed 2000 birds. January numbers vary considerably between years because most leave Romania in severe winters with low temperatures and heavy snowfall. In the 1980s, 20,000-364,000 (average c. 100,000) wintering Whitefronts were counted during the January counts in Romania. During the 1990s, January numbers varied between 50,000 and 220,000 (average c. 110,000). Because count coverage in Dobrodja is good compared to that in the rest of the country, the actual number of wintering Whitefronts in Romania may be higher. At present no clear trend is recognisable (Munteanu 1992, Munteanu et al. 1992, Wetlands International Goose Database unpubl.).

4R.3 Research

Since the late 1980s, regular goose counts have been made in Romania and, since the beginning of the 1990s, the coverage of the national waterfowl census has improved, although only in Dobrodja has census coverage been regular (Munteanu et al. 1991, Wetlands International Goose Database unpubl.).

4R.4 Protection and conservation

Hunting legislation: All goose species are huntable in Romania. All hunters have to participate in a preliminary year of practice in a hunting team, then pass an examination and pay an annual fee for a game licence. The hunting season is from 15 August to 15 March and goose hunting is allowed throughout the day from before sunrise to after dusk, but is forbidden at night. Every hunter is obliged to hunt only in the territory of his team, to have a permit for each hunting day, for hunting in other territories, to hunt with two or more colleagues and to report the bag. During the late 1960s, the annual goose bag in Romania was estimated at c. 5000 geese, more than 50% of which were Whitefronts. During the 1970s, Scott (1982) estimated the Romanian goose bag at c. 3000. Although there is no information in recent years, there are no indications that hunting pressure has increased (Munteanu 1992).

Site safeguard: The main Whitefront roosts in Dobrodja are within the Danube Delta Biosphere Reserve in strictly protected areas, where hunting is prohibited. However, the geese are hunted when they leave the protected sites in the morning for feeding on the adjacent agricultural land. Flocks roosting on large lakes are afforded protection by the sheer size of these lakes.

Agricultural conflict: On a local level there are conflicts with agriculture in Romania, but no data exist relating to the extent of crop damage. Inside the Danube Delta and along the lagoon complex, up to 200 ha of agricultural crops have been affected by goose grazing. On recently created agricultural land within the Danube Delta, increasing goose grazing pressure has been noted. The main crop reported damaged by goose grazing is winter wheat; this is grazed at an early growth stage which causes decreased plant density and yield loss. In Romania, there is no compensation paid for goose damage and no measures have been taken to date. In some areas hunting causes local movements of the geese, which often prevents over-grazing (Munteanu 1992).

4S. SLOVAKIA

4S.1 Distribution

Range: The main White-fronted Goose haunt is situated on the flood plains of the Danube between Bratislava and Chlaba close to the Hungarian border. The site is characterised by fragments of floodplain forests, marshes, numerous backwaters and islands, natural and artificial grasslands as well as intensively used agricultural land. In recent decades, these have been affected by major agricultural development and water management projects, which have had a major impact on the ecological character of the area (Grimmett & Jones 1989).

Habitat and feeding ecology: White-fronted Geese roost in natural and semi-natural areas (islands and old river oxbows) and feed on surrounding grasslands and agricultural land. In most cases they are associated with Bean Geese which predominate at this site (Hudec & Simec 1994, Philippona 1972).

4S.2 Abundance

Phenology: The Austrian, Czech, Slovakian and northwestern Hungarian Whitefront sites have to be treated as a unit because of the proximity of sites and high degree of exchange of individuals. White-fronted Geese occur in these countries between October and April. Highest numbers are counted in November and December (Hudec & Simec 1994, Philippona 1972).

Trends and numbers: During the 1960s, 10,000 Whitefronts occurred in Slovakia in autumn and 4000 in January. In the 1970s, an estimated 500-2500 wintered there. Maximum numbers of geese were estimated at 10,000-20,000 in the 1980s and up to 40,000 during the 1990s (predominantly Bean Geese). The increase seems mainly a result of increased numbers of Bean Geese, which have increased considerably throughout the former Czechoslovakia. During January counts in the 1980s and 1990s, few Whitefronts were reported from Slovakia (Hudec & Simec 1994, Grimmett & Jones 1989, Philippona 1972, Timmerman et al. 1976, Wetlands International Goose Database unpubl.).

4S.3 Research

Since the early 1990s, the coverage of the national waterfowl census has improved and Slovakia delivers regular count data to the Wetlands International Goose Database.

4S.4 Protection and conservation

Hunting legislation: In the former Czechoslovakia, the White-fronted Goose was a huntable species with an open season between 1 October and 31 December. During the 1960s and 1970s, the annual hunting bag for the former Czechoslovakia was estimated at c. 1500-2000 geese (Lampio 1983, Rutschke 1973, 1978). It is not known how many of these were shot in Slovakia and there is no recent information about the goose bag in Slovakia.

Site safeguard: In the 1980s, the Slovakian Whitefront haunt in the Danube valley was unprotected, but was proposed as a Protected Landscape Area after completion of the Danube Water Protection Scheme, which involves the construction of a large reservoir and canal between Bratislava and Gabcikovo. The reconstruction of this formerly semi-natural part of the Danube, which will have a major impact on the ecological character of the site (Grimmett & Jones 1989), is not yet completed and there is no recent information about the present ecological and protection situation.

Agricultural conflict: No information.

4T. SLOVENIA

4T.1 Distribution

Range: The only important Slovenian haunt for White-fronted Geese is the Ormoz Reservoir in the Drava River valley, close to the Croatian border. Here, the Drava River opens out into a wide flood plain, dominated by open wet grasslands regularly inundated by flooding. The area is characterised by the meandering river, backwaters and large sandbanks, flanked by wet grasslands, marshes, groves and copses. Land use includes agriculture, forestry, gravel extraction, hunting, fishing and hydro-electric power generation (Grimmett & Jones 1989, Vogrin 1996).

Habitat and feeding ecology: White-fronted Geese roost on the reservoir and feed on the surrounding wet grasslands.

4T.2 Abundance

Phenology: White-fronted Geese occur between November and February.

Trends and numbers: Peak numbers can reach 1500 birds, but during the January counts an annual average of 80 birds was recorded here during the 1990s (Wetlands International Goose Database unpubl.).

4T.3 Research

Since the early 1990s, the coverage of the national waterfowl census has improved and Slovenia delivers regular count data to the Wetlands International Goose Database (Vogrin 1996, Wetlands International Goose Database unpubl.).

4T.4 Protection and conservation

Hunting legislation: In the former Yugoslavia, White-fronted Geese had no open season in Slovenia. Since Slovenian independence the situation has not changed (Varicak, Slovenian Hunting Organisation pers. comm.).

Site safeguard: There have been great changes to the Drava River during the last 30 years. Hydro-electric dams now regulate the flow of the river, many of the floodland areas have been drained and 70% of the alluvial forest has been lost. The changes to currents and flooding patterns have had a great influence on the river wetlands, and intensive agriculture continues to claim land in the valley. At present, the river section from Maribor to Ptuj is protected as a Landscape Park, and the section between Maribou and Ormoz is listed as an Important Bird Area. The area is the most important waterfowl wintering area in Slovenia and qualifies for Ramsar site status for a number of waterfowl species. However, in recognition of its international importance, control of hunting and other tourist activities and a halt to further changes to the hydrological control of the river system and agricultural use remain important objectives for its adequate conservation in the future (Vogrin 1996).

Agricultural conflict: No information. Because of the increase in intensive farming in the Drava valley, conflict may be expected in the future.

4U. SWEDEN

4U.1 Distribution

Range: The most important sites for White-fronted Geese in Sweden are located in the lowlands of southwest Scania (Skåne), the southernmost province of the country. The area is characterised by a mosaic of agricultural land, forests and numerous small and large lakes (Andersson & Nilsson 1994, Nilsson 1984, 1991, 1993, Nilsson & Persson 1989).

Habitat and feeding ecology: The Swedish Whitefronts utilise an agricultural area characterised by large fields. The main crops are cereals (wheat and rye), rape and sugar beet. Around several lakes and along the coast at Foteviken there are large areas of permanent grassland. Within the daily-flight range of suitable feeding areas there are a number of small and medium-sized lakes that are suitable as roosting sites for geese. The sea along the west coast is shallow, and the coast south of Malmö as well as some bays further north in the Öresund offer protected roosting sites. White-fronted Geese usually form local concentrations, but in some areas the species is also found in small numbers associated with Bean Geese. In Sweden, White-fronted Geese mainly feed on autumn-sown cereals and grasslands, with cereals prevailing except in March, when the vast majority of the Whitefronts are found on permanent grassland (Nilsson & Persson 1989).

4U.2 Abundance

Phenology: White-fronted Geese remain in Sweden between early October and the end of March. Peak numbers are counted in October or November (Fig. 5.7, Andersson & Nilsson 1994, Nilsson 1984, 1991, 1993, Nilsson & Persson 1989).

Trends and numbers: In the 1950s and early 1960s, White-fronted Geese were rare in Sweden. Since then, numbers have increased considerably in parallel with the increase along the Baltic-North Sea flyway of the species. During the late 1970s and in the 1980s, the peak number in autumn was c. 2000 birds and during the January counts an average of c. 550 Whitefronts were recorded. In the 1990s the peak number in autumn was c. 5000, with 2650 counted in January. Since the 1980s, Whitefront numbers seem to have stabilised (Andersson & Nilsson 1994, Markgren 1963, Mathiasson 1963, Nilsson 1984, 1991, 1993, Nilsson & Persson 1989, Philippona 1972).

4U.3 Research

In Sweden there is a long tradition of research on the ecology and population development of geese (e.g. Andersson & Nilsson 1994, Markgren 1963, Mathiasson 1963, Nilsson 1984, 1991, 1993, Persson 1989). Since the 1960s, Sweden has delivered regular count data to the Wetlands International Goose Database.

4U.4 Protection and conservation

Hunting legislation: All birds and mammals are protected in Sweden by the Game Act. There is no open season for White-fronted Geese. Hunting is usually forbidden in nature reserves, but is permitted at some of the sites important for geese. Only a few goose feeding sites are hunting-free.

Site safeguard: Some goose roosts are nature reserves and Ramsar sites (e.g. Bay of Foteviken, Lake Krankesjön), others have national protection status. Most feeding sites are unprotected. Hunting is normally forbidden in nature reserves, but in some of the important sites for geese it is permitted. Only a few feeding sites for geese are free from hunting (Grimmett & Jones 1989, Hedlund 1992).

Agricultural conflict: In Sweden, crop damage conflict caused by geese exists but due to their relatively small numbers, conflicts caused by Whitefronts are unimportant (Hedlund 1992).

4V. TURKEY

4V.1 Distribution

Range: Wintering Whitefronts are known from European Turkey (main roost in the Evros or Meriç Delta) and western Anatolia. Except from a few coastal areas, most Whitefront haunts in Asian Turkey are situated around saline and freshwater lakes in inland western Anatolia. This region is mountainous, with many plateaux and a great number of lakes especially in the southwest. Due to overgrazing and human exploitation, most of the region is steppe, much of which has been converted into agricultural land (mainly cereals). No Whitefronts are reported east of 36° E, where the terrain is higher and more arid (Grimmett & Jones 1989, Philippona 1972).

Habitat and feeding ecology: Most Turkish Whitefront haunts include a lake, saline or freshwater, surrounded by marshes, natural and artificial grasslands and arable land. Drainage projects at most sites have reduced the size of reedbeds and marshes and expanded agricultural areas in many cases. Almost nothing is known about the feeding ecology of Whitefronts in Turkey, but the scant information indicates that they feed on marshes, natural and artificial grasslands as well as on cereals surrounding the roosts. At a number of sites, Whitefronts may remain in severe winters because parts of lakes remain unfrozen, either due to salt concentrations or warm water springs. In spite of snow fall, food remains available to geese because of the strong winds that blow the snow cover from the higher parts of the feeding sites (Grimmett & Jones 1989, Philippona 1972).

4V.2 Abundance

Phenology: The White-fronted Goose occurs in Turkey between November and March. There are no data relating to arrival and departure. Peak numbers have been recorded in December, January and February on different sites. Because of the small number of ornithologists, the inaccessibility of many sites and variable winter weather, it is extremely difficult to organise simultaneous goose counts at all sites. The problem of large scale movements of geese between sites during counts is great, making it almost impossible to make reliable statements about the phenology and the reliability of counts (Grimmett & Jones 1989, Klemann & Dijksen 1994, Philippona 1972, L. Dijksen pers. obs.)

Trends and numbers: Numbers of wintering Whitefronts in Turkey vary greatly from year to year. In severe winters the geese abandon many sites, although they may not leave the country, and so are missed during censuses. In severe winters, several sites are almost inaccessible. After experimental and exploratory counts in the late 1960s, regular mid winter goose counts have been performed in Turkey since 1970. Because of differences in accessibility of sites and weather conditions during the counts, synchronous monitoring could not be achieved. The annual distribution of waterfowl is governed by weather conditions. Until 1990, one small team performed all counts, spreading the mid winter count over the whole of January and limiting the reliability of counts from that period. Since 1990, several teams of Turkish birdwatchers have performed the counts, shortening the count period and thereby improving the reliability of counts considerably.

During the 1960s, the number of Whitefronts wintering in Turkey was estimated at 60,000-100,000 birds (Cramp & Simmons 1977, Johnson & Hafner 1970, Philippona 1972, Timmermann et al. 1976). During the January counts (which probably does not coincide with the winter peak) of the 1970s, an average number of 55,000 Whitefronts was recorded at 32 sites (although probably not all haunts were covered). During the 1980s at these same sites, an average of c. 50,000 and during the 1990 counts of c. 22,000 Whitefronts were recorded in January (Klemann & Dijksen 1994, Wetlands International Goose Database unpubl.).

4V.3 Research

Since the second half of the 1980s, Turkey has participated in the International Waterfowl Census and contributes regular data to the Wetlands International Goose Database.

4V.4 Protection and conservation

Hunting legislation: The White-fronted Goose is a huntable species with an open hunting season from mid October to the end of February. During the hunting season, geese can be hunted only on Wednesdays, Saturdays and Sundays as well as on official holidays. There is a bag limit of four geese/hunter per day or hunting tour. For the last 10 years, only Turkish citizens have been allowed to hunt geese. There is an official hunting inspection and hunters that exceed the bag limit have to pay some 5 million Turkish Lira (about US$ 65) per goose shot over the limit, however, the number of wardens is too small for effective control (A. Güray pers. comm.). There are high disturbance levels due to hunting at most Whitefront haunts in Turkey. Illegal hunting is common at a number of sites. There is no information about the annual hunting bag, which must have been high in former years, but has been reduced in recent decades after the exclusion of foreign (mainly Italian) hunters. (Grimmett & Jones 1989, Lampio 1983, Philippona 1972, A. Güray pers. comm.).

Site safeguard: Only a few Whitefront haunts in Turkey are protected (e.g Sultan Marshes) although several sites have the status of temporary hunting free zone. This status provides no habitat protection, only prohibits hunting, and has to be renewed every year, which results in considerable changes in local protection status (Grimmett & Jones 1989).

Agricultural conflict: No information.

4W. UKRAINE

4W.1 Distribution

Range: The main Whitefront haunts in the Ukraine are situated along the northwestern coast of the Black Sea, the Sea of Asov, the Dnestr, Danube, Dnepr and Yushny Deltas and the northern part of Crimea. The eastern part of the coastal area is mainly important as a staging area during migration, whereas the western part, and especially the Ukrainian part of the Danube (Dunay) Delta, has become more and more important as a wintering area during the last decade. In the Ukrainian part of the Danube Delta, the most important Whitefront haunts are the Sasyk Reservoir, the Stentov wetlands, the Yalpug-Kugurluy-Kartal lake system and the Tuzlov group of limans (Ardamatskaya 1994, Ardamatskaya & Sabinevsky 1990, A. Korzyukov unpubl., Lysenko 1990, I. Rusev unpubl., Zhmud 1996).

Habitat and feeding ecology: The main White-fronted Goose roosts are reported from limans (lagoons characteristic of the northern Black Sea coast), lakes and reservoirs. They primarily feed on surrounding fields with winter cereals and less often on harvested fields of corn and soya beans (Zhmud 1996).

4W.2 Abundance

Phenology: White-fronted Geese appear in early October, but peak numbers are recorded in late October/early November. Mass departure and spring migration depends on the weather and takes place throughout March. Last migrants cross Ukraine in mid April. Severe winter conditions and snow cover usually result in the complete departure of Whitefronts from Ukrainian territory (Zhmud 1996).

Trends and numbers: During the 1970s and early 1980s, the number of Whitefronts wintering in the Ukrainian part of the Danube was estimated at up to 35,000 birds with up to 140,000 Whitefronts migrating through every year, with an increasing trend since the mid 1970s. In recent years, peak numbers of Whitefronts have reached 50,000-100,000 birds in the Ukrainian part of the Danube Delta and 185,000-330,000 birds along the Ukrainian Black Sea coast. The number of Whitefronts staging and wintering in the region has increased in recent decades (Ardamatskaya

1994, Ardamatskaya & Sabinevsky 1990, Grimmett & Jones 1989, A. Korzyukov unpubl., Lysenko 1990, I. Rusev unpubl., Zhmud 1996, Wetlands International Goose Database unpubl.).

4W.3 Research

A number of waterfowl sites in Ukraine have been monitored for some decades but since the beginning of the 1990s these counts have been coordinated throughout the entire Ukrainian Black Sea coast and Ukraine delivers regular count data to the Wetlands International Goose Database.

4W.4 Protection and conservation

Hunting legislation: The White-fronted Goose is a huntable species in the Ukraine with an open season throughout the winter. In the 1960s, the goose bag was estimated at c. 200 birds for the whole state (Rutschke 1973) and c. 100 during the 1970s (Scott 1982). According to Lampio (1983), there was no open season for geese in the Ukraine in the early 1980s. At present, c. 1400 geese (of which about 1000 are Whitefronts) are shot each year in the Ukrainian part of the Danube Delta (Zhmud 1996). There is no information about the present goose bag in the rest of the country but hunting pressure seems to have increased since the 1980s.
Site safeguard: The most important wintering site for Whitefronts in the Ukraine is the Danube Delta. Most of the area lies within the Dunay Zapovednik, which is designated as a Ramsar Site. Most other sites are unprotected. The natural course of daily activities of the geese is often disturbed, especially in early winter when hare hunting takes place at goose feeding sites (Grimmett & Jones 1989, Zhmud 1996).
Agricultural conflict: No information.

4X. UNITED KINGDOM

4X.1 Distribution

Range: The White-fronted Goose exhibits a localised distribution in Britain with only the Wildfowl & Wetlands Trust's (WWT) Slimbridge reserve, in southwest England, formerly regarded as internationally significant. As the northwest European population has grown substantially, Slimbridge, with an average of just 3060 Whitefronts during 1989/90 to 1993/94 (Cranswick et al. 1995), no longer qualifies as internationally important but remains the premier British site generally with over 50% of the British wintering total.

Among other important British sites are the Swale Estuary in Kent (c. 1500); several localities around the Norfolk coast (each < 300); and the Avon Valley in Hampshire (c. 150) (see Cranswick et al. 1995). Elsewhere, there have been records from at least 415 wetland sites since 1960/61, but only 69 have had 5-year peak means of more than 25 birds and many of these are satellites of larger haunts (WWT unpubl.). The Towy Valley in south Wales has greatly declined in importance supporting, for example, 2500 in 1971 but less than 50 birds now (Lovegrove et al. 1994). All regular wintering areas are now in southern England.
Habitat and feeding ecology: Though traditionally wintering on coastal grasslands and inland floodplains, arable land, sometimes far inland, is now the favoured habitat. Most roost on estuarine sandbanks, but some now roost on shallow lakes or riverside floodwater. In winter, foraging takes precedence over other daily activities (Owen 1972a), with some moonlight feeding. The geese usually feed only short distances from the roost (usually less that 10 km: Owen et al. 1986) and the winter diet is taken almost exclusively from pastures. The commonest foods on saltmarshes are *Puccinellia maritima, Festuca rubra, Alopecurus bulbosus* and *Hordeum secalinum*, whilst on inland pastures *Lolium perenne, Poa trivialis* and *Holcus lanatus* are favoured (Owen 1976).

4X.2 Abundance

Phenology: At Slimbridge, some Whitefronts arrive in October but numbers steadily increase through the winter and generally peaked in January at the end of the 1960s (Owen 1972b) and in February since the 1980s (daily counts, WWT unpubl.), declining rapidly by March (Fig. 5.7). Periods of hard weather in the Netherlands may cause further movements into Britain, often in late February or even March. Very few remain at British localities in the second half of March.
Trends and numbers: WWT counts since 1946/47 show that the British total remained relatively stable through the 1950s and early 1960s (c. 8000) but increased to more than 10,000 between 1967 and 1970. Thereafter, there has been a continued decline, with temporary peaks (of 7000-9500) when severe weather forces further birds into Britain (e.g. 1978/79, 1981/82, 1985/86, 1987/88, 1991/92); the average count for the 1990-94 period was just 4600, representing less than 1% of the northwest European wintering population.

Numbers at Slimbridge have declined also, the lowest ever annual maximum of 1400 recorded in 1992/93. However Slimbridge is becoming progressively more important in a national context, currently supporting c. 60% of the British total compared with c. 50% in the 1950s. The decline in the British wintering population is a classic case of "short-stopping", where geese winter closer to their breeding areas following an improvement in feeding conditions (Owen et al. 1986).

4X.3 Research

Census: Regular, and fairly complete, winter censuses have been coordinated since 1946/47 (see Boyd 1954, 1957, Ogilvie 1966, 1968, 1978, Owen et al. 1986). The numbers and distribution of birds at Slimbridge is recorded frequently, often daily. Monthly counts at other sites are collated via the Wetland Bird Survey (organised by the British Trust for Ornithology (BTO), WWT, Royal Society for the Protection of Birds (RSPB) and Joint Nature Conservation Committee (JNCC)) and published annually (e.g. Cranswick et al. 1995).

Ringing: WWT has ringed the vast majority of European Whitefronts in Britain, mostly in the 1950s and 1960s.

Other: Slimbridge birds have been the focus of detailed observational studies. Boyd (1953) studied aggression between individuals and families, whilst early results from population studies were reported by Boyd (1954, 1957) and Ogilvie (1966, 1968). Feeding ecology was the subject of detailed investigations in the early 1970s (e.g. Owen 1971, Owen 1972a, b, Owen 1975), whilst behavioural studies included pioneering work on vigilance in relation to flock size (Dimond & Lazarus 1974, Lazarus 1978). Apart from monitoring, there has been little research at Slimbridge subsequently and no studies elsewhere in Britain.

4X.4 Protection and conservation

Hunting legislation: The Wildlife and Countryside Act 1981 (WCA) provides the legal basis for the protection of Whitefronts in Britain. Listed on Schedule 2, part 1, they may be legally shot from 1 September to 20 February in England and Wales only, but not in Scotland (in order to protect Greenland Whitefronts). The size of the annual hunting bag is not known but is probably quite small.

Site safeguard: Just 11 sites currently qualify as nationally important for Whitefronts in Britain (Cranswick et al. 1995). Many of these fall within Sites of Special Scientific Interest (SSSIs) and as such are designated as conservation areas under the WCA. The three highest ranking sites (Severn and Swale estuaries, and North Norfolk Marshes) are sites of international importance and designated as Ramsar and Special Protection Areas.

Continued conservation of traditional roosting sites is important in enabling the population to exploit potential feeding habitats, and appropriate management of sites may help in maximising the numbers of geese wintering in Britain. However, if the current range within Britain is to be maintained, small flocks are in greatest need of conservation action since these are tending towards extinction, as is apparent during both historic and recent times.

Agricultural conflict: On account of a small population size, fragmented distribution and short period of residency in Britain, there is minimal conflict with agricultural interests.

4Y. YUGOSLAVIA

4Y.1 Distribution

Range: Largest concentrations of Whitefronts on the territory of the existing Yugoslavia occur in Vojvodina, northwestern Serbia and southern Montenegro. In Vojvodina, geese occur in marshes west of the Begej River (Carska Bara), at Slano Kopovo along the Tisa valley and along the Danube River bordering with Croatia (Kopacki Rit). In northwestern Serbia, Whitefronts are reported from the Danube and Sava valleys. In Montenegro, White-fronted Goose haunts are located around Skadarsko Jezero and at the Ulcinj saltpans on the border with Albania (Grimmett & Jones 1989, Mikuska & Kutuzovic 1982, Philippona 1967, 1972).

Habitat and feeding ecology: White-fronted Geese are associated with river valleys, and fresh or salt lakes in Yugoslavia. Geese roost on lakes and marshy areas and mainly feed on the surrounding agricultural land, grasslands as well as arable land (Grimmett & Jones 1989, Mikuska & Kutuzovic 1982, Philippona 1967, 1972).

4Y.2 Abundance

Phenology: The first White-fronted Geese arrive in Vojvodina in late September and leave in March. Peak numbers occur here in autumn when they are found at a number of sites in northern Yugoslavia. In winter, most migrate along the Morava River to Montenegro, Macedonia and Greece. Some fly to the Dalmatian coast in Croatia (Mikuska & Kutuzovic 1982, Philippona 1967, 1972).

Trends and numbers: Last century, there were hardly any records of White-fronted Geese from Yugoslavia. Since then, increasing numbers have been reported, with maximum numbers between the two World Wars. In the 1980s, between 500 and 2100 were counted in January in the present Yugoslavia where 300-800 birds were reported in the 1990s (Mikuska & Kutuzovic 1982, Wetlands International Goose Database unpubl.).

4Y.3 Research

Since the mid 1980s, Yugoslavia has participated in the mid winter goose counts under the International Waterfowl Census.

4Y.4 Protection and conservation

Hunting legislation: White-fronted Geese had an open season between 1 September and the end of February in the former Yugoslavia, except in Slovenia (Lampio 1983) and, during the 1970s, an annual bag of c. 4000 geese was shot (Scott 1982). There is no information since the formation of new countries on the territory of the former Yugoslavia. Although hunting at some roosts is prohibited, geese are hunted when leaving to feed on surrounding agricultural land. There is no recent information on the size of the annual goose bag.

Site safeguard: Skadarko Jezero is a National Park where hunting is prohibited, Carska Bara is a Regional Park with a strict sanctuary and in Slano Kopovo hunting is prohibited. A number of sites experience considerable ecological problems caused by overgrazing by livestock, drainage programmes and intensified human land use (Grimmett & Jones 1989).

Agricultural conflict: No information.

5. DISCUSSION

Population status: During recent decades an increase in Whitefront numbers has been reported from some western European wintering sites (Belgium, Czech Republic, Germany, the Netherlands, Poland, Slovakia, Sweden) and a decrease from others (Denmark, France, United Kingdom). An increasing trend has been reported from the Black Sea coast in Bulgaria and the Ukraine, and stable numbers in Romania, whereas all other countries in central and southeast Europe have reported decreasing Whitefront numbers (Albania, Austria, Azerbaijan, all countries on the territory of former Yugoslavia, Greece, Hungary, Italy, Turkey). Parallel with the change in numbers have been changes in phenology in most countries which, in conjunction with the more or less stable numbers estimated for the entire Western Palearctic breeding and wintering range, indicate major changes in the distribution of Western Palearctic Whitefronts within the wintering range. It seems that during past decades, the species has concentrated more and more in continental western Europe and the western Black Sea coast. Early this century, Menzbier and Eversmann (in Alphéraky 1904), Alphéraky (1904) and Niethammer (1938) all reported large scale changes in migratory routes and local Whitefront concentrations, and Johnson & Hafner (1970), Phillipona (1972), Kuijken (1975), Ebbinge et al. (1987), Kuijken & Meire (1990) and Mooij (1996a, b, 1997a, b) suggested a redistribution of wintering Whitefronts within Europe.

Although there are too few data to support the hypothesis of a major shift, there is little evidence to support the hypothesis of an increasing Whitefront population in the Western Palearctic as a whole. The recent increase in Whitefront numbers is due to better coverage during the mid winter counts, especially in central and southeastern Europe (e.g. formerly no counts from the Ukraine and only irregular counts from some other countries contributing considerable numbers to the total since the 1990s). Therefore, it is prudent to accept the hypothesis that there is no real increase in Whitefront numbers in the Western Palearctic.

Conservation issues: At present, the Western Palearctic Whitefront population seems to be stable, although the annual reproductive rate has dropped from c. 32% in the 1950s to c. 27% in the 1990s. In recent decades there has been a considerable increase in goose bags (especially of *Anser* species) in a number of countries (Table 5.3), particularly in western Europe. Because hunting is the most important cause of mortality in White-fronted Geese, one of the most important mechanisms for protecting the species is better control and management of hunting activities throughout their range. At present, hunting activities are not harmonised between countries, information about hunting bags is still poor and most estimated goose bags give no information about the species composition. Without better coordination and the establishment of national bag limits based on annual goose counts and reproductive success, increased hunting pressure on staging and wintering Whitefronts in the Western Palearctic could easily become a threat to the species.

With the exception of a few countries (e.g. Belgium, Slovenia), the White-fronted Goose is a huntable species throughout most of its range. In all range states it is necessary to designate hunting free areas at important Whitefront sites to create an adequate network of undisturbed roosting and feeding areas for the species (Reichholf 1973, Lampio 1982b, Lebret 1982, Lebret et al. 1976, Madsen 1994, Mooij 1996a).

Nowadays most geese are shot in flight with shotgun pellets which results in a considerable number of geese being hit but not killed; for every goose bagged, 0.2-4 were hit (Den Uil et al. 1982, Ekman 1980, Jönnson et al. 1985, Kalchreuter 1994, Lampio 1982a, b, Meltofte 1979, Mooij 1990, 1991c, Sanderson & Bellrose 1986, Scott 1982, Noer & Madsen 1996). In most countries, the use of lead pellets is still allowed, which magnifies the negative side-effects of this hunting method (Lampio 1982c, Mooij 1990, 1991c, Thomas 1982, Pain 1992). For long-term conservation goals, it is crucial to regulate hunting in such a way that the bag is within the limits set by natural reproductive and mortality factors.

Agricultural conflict: With the increase of local goose concentrations and the shift of wintering geese away from semi-natural and natural habitats, conflicts with agriculture have developed or increased in some countries. A growing number of farmers in a number of countries now complain of considerable yield losses caused by waterfowl (van Roomen & Madsen 1992). There is no complete overview of the extent of these yield losses nor the species that cause it. Because of the high number of Whitefronts wintering in most countries with goose damage problems, it can be assumed that Whitefronts contribute to the problem to a considerable degree. It was estimated that the cost of waterfowl damage in Europe has reached 5-10 million US$/year, of which about half was caused by geese. Whitefronts are probably responsible for about one third of reported goose damage (c. 1.2 million US$/year Europe-wide). After the privatisation of agriculture in central and eastern Europe, it can be expected that conflicts between agriculture and waterfowl also will occur in most of the former communist countries.

Future research needs: Because of the considerable gaps in knowledge about breeding biology, migratory routes, population dynamics and factors influencing the distribution of the species, it is necessary to continue long-term research programmes addressing these, including continued monitoring of the population through census, assessment of reproductive and mortality rates and the factors influencing these. Monitoring of migration and changes in migratory routes through individual marking programmes would enhance our understanding of these changes as well as shifts in wintering area and feeding behaviour.

International conservation: Because the range of White-fronted Geese includes a large number of different countries, international coordination of research and protection efforts is essential. A species management plan could be developed under the African-Eurasian Migratory Waterbird Agreement.

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6 Greenland White-fronted Goose *Anser albifrons flavirostris*

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1. POPULATION REVIEW

1.1 Range

The Greenland White-fronted Goose breeds in low arctic west Greenland mostly between Nuuk (64° N) and Upernavik (73° N, Salomonsen 1967), with summering birds found further north as far as Qanaq (77° N, Best & Higgs 1990). In autumn, it migrates south through south and west Iceland (Francis & Fox 1987, Stroud 1992) to winter exclusively in Ireland and Britain. Its wintering range on the north and west fringe of Britain and Ireland (Fig. 6.1) is associated with a landscape characterised by peatlands and low intensity agricultural land. In the last 30 years, in a few areas, notably the most important wintering areas of Wexford (southeast Ireland) and Islay (southwest Scotland) the geese have increasingly used intensively managed grasslands. Unlike many other northern-nesting geese, their wintering areas are often remote and the flocks relatively small and difficult to locate.

1.2 Delineation of flyways

Boyd (1958) analysed the ringing and recovery data generated by catching programmes stimulated in Greenland by Dr Finn Salomonsen at the Zoological Museum in Copenhagen. The results of this ringing scheme underpin our current knowledge of the migration routes and timing of passage. Subsequent ringing analyses of ringed and collared individuals have added to our understanding and have confirmed some tendency for leapfrog migration, those breeding furthest north tending to winter furthest south (Salomonsen 1967, Fox et al. 1983, Kampp et al. 1988). Literature review (Stroud & Fox 1981) and more recent radar studies (Alerstam et al. 1986) have given additional information on migration routes between staging areas in Iceland and the breeding grounds. Studies in Iceland have also provided a basis for understanding of patterns of occurrence there in both spring and autumn (Francis & Fox 1987, Stroud 1992).

1.3 Population trends

Regular counts are available from Islay since 1965 (initiated by Hugh Boyd from the then Wildfowl Trust, and continued for many years by Malcolm Ogilvie) and Wexford since 1968 (initiated by Oscar Merne from the former Forest and Wildlife Service, Dublin, Figs. 6.2 & 6.3), as well as from a few other sites in Britain and Ireland. Elsewhere, however, count information has not been collected on a regular basis. Using actual counts

and much other information, Ruttledge & Ogilvie (1979) suggested that the population of between 17,500 and 23,000 birds in the 1950s had fallen to perhaps as few as 14,300 by the late 1970s.

Based on Ruttledge & Ogilvie (1979) and further research and survey since their time, it is now known that the population winters in 35 flocks in Ireland and 33 in Britain. Total monitoring of the whole population through a count network covering all the known wintering sites did not begin until 1982/83, since when numbers have increased from 16,000-17,000 to 29,000-30,000 in 1993/94, an annual rate of increase of 5.2% (Fig. 6.3, Fox et al. 1994, 1998a). Numbers have reached 33,000 at present. The most dramatic increases have occurred at the two most important wintering sites at Wexford (where numbers increased from 5000-6000 to just over 10,000, Fig. 6.2) and Islay (where numbers increased from 3500 to 9000-11,000, Fig. 6.2). The geese are distributed mainly in north and west Ireland, at sites supporting flocks ranging from less than ten to more than 500. At seventeen of these sites, numbers have increased over the period, at eight numbers have decreased and at ten trends show stable or fluctuating numbers. In Britain, there are four sites where numbers exceed 1000 birds, and whilst most sites support stable or increasing numbers over the twelve year period, at five numbers continue to decline. Another six sites have been abandoned in the period.

1.4 Breeding success

Greenland Whitefronts differ from most other races of Whitefront in their low productivity. Geese wintering in different parts of their range in Ireland and Britain exhibit different levels of breeding success. Data have been collected on Islay by Malcolm Ogilvie (latterly under contract to The Wildfowl & Wetlands Trust (WWT)) and by the National Parks and Wildlife Service (NPWS) co-ordinated by Oscar Merne over a long period. Data for other resorts have been co-ordinated by NPWS and Greenland White-fronted Goose Study (GWGS) since the inception of the full census in 1982. The long term means for Islay (14.1%±1.7% s.e., 1970-1981; 15.4%± 1.6% s.e., 1982-1993) are consistently lower than those from Wexford (16.6%±1.2% s.e., 1970-1981; 17.7%± 1.9% s.e., 1982-1993), although not statistically significantly so (t_{20} = 1.16, P = 0.26 for 1970-1981; t_{21} = 0.93, P = 0.36 for 1982-1993). Wexford wintering birds tend to have a higher percentage of young than flocks elsewhere in Ireland (means of 17.7% and 15.7% for the years 1982-1993; Fig. 6.4). Islay geese generally return with similar proportions of young to those found in flocks elsewhere in Scotland (15.4% and 15.1% for 1982-1993; Fig. 6.4). Overall, however, the annual patterns of breeding success are highly correlated throughout the winter range, so a good breeding season means a high proportion of young at all wintering resorts, whilst a poor season is reflected in uniformly low production (as in 1972 and 1992).

For this reason it has been important to obtain estimates in the field of the proportion of young geese in as many different flocks as possible. It is interesting to note that whilst in the 1970s and early 1980s, the productivity of the Wexford birds was nearly always greater than that of Islay wintering geese, in recent years this difference has reduced and Islay productivity has in some recent years exceeded that at Wexford.

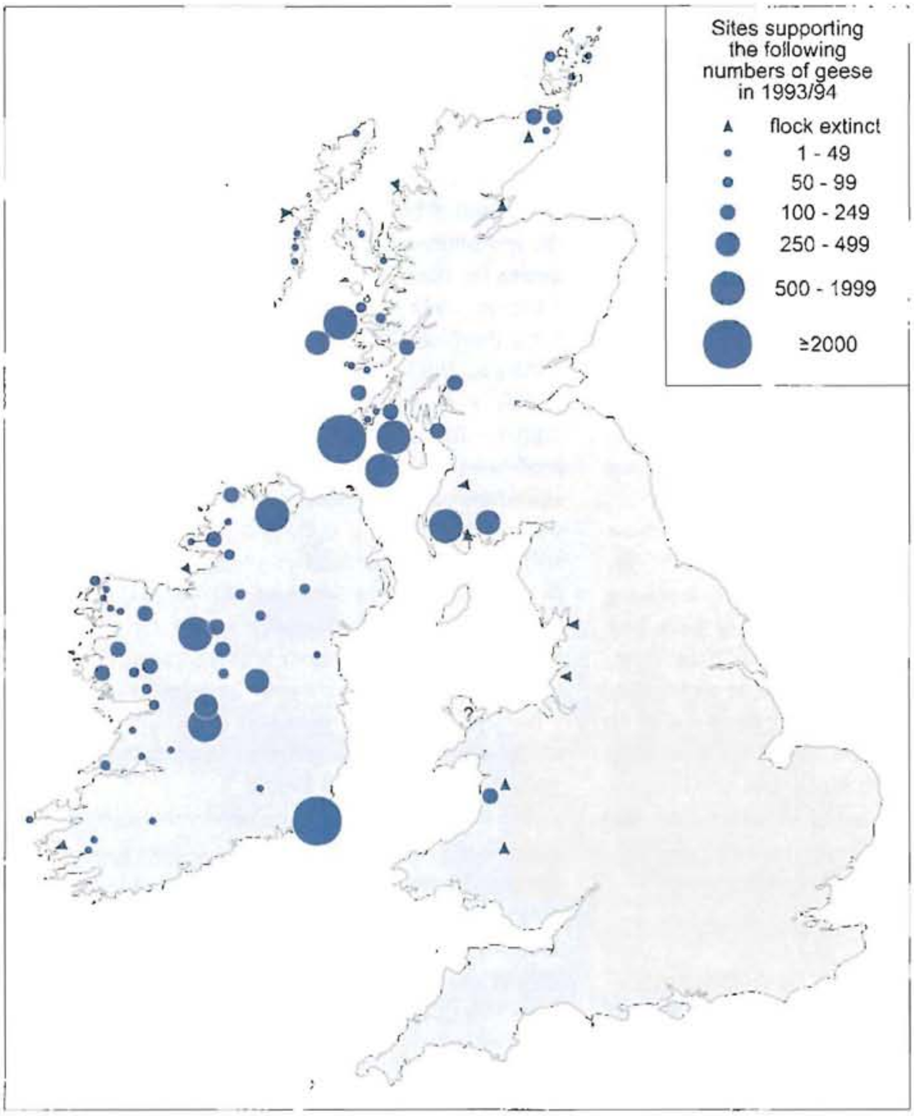

Fig. 6.1. Distribution of wintering Greenland-White-fronted Geese in Britain and Ireland 1993/94. Sites with a high probability of exchange of birds within a winter, unrelated to spring or autumn migration, are linked by lines.

As yet, the significance of such changes can only be speculated upon, but demonstrates the need for long-term monitoring to interpret such data.

1.5 Mortality

Before 1981, the Greenland White-fronted Goose was legal quarry throughout all of its range. During the 1950s, 1960s and 1970s, the effects of habitat loss and modification on the population were exacerbated by the considerable off-take of birds through hunting (Ruttledge & Ogilvie 1979, Fox et al. 1994). Birds were being killed on the breeding areas, shot legally in Iceland on migration in autumn as well as poached illegally there in spring, whilst substantial numbers were killed on the wintering areas, particularly in Ireland (where this was the only wild goose species widely available as a quarry species). Using the Haldane (1955) method, Boyd (1958) calculated annual adult survival rate at 66.1% (± 3.6% s.e.) based on ringing recoveries of birds ringed in 1946-1950, compared with 76.7% (± 3.4% s.e.) based on recoveries of birds ringed during 1946-74 (Kampp et al. 1988). More recently, Bell et al. (1993) used resightings of neck-collared birds marked during 1984-1989 to calculate adult survival with SURGE4 models (Clobert et al. 1987, Pradel et al. 1990) to generate maximum likelihood estimates of 78.5% (± 1.4% s.e.). This compared with 72.4% (± 7.3% s.e.) based on ringing recoveries using BROWNIE (Brownie et al. 1985) from the same ringing programme based at Wexford Slobs in Ireland. Attempts to calculate crude annual survival rates from census data showed that these varied between 68.4% and 97.7% during 1970/71 to 1989/90, mean 84.4%. The discrepancy may be partly explained by emigration from Wexford which, based upon resightings of birds seen elsewhere on the wintering range, during 1983/4 to 1993/4 ranged from 2.9% to 16.7%, mean 9.3%.

Analysis of census data since 1970 suggests that hunting caused additional mortality to that of natural causes at Wexford Slobs, since mortality was higher in years with the greatest shooting bags (M.C. Bell & A.D. Fox unpubl.). Since 1982, the population has been protected throughout much of its range (see below) and has shown an increase, presumably as a direct response to this protection.

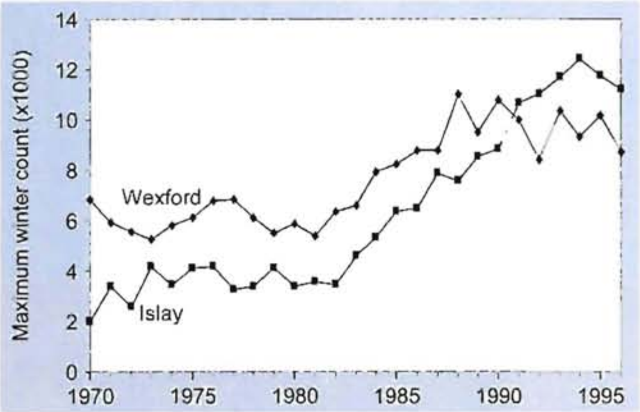

Fig. 6.2. Annual maximum winter counts of Greenland White-fronted Geese at their two most important wintering sites, Wexford Slobs (southeast Ireland) and Islay (southwest Scotland), 1970-1994.

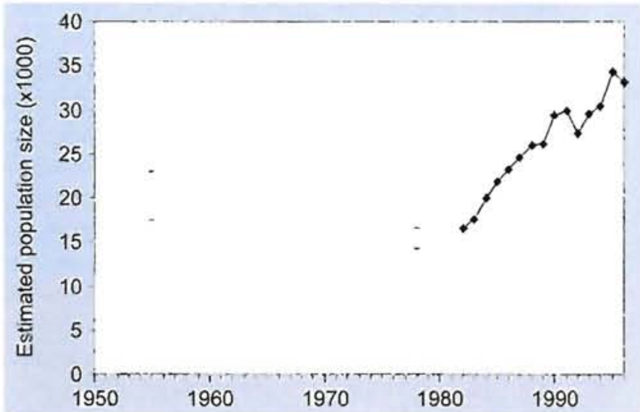

Fig. 6.3. Total numbers of Greenland White-fronted Geese counted on the wintering grounds. Counts for the 1950s and late 1970s are estimates from Ruttledge & Ogilvie (1979).

2. BREEDING GROUNDS AND BREEDING ECOLOGY

2.1 Distribution

Range: Greenland White-fronted Geese breed on the relatively mild, oceanic west coast of Greenland. Southernmost birds occur around Nuuk in the interior parts of Godthåbsfjord closest to the ice-cap, with relatively few birds northwards to the Sukkertoppen ice-cap which reaches to the sea (Fig. 6.5). Immediately north of the Sukkertoppen ice-cap, the relatively high plateau areas are devoid of suitable vegetation and consequently of geese. Greatest densities of birds occur close to the ice-cap northwards from Kangerlugssuaq, with numbers declining towards the coast. In part, these patterns may relate to spring snow melt and soil thaw, since satellite imagery shows that inland areas lose their snow cover more than one month earlier than the coastal areas near Sisimiut. Important concentrations occur all the way northwards to the inland areas south of Naternaq.

The lowland Naternaq area supports at least 2600 breeding and moulting Greenland White-fronts in a relatively small area amongst the numerous lakes and wetlands studded throughout a flat open plain composed of highly unstable fine glacial deposits. Further northwards, important concentrations occur in the Sullorsuaq and Kuusuat areas on Disko Island and in the lowlands of the Svartenhuk Peninsula. Large tracts of lowland areas are highly restricted in west Greenland, and extensive aerial surveys in 1992 and 1995 suggested that there were few other comparable areas of lowlands suitable for the population, with the deep fjord geography of the northern coast beyond Disko Bay resulting in very low densities of geese over large areas. However, over 700 geese moult in the upland interior part of the Nuusuaq Peninsula, north of Disko Island in generally dry barren habitats atypical of other known moulting areas. Geese breed as far north as Upernavik, but at least some White-fronted Geese occur in the vicinity of Avanersuaq (Thule), which probably represents a recent range extension.

Away from these few fertile lowland sites, White-fronts in Greenland occur at very low densities over vast areas. Unlike some other arctic-nesting goose species, the Greenland Whitefront does not breed colonially. This clearly has particular implications for site-based conservation. On arrival in spring, weather and snow conditions may vary widely from year to year, with inland areas around Godthåbsfjord and Kangerlussuaq

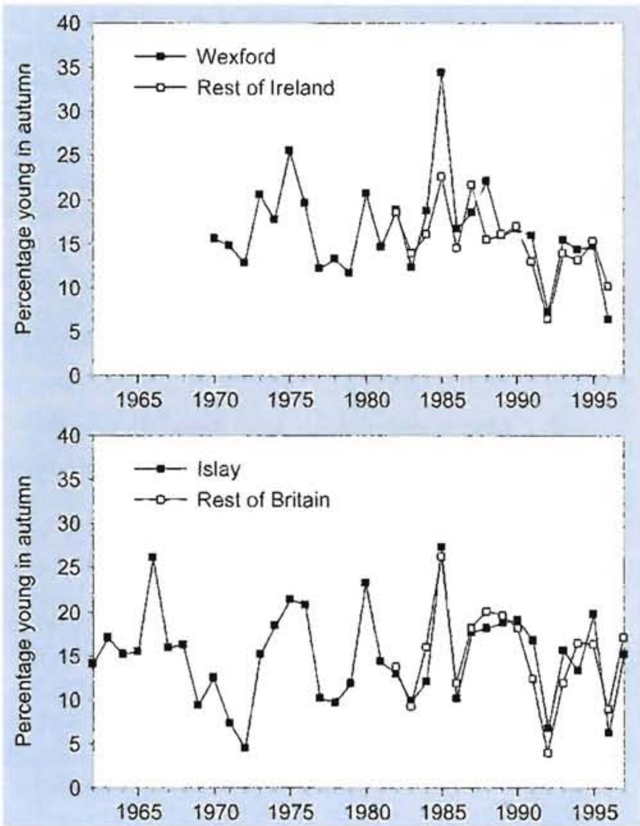

Fig. 6.4. Annual productivity estimates for Greenland White-fronted Geese at Wexford, remainder of Ireland (upper), and on Islay and from the remainder of Scotland (lower).

being the first to thaw. In these two areas, studies carried out since 1993 have shown that the area from Kangerlussuaq to Naternaq contains the most important staging areas. Between Svartenhuk and Paamiut (62° N), 46 areas were selected as potential spring staging areas from knowledge obtained from two known gathering areas near Sisimiut and in Eqalummiut Nunaat. Analysis of two sets of NOAA satellite images from April to June 1985 and 1988 to derive snow coverage and vegetation indices suggested that 14 areas, primarily on Disko and Svartenhuk were unsuitable at the time of arrival of Whitefronts in west Greenland. The remaining 32 areas plus the two original areas were visited on the ground and by aerial survey in May 1994 and 1995. More than 90% of the geese counted by aerial survey (n=1085) were present between Kangerlussuaq and Naternaq, within which seven sites (including the two known sites) held more than two-thirds of the total. In May 1996, spring staging was studied in Eqalummiut Nunaat, when some 500 birds used the area in the early days of May, declining to c. 50 by 20 May, almost all of which were adults. This and other staging areas may be used by locally breeding birds, but limited resighting information suggests that these may be joined by geese breeding further north in the range which use these as staging areas en route to ultimate summering grounds (Fox & Ridgill 1985). Identification and protection of these crucial staging areas, where the geese may be especially vulnerable to disturbance, remains a particularly high priority.

Habitat and feeding ecology: Greenland Whitefronts generally select a range of wetland habitats associated with the favoured food plants. They feed initially on the over-wintering below ground parts of *Eriophorum* and *Triglochin*, as well as berries left from the previous autumn, switching to fresh green growth (mainly grasses and sedges, especially *Carex rariflora*) later in the season (Fox et al. 1983). During moult in more mountainous parts of the range, forages on sedge-rich meadows adjacent to lakes and late snow patch vegetation close to water which offers safety from predators. In autumn, after the moult, the geese feed on berries on heathland habitats.

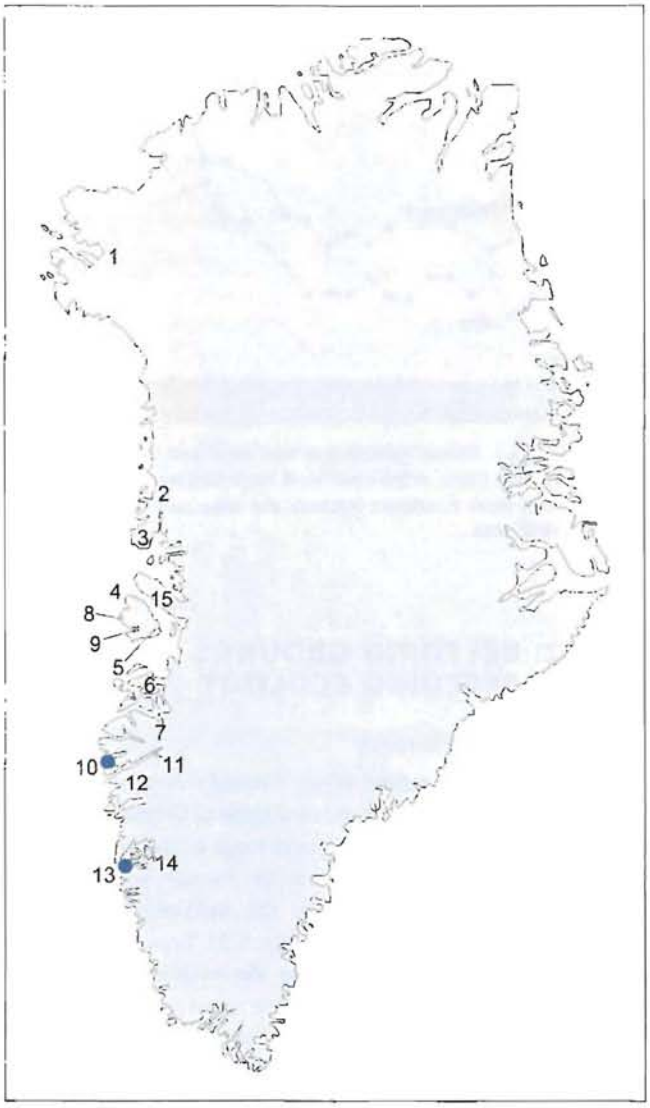

Fig. 6.5. Map of Greenland locating areas and towns (filled circles) referred to in the text: 1 - Avanersuaq (Thule), 2 - Upernavik, 3 - Svartenhuk Peninsula, 4 - Disko Island, 5 - Aqajarue-Sullorsuaq, 6 - Naternaq (Lersletten), 7 - Eqalummiut nunaat-Nassuttuup nunaa, 8 - Qinguata-Kuussuaq, 9 - Kuannersuit kuussuat, 10 - Sisimiut (Holsteinsborg), 11 - Kangerlugssuaq (Søndre Strømfjord), 12 - Sukkertoppen Ice Cap, 13 - Nuuk, 14 - Godthåbsfjord, 15 - Nuusuaq Peninsula.

2.2 Moult migration and moulting areas

In late summer, non-breeders and family groups move to traditional moulting areas, which in the central parts of the range at least, tend to be on high plateau lakes which are the last to thaw. In the northern, more mountainous parts of the range, moult takes place in lowland areas, often coastal deltas. Birds in the north of the range are thought to be supplemented by moulters moving up from further south (Salomonsen 1967), and one recent resighting/recovery record supports this assertion. Aerial census suggests that there are relatively few families in the large groups of geese which characterise the delta systems and other lowland wetlands of Disko, inland Nugssuaq and Svartenhuk where large numbers of geese can be found during the moulting period. Again, a full identification of the areas and sites of especial importance remains a high research priority, to enable land use planning to take account of them.

2.3 Research

Greenland White-fronted Geese have been ringed in West Greenland since the late 1940s, which have generated a large number of recoveries and defined mortality rates and migration routes at that time. Recoveries from the 1950s showed that there were peaks in May (arrival) and July (during the flightless moult), the two periods of concentration and vulnerability (Kampp et al. 1988).

Ringing was recommenced in 1979 (Fox & Stroud 1981) and 1984 with the major expeditions to Eqalummiut Nunaat, with follow-up projects in the area immediately north of Kangerlugssuaq in 1989 and 1992 (Wright & Mitchell 1993). Spring studies were carried out to identify important spring staging areas in 1994 and 1995, and detailed studies in Eqalummiut Nunaat in spring 1996. Major ecological studies took place on the former two expeditions, and aerial survey continues, with major efforts in 1992 and 1995.

2.4 Protection and conservation

Hunting legislation: Until 1985, Whitefronts could be shot in Greenland at any time, but from that year, legislation restricted hunting to the period from 16 August to 30 April. The limited information we have suggests that geese move into very remote interior areas post moulting and are highly dispersed, such that by the 16 August, few geese are shot owing to the considerable difficulty to hunters of finding them. No statistics are available to assess either the number of hunters involved in goose shooting, nor the total bag size involved. Local information however, suggests that summer goose shooting is a highly specialist activity undertaken by very few individuals and does not generate a large annual bag. Some illegal hunting in May does occur.

Site safeguard: In 1989, the Home Rule Authority announced the declaration of five major Ramsar wetlands of international importance covering an estimated 700,000 hectares of the goose summering grounds. These represent the summering areas of c. 22% (6300 out of a population of 29,000) of the total world population of Greenland White-fronted Geese. Another area of lowlands on the Svartenhuk Peninsula, holding more than 1000 geese is being considered as an additional proposed Ramsar site for future designation.

Public awareness: The Home Rule Authority has produced a series of leaflets on the Ramsar sites and their importance, available in four different languages which have been widely distributed amongst interested parties.

3. STAGING AREAS

3A. ICELAND

3A.1 Distribution

Range: Analysis of ringing recoveries and resightings of Greenland White-fronted Geese in Iceland shows two major concentrations, the southern lowlands and western part of the country (Fig. 6.6). Numbers tend to be larger in the southern lowlands where the majority of the birds appear to stage. Most recoveries come from early October when the geese are probably arriving in Iceland in large numbers. There are fewer recoveries in spring, when shooting of the geese is illegal, but still occurs (Fox et al. 1994).

Habitat and feeding ecology: The Greenland Whitefront traditionally fed on *Eriophorum*-dominated vegetation in the western staging area where this habitat was formerly more common than today, and fed on *Carex lyngbei* in both staging areas in former times when this plant was extensively grown in artificially flooded areas as a hay crop. Both these sources of food are still exploited in areas where such habitat remains, but the majority now feed on drained hayfields with *Phleum pratensis*, *Poa pratensis* and *Deschampsia caespitosa*-dominated swards in spring and autumn, although waste potatoes and spilled grain are both taken in the southern lowlands where these are grown. Some natural wetlands are used especially in the western staging area, although often mainly as roost sites.

3A.2 Abundance

Phenology: Birds generally start to arrive in early to mid April, building through the month with peak numbers in the last week of April and the first days of May. Most have left by the end of May. The return passage in autumn starts in late August, but numbers never become very high before mid September. Numbers peak late that month and early October, with most geese departing for the wintering grounds by the end of October, although there are few good census counts from staging areas to give precise patterns or indications of turnover at particular sites.

Trends and numbers: There are no accurate time-series census data available for anywhere in Iceland. The geese pass through in spring and autumn over a vast area which makes accurate counting difficult. Up to 3500 were counted in spring 1986 in the southern and western lowlands (Francis & Fox 1987), but it seems likely that the entire population stages in Iceland at some time, although there is considerable turnover. In autumn, use of more wetland habitats and the wariness of birds (due to hunting) makes assessment of numbers even more difficult, however, it seems probable that the entire population stops off in Iceland during the autumn as in spring.

3A.3 Research

There has been relatively little published research carried out in Iceland on the Whitefronts, although in re-

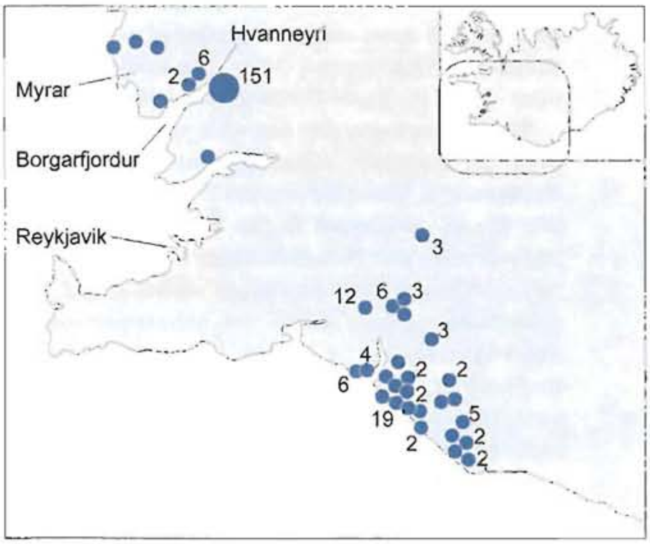

Fig. 6.6. Map of Iceland showing areas referred to in the text and the distribution of ringing recoveries and resightings of individually marked Greenland White-fronted Geese in south and west Iceland; digits indicate numbers of different birds seen at each location.

cent years, expeditions to study their behaviour and feeding ecology (e.g. Fox et al. 1998b, Kristiansen et al. 1998), abundance and staging time have been carried out by the GWGS and WWT in conjunction with local ornithologists who have been collecting resighting data on collared birds for many years. The results of this work will be forthcoming in the near future.

3A.4 Protection and conservation

Hunting legislation: The main legislation relating to geese is the Bird and Mammal Protection Act of 1994. Under this legislation, annual hunting licences are granted only on submission of a record of the number and species taken the previous year. This legislation gives the Ministry for the Environment more flexible means of protecting a species than previous legislation, such as protecting important roost sites or staging areas. Although protected in spring, there may be considerable numbers killed illegally at this time. There is no limit on the hunting bag at present, but bag statistics are available from 1995 onwards so size and extent of the kill each year may be assessed. Over 20,000 gun licences are issued in Iceland and in 1995, when hunting licences were required for the first time, 11,200 hunting licences were issued and 3214 Greenland White-fronted Geese were reported shot. In contrast to most western European states, the number of hunters appears to be increasing, with an estimated 800 new gun licences granted each year. However, not all gun licence holders hunt as some only hold a gun permit for sporting purposes and target shooting. In addition, hunting by foreign tourists has started to become more popular in Iceland. It would seem difficult to persuade Icelandic hunting organisations of the need for a ban on shooting of this population given the dramatic increase in its numbers but protection of important roost sites might be more feasible.

Site safeguard: The Icelandic government is signatory to the Ramsar Convention. Two sites in Iceland are declared as Ramsar sites, and neither of these support Greenland White-fronted Geese. The Iceland Government signed the Berne Convention in 1993.

There is currently one site with protection at least partly for Greenland Whitefronts, namely Pollengi in Biskuptungur. There are six sites known to be used by Whitefronts mentioned in the Nature Conservation Register of Iceland (which lists sites of national importance, although these only enjoy weak non-statutory protection) and these also feature in the Important Bird Areas list compiled by BirdLife International. Five of these are in the southern lowlands, the sixth in the west. There is a possibility of locating more sites which are important for the geese, particularly where high diversity of other organisms make sites of general scientific interest rather than being based on a single species. However, none of these sites have any statutory protection at the moment, nor is there any management planning work, wardening or monitoring.

The most important known site, at Hvanneyri in the west of Iceland, is an experimental farm and the establishment of a nature reserve is currently being negotiated there. It is important that this area should soon have special protection to ensure the maintenance of its present high interest as a staging area. Local planning authorities are now obliged to structure local plans which register, and take account of, local sites of nature conservation interest.

Agricultural conflict: Although unlikely to cause significant agricultural damage in spring, the Greenland White-fronted Goose is regarded as just another goose causing agricultural damage to farmers. In the last 15 years, no licences have been given to any farmers to permit the killing of Whitefronts causing agricultural damage (as are granted for the killing of Greylag Geese *Anser anser* for example). However, there are considerable problems with the identification of species by shooters and general animosity towards geese amongst the farming community. It is likely that quite high numbers of geese are shot illegally in spring, but programmes aimed at better education of the hunters are being established and this should improve the situation in the future.

4. WINTERING AREAS

4A. GREAT BRITAIN

4A.1 Distribution

Range: The present range of the Greenland White-fronted Goose has not changed markedly since the review of Ruttledge and Ogilvie (1979), and remains restricted to the north and west of Britain, principally in Scotland. As in Ireland, this range follows the natural distribution of ombrogenous bogs and wetlands which were its former traditional wintering areas, although several flocks exist now on sites which are known to have been newly colonised during the 1930s (e.g. Colonsay and some areas on Kintyre). More latterly, new flocks have become established on Jura (during the early 1980s) and at Sullom Voe on Shetland (first recorded in 1987/88 on artificial habitat).

Overall, therefore, there have been three flock extinctions and two new sites colonised in the last twelve years. Seven additional flocks (sites 37,38,45,51,58,59 and 64 in Fox et al. 1994) have been discovered since the account of Ruttledge and Ogilvie (1979) which are now known to have existed prior to 1982/83. Improved coverage has also confirmed the presence of a flock on Benbecula and two groups on South Uist in the Outer Hebrides, as well as regular flocks at Lismore, Benderloch and Moine Mhor in Argyll, where the status of Greenland Whitefronts remained obscure at the time of the earlier analysis.

Habitat and feeding ecology: The traditional food appears to have been the overwintering parts of *Eriophorum angustifolium* and *Rhynchospora alba* on bogland biotopes, but no flocks are known to exploit exclusively this habitat to the present. Geese now feed on a range of agricultural grasslands, although several flocks do glean waste root crops and spilt cereals from stubble fields in autumn. They then move onto grasslands which are the main spring feeding habitats used prior to departure. Several flocks retain bogland roost sites where traditional feeding may still take place at night.

4A.2 Abundance

Phenology: First birds arrive in early to mid October in most years, especially at the major sites and numbers increase rapidly during October. Resighting of individually marked birds shows some staging within Britain and Ireland en route to ultimate wintering areas, so peak numbers are often delayed to December/January, whilst those sites used for staging may show highest numbers in November. There is also a limited redistribution in spring with birds sometimes moving to the smaller flocks before ultimate departure. Most birds depart during the second week of April, and virtually all have gone by the beginning of May.

Trends and numbers: The wintering population in Scotland has doubled from c. 7000 in 1982/83 to c. 14,000 in 1993/94. Over two-thirds of these now occur on the island of Islay, where numbers have increased from 3500 in 1982/83 (i.e. approximately half the Scottish total) to between 9500 (spring) and 11,700 (autumn) in 1993/94. On the basis of recorded movements of individually marked birds, it is known that Islay has several flocks and hence cannot be regarded as a single "site" or flock unit in its own right. Away from the island, there are a further 33 regularly used wintering areas, mostly in western Scotland, varying in size from less than ten individuals to more than 1000. Four sites (Tiree, Coll, Rhunahaorine and Machrihanish) all support more than 500 birds and all have shown increases in the last twelve years. Eleven sites have recently supported 100 or more birds (two flocks in Caithness, Benderloch, Colonsay, Jura, Keills/Danna, Loch Lomond, Bute, Stranraer, Loch Ken and Dyfi Estuary) of which six show stable trends in numbers; the remainder have increased. Six sites supporting 50-100 birds have been stable or slightly increased their numbers, but of the remaining eleven flocks with less than 50 individuals, five continue to decline and none show any sign of increase. Overall, 11 flocks show significantly increasing trends, five have decreased and 17 show no significant trends. As is the case in Ireland, it is precisely the small groups which are in need of the most urgent conservation action, to maintain current geographical range, since we have seen four extinctions of small flocks during the last twelve years and we may be witnessing the beginning of the end of yet more (see Fox et al. 1998a).

The current threshold of 1% of the population to qualify a site for international importance fails to protect these smaller groups, which are typically far from other wintering resorts. Hence attention must be given to these flocks if range contraction (flagged as a very important conservation objective in the management plan for Greenland White-fronted Geese and an obligation of governments under the European Union (EU) Birds Directive) is to be avoided.

4A.3 Research

Census: GWGS first established a network of observers throughout the wintering range in Scotland and Wales and has co-ordinated the census of the population ever since in collaboration with NPWS, RSPB and DoE(NI) in Ireland to ensure synchronised international coverage. A number of accounts of the analyses of local flock abundance, distribution and behaviour have been published over the years, detailed in the following site reports. In addition, counts supplied to the Wetland Bird Survey (organised by the British Trust for Ornithology, WWT, RSPB and Joint Nature Conservation Committee (JNCC)) often include counts from sites not included in the regular monitoring of traditionally used sites.

In more recent years, detailed counts have been carried out by various involved bodies. In Scotland, staff from Scottish Natural Heritage (SNH) have begun to count Greenland White-fronted Geese in their South West Scotland Region, including 10-15 counts each winter on Islay. At the RSPB Loch Gruinart Reserve on Islay, special counts are done for the entire reserve on an even more frequent basis. In Wales, the statutory nature conservation body there, the Countryside Council for Wales (CCW) has recently carried out special surveys of upland resorts historically used by the geese. Special surveys of some of the Dumfries and Galloway and Kintyre flocks have also been carried out for SNH by the RSPB and WWT in recent winters.

Ringing: Marking and resighting of individually marked birds was first initiated by GWGS as a result of their 1979 expedition to west Greenland (Fox & Stroud 1981), and small numbers have also been caught by WWT on Islay.

Other: WWT also initiated detailed studies of the geese on Islay under contract to SNH, with particular emphasis upon the definition of flock units on the island, relating feeding areas to specific roost sites and assessing home ranges of collared and radio-tagged geese. The studies demonstrated that there were substantial differences between the reproductive success of different "sub-populations" between different parts of the island and in different years. Their studies also concentrated on habitat use and assessed the effectiveness of different management techniques (such as liming, fertilising and rush-cutting in old pastures) as a basis for creating refuges which could be used to "decoy" geese away from more sensitive crops. All these studies were initiated to provide detailed information to underpin the Goose Management Scheme on the island (see below). The RSPB has also demonstrated, through experimental management of their Loch Gruinart reserve, that Greenland White-fronted Geese may be attracted to formerly little used areas through targeted agricultural management. This work has the potential to improve significantly the carrying capacity of other areas if widely applied.

4A.4 Protection and conservation

Hunting legislation: The legislative basis for the protection of Greenland White-fronted Geese in Great

Britain is provided by the Wildlife and Countryside Act (1981) and for the protection of internationally important sites, The Conservation (Natural Habitats, &c) Regulations (1994). As in Ireland, these domestic legislation instruments incorporate the requirements under the EU Birds Directive which lists Greenland Whitefronts on Annex 1 (see the Irish section for full details). The obligations of the Ramsar, Bonn and Berne Conventions also apply.

In England and Wales, the Wildlife and Countryside Act (WCA) permits an open season for White-fronted Geese during 1 September - 1 February; in practice this applies to Russian breeding White-fronted Geese *Anser albifrons albifrons* (see Mooij et al. this volume), except at the last remaining regular Greenland Whitefront resort on the Dyfi Estuary. Fortunately, the Dyfi flock has been the subject of a voluntary ban by the local wildfowling organisations since 1972. In Scotland, since 1982, White-fronted Geese have been protected under the Wildlife and Countryside Act, which grants effective protection to Greenland Whitefronts as few Russian breeding Whitefronts occur here.

Site safeguard: Site protection in Great Britain is based upon designation of Sites of Special Scientific Interest (SSSI), and many of the roost sites and some of the feeding areas used by the geese are protected under this mechanism. In all 21 flocks use areas which are at least partly designated SSSI, including parts of three National Nature Reserves and four RSPB reserves. Additional protection through international recognition has been forthcoming for many sites which qualify, but further progress on declaration of the list of proposed Ramsar and EU Special Protection Areas (SPAs) is awaited to complete this level of site safeguard for the population wintering in Britain. At present, flocks use 11 designated Ramsar and nine SPAs, as well as a further 11 proposed sites. The British Government has undertaken to complete the listing of all internationally important sites by 2004. These sites, as with SSSIs, will then require the further formulation and implementation of site management plans to ensure their future favourable conservation status. This process is now underway. At present, 13 flocks remain without any form of protection.

Agricultural conflict: Despite protection under the WCA, between 1988 and 1992, more than 150 geese were shot under licences issued by the Scottish Office to shoot unlimited numbers on the island of Islay. In response to criticism of this licensed killing and because of Islay's outstanding international importance for Greenland White-fronted and Barnacle *Branta leucopsis* Geese, a Goose Management Scheme was introduced in 1992/93 by SNH to encourage sympathetic management on land where the geese occur regularly. Financial incentives have been offered under this voluntary scheme to support goose use on farms throughout the island. Payments are offered on the basis of the average numbers of geese using specific fields and in return, the recipients of financial support agree not to disturb geese and to undertake specific farming practices to ensure sympathetic management for geese. The mechanism has been welcomed, since previously, only farmers who managed areas already of importance for geese could receive financial inducement to encourage geese. The Scheme is a great step forward for goose conservation on the island, towards a better integration of goose conservation needs in an agricultural landscape that may be useful as a model elsewhere.

4B. IRELAND, REPUBLIC OF NORTHERN IRELAND

In this section, the island of Ireland is treated as a single biogeographical unit, even though White-fronted Goose conservation is reliant upon the actions of two separate jurisdictions. This has been possible due to excellent co-operation traditionally forthcoming with habitats and species of mutual interest and concern. In the case of the Greenland White-fronted Goose, joint surveys have taken place since their establishment in 1982.

4B.1 Distribution

Range: The present range of the population has not changed markedly over time. The distribution is essentially restricted to the west and the north midlands of Ireland, with the notable exception of Wexford Slobs (historically a relatively recently colonisation). The existing range still closely follows traditional habitats, the bogs and callows which often occur in close juxtaposition. Loss of these traditional habitats, through peat harvesting and arterial drainage, accelerated in the 1940s, causing local flock declines and extinctions. Afforestation, particularly of the western blanket bogs also became an important factor from the 1950s onwards. Some cases of habitat loss have been offset by a move to agricultural land. Nonetheless, despite a steady increase in overall population, the underlying trends are a gradual contraction of range and a reduction in size of some flocks, with flock extinctions at five sites (Inny Valley, the Blasket Islands, Kilcoman, Fergus and Shannon and Bunduff) since the survey began in 1982 and no geese present at a further two sites (Doo Lough and Blasket Islands) since spring 1994.

Habitat and feeding ecology: The Greenland Whitefront traditionally fed on the overwintering parts of *Eriophorum angustifolium* and *Rhynchospora alba* on bogland biotopes, and a very few flocks continue exclusively to exploit this habitat. More commonly, the geese now feed on poor quality to highly managed agricultural grasslands, although several flocks do glean waste root crops and cereals from stubble fields in autumn before moving onto grasslands which predominate in spring prior to departure. Several flocks retain bogland roost sites where traditional feeding may still take place at night.

4B.2 Abundance

Phenology: Similar to Britain, possibly with a slightly earlier, late September to early October arrival date at most main sites.

Trends and numbers: Since 1982, the total population has effectively doubled in size from 16,500 to 29,000, increasing at a rate of 8-9% per annum. In Ireland, growth overall has been slower, 5.5-6.5% per annum, from c. 8500 to c. 14,600. Approximately two-thirds of the population is located at one site, the Wexford Slobs, where numbers have increased from c. 6000 to a stable level of c. 9000-10,000 during 1989-1995. The remainder winter in 33 flocks throughout the west and north, varying in size from less than 10 to more than 500 individuals. Nine flocks have shown significant increases, thirteen significant decreases and sixteen have shown no significant trend (i.e. are stable or fluctuating) since the shooting moratorium. Full details of all the wintering flocks can be found in Ruttledge & Ogilvie (1979) and Fox et al. (1994). Flocks on large and medium-sized ranges had increased on average by 17% and 4% respectively, while those with small ranges had declined by 52%. Hence, trends are strongly related to range size, specifically to the number and size of feeding sites. Those flocks showing declines or in need of remedial conservation action are generally the smaller ones, which fall below the 1% Ramsar threshold for international importance (currently 330 birds) and the 1% threshold for importance in an all-Ireland context. Urgent efforts must focus here if further range contraction is to be avoided.

4B.3 Research

Census: In the Republic, the NPWS was instrumental in putting in place a reliable system for estimating the size and distribution of the population on its wintering grounds. Co-operation with the Irish Wildbird Conservancy (IWC), Royal Society for the Protection of Birds (RSPB), Department of the Environment for Northern Ireland (DoE (NI)) and GWGS (in the UK) ensures regular and simultaneous coverage of the species range throughout the Republic of Ireland, Northern Ireland, Scotland and Wales on a number of occasions each winter (Fox et al. 1994). The system achieves the necessary international coverage as well as being flexible to meet more localised population monitoring requirements.

Ringing: A marking and resighting programme was initiated in 1983 at the Wexford Slobs which continues (Wilson et al. 1991). This is a co-operative programme, launched by the first GWGS expedition to Greenland in 1979. Whitefronts have been caught during further expeditions there in 1984, 1989 and 1992, on Islay in 1991 and 1992 (by WWT), and at Sheskinmore (County Donegal) and Lough Owel (County Westmeath). A total of 1265 Whitefronts have been marked in Ireland since 1983, the majority in Wexford. As well as providing information on mortality (Bell et al. 1993), between-site movements (Warren et al. 1992b) and aspects of social biology (Warren et al. 1992a, Warren et al. 1993), the ringing programme has demonstrated that geese wintering at Wexford occur in a number of structured sub-flocks, each with discrete home ranges (Wilson et al. 1991). This, together with the high level of site-loyalty has a range of implications for the conservation management of the Wexford Slobs.

Other: In addition to these primary studies, investigations of habitat use, feeding ecology (Mayes 1985, 1991) and the factors affecting flock size trends have been analysed, together with the effects of disturbance. Disturbance in particular has proved to be an important component affecting rate of change in numbers, especially as it relates to the number of different feeding sites available to a flock. Hence sites with low disturbance and many alternative areas to resort to when disturbed generally show higher increases than birds using very few sites liable to higher disturbance levels (Norriss & Wilson 1988, 1993). Because the birds show such a high level of site loyalty (Wilson et al. 1991), there is little possibility of recolonisation of deserted sites, nor large scale immigration from other areas to supplement declining flocks. Results of the census suggest that the flocks in the extreme south of the Irish winter range are showing the greatest declines of anywhere in the range, and the Wexford wintering numbers have shown signs of stabilisation in recent years, perhaps as a result of the declining quality and quantity of well-managed grass at the site.

4B.4 Protection and conservation

Hunting legislation: The national legal frameworks are provided by the Wildlife Act 1976 (Republic of Ireland), and the Wildlife, and Nature Conservation and Amenity Lands Orders of 1985 (Northern Ireland). These incorporate the obligations of the EU Birds Directive which lists the Greenland White-fronted Goose on Annex 1 (rare, vulnerable and endangered species) making it subject to the provisions of Article 4.1, requiring special protection measures to be taken for the most important wintering areas. The Ramsar, Bonn and Berne Conventions add considerable additional international weight to existing measures.

In the Republic of Ireland, open shooting seasons may be changed annually and may incorporate bag limits; the actual open season has been progressively shortened since 1975/76 (from September to January inclusive, to mid November to January in 1982). A national moratorium on Whitefront hunting was introduced in 1982/83, but lifted at Wexford in 1985/86 and 1989/90 with bag limits in both years.

Site safeguard: Both sets of legislation (including proposed amendments) allow for the identification, designation, acquisition and management of sites, as Nature Reserves for example, the setting up of management agreements with landowners and the securement of land already in government ownership. Management agreements may cover such issues as maintenance of habitat, control of disturbance levels, provision of access for research and monitoring, certain roles for landowners and farming practice. The principal difference between the north and south jurisdictions exists in relation to Areas of Scientific Interest (ASIs) in the Republic of Ireland and Areas of Special Scientific Interest (ASSIs) in Northern Ireland. ASSIs are a statutory designation and protection while in the Republic this status is presently being developed. However, the majority of the 450 feeding sites identified in the research programme were given ASI status within 103 separate ASIs in the Republic and as such have been incorporated into County Development Plans giving them quasi-legal status. In 1992, a resurvey of ASIs commenced with the result that all surviving sites have been incorporated into proposed National Heritage Areas which in turn await specific statutory recognition, although like the ASIs they are being incorporated into County Development Plans currently.

To date 13 nature reserves have been designated in the Republic with White-fronted Goose interest. These reserve areas have been given further international recognition under the EU Birds Directive as Special Protection Areas (4), Ramsar Sites (9) and as Council of Europe Biogenetic Reserves (3) implemented under the Berne Convention. These include a number of raised bog sites in the Midlands (flock numbers 3, 22, 23 and 26 in Fox et al. 1994) whose purchase has been assisted by the precursor to the LIFE programme, the ACE-Biotopes Programme, under the EU Birds Directive. A number of other sites have been identified as qualifying for international status. Management agreements were also established for eight sites, mainly concerned with the category of small flocks which otherwise had low conservation priority. Here, the landowner's co-operation has been sought to provide suitable feeding, protection from poaching and to minimise disturbance at preferred feeding sites. Several agreements have lapsed recently and these cases should be re-examined.

Sixty-eight statutory "no shooting areas" have also been established in the Republic with the consent of landowners and hunters, of which 23 cover important sites within the ranges of 19 separate flocks. Some sites are also listed on the European CORINE conservation site database, which whilst offering no statutory protection, identifies the site as being of considerable importance.

Agricultural conflict: Compensation for alleged damage to agriculture is not paid by either jurisdiction, but management agreements have been negotiated on specific areas to accommodate geese within the agricultural framework.

5. DISCUSSION

Population status: The Greenland Whitefront population has undergone a period of expansion as a result of the reduction in hunting mortality, which clearly played a role in the regulation of the population in the past. Past habitat loss has also undoubtedly played a role in the former overall population decline. However, the continued decline of some flocks and the recent levelling off of numbers wintering at the most important Irish wintering site (Wexford) suggests that other factors are now acting to limit continued expansion. In recent years, there has been a reduction in the proportion of potential breeders amongst birds wintering at both Wexford and Islay which return with young, suggesting there may be some check on recruitment of adults. This may limit future population growth. The recent spread of nesting Canada Geese *Branta canadensis* into west Greenland (Fox et al. 1996) has introduced the possibility of potential competitive interactions on the breeding grounds which may act to limit breeding potential in the future.

Conservation issues: At present, the most important statutory mechanisms for protecting Whitefronts on the wintering areas are those which regulate hunting (discussed above) and conserve sites. The latter enables designation of sites of local, national or international importance for the geese to ensure sympathetic management for the future. The selection of protected sites is undertaken on the basis of the numbers of birds at particular resorts. In the UK, many of the most important wintering sites are protected (as Sites of Special Scientific Interest, SSSI or Areas of Special Scientific Interest, ASSI in Northern Ireland). Sites supporting at least 1% of the world population of Greenland Whitefronts qualify under Ramsar as Sites of International Importance, while those supporting at least 1% of the British population qualify a site for consideration for protection under British legislation. Under the EU Directive on the Conservation of Wild Birds 79/409/EEC, Ireland and the UK have an obligation to conserve bird habitats as a means of maintaining populations and their geographical ranges. In part, this is achieved by the establishment of a network of protected areas for Annex 1 bird species throughout the Union, namely SPAs. The Directive also obliges member states to ensure the survival of all wild bird species by ensuring their survival and reproduction throughout their area of distribution. However, under existing procedures, most of the flocks which continue to decline (some of which approach extinction) are not of sufficient size to merit site-based protection measures. Thus, current legislation and hence site-safeguard programmes are clearly not sufficient to protect these flocks. New or enhanced mechanisms are therefore required to maintain these flocks and the existing range of the population. In part, this may be achieved through targeting wider countryside policies, e.g. the designation of Environmentally Sensitive Areas (ESA) or other agri-environmental programmes to encourage appropriate management of feeding sites at the scale of the agricultural landscape (e.g. Bignal et al. 1988, 1995, Dixon 1995).

Despite some progress in Britain and Ireland, adequate site protection and the development of management plans for all sites on the wintering grounds, is still required. In Iceland, too, there is presently no site protection at all, except for the experimental farm at Hvanneyri where the persistent anti-hunting stance of the local manager and the fortunate sympathetic management have coincidentally ensured the effective protection of a site of considerable international importance. The identification of roost sites in particular, as candidates for international and national site safeguard, remains a priority.

In Greenland, the designation there of five Ramsar sites of international importance has protected the summer habitat of perhaps 20% of the world population. This, together with the development of future educational links between Greenland and other range states is an extremely encouraging leap forward for a country with very limited funding for nature conservation, but with a very real appreciation of the importance of sustaining its natural resources.

Agricultural conflict: With the increase in the overall population size and as the geese have been displaced increasingly from more traditional feeding areas, there has been a growing tendency for them to feed on more intensively managed agricultural grasslands in Ireland, Britain and Iceland, which brings them into direct conflict with farmers (Norriss & Wilson 1993). These undoubtedly have caused local problems, as on Islay, where numbers continue to increase. While individual farmers bear the cost of damage on their land, nationally, the impact on agriculture is infinitesimally small. However, this led in 1988 to the issuing of licences by the Scottish Office to kill Greenland White-fronted Geese on Islay in response to alleged "serious" agricultural damage. This highly contentious move created very vocal opposition from conservation groups, as well as the Greenlandic Government, who claimed that such killing could not be justified amongst a population so small in world terms, especially in the absence of any definition of what actually constituted serious agricultural damage.

For this reason, a package of proposals was drawn up by the Scottish Office and SNH to enter into management agreements with farmers on Islay. From 1992/93, this provides financial assistance to those farmers bearing the brunt of the goose grazing and does away with any need for granting of shooting licences. In the Republic of Ireland, such conflict situations may result in licences to scare, although Section 47 of the Wildlife Act may allow killing as a last resort. This has not occurred to date. As noted above, there remains the need to address Greenland White-fronted Goose conservation needs in the context of the wider conservation importance of low-intensity agricultural land, through non-site-based policies. ESAs in particular may be helpful in assisting the integration of nature conservation needs with that of traditional farming and crofting practice (Crofters Commission 1991). To this end, the success of the implementation of the recently designated Argyll ESA in western Scotland (which includes several flocks of Greenland White-fronted Geese) should be the subject of careful review.

Future research needs: There is an urgent need to understand the population processes underlying the changes in numbers and distribution which have taken place amongst Greenland White-fronted Geese. In particular, an understanding of the proximate and ultimate causes of the declines in flocks which continue to head for extinction is required if range maintenance is to be a realistic objective. Continued monitoring of the population through census, assessment of breeding success, and monitoring of emigration/immigration and mortality patterns through individual marking are all basic requirements for the immediate future. In all these areas of research, there is the continuing need for close collaboration and sharing of data at an international level (see below).

International conservation: The world range of this small population of geese remains restricted to just four countries, Greenland, Iceland, Britain and Ireland. This creates both problems and opportunities. It enables, for instance, the development of a flyway conservation plan for the population to guide national and international conservation and management actions, since the involvement of relatively few governments and organisations eases the development of such an agreed programme. Such a Plan was developed, at the invitation of, and funded by, the Irish Government, assisted by Wetlands International and drafted by JNCC in the United Kingdom (Stroud 1992, 1993). The project culminated in the Wexford Workshop of March 1992, where a meeting of all the governments and organisations involved with Greenland White-fronted Geese agreed to adopt the proposed Plan tabled at the Workshop. There are possibilities in the future to bring this Plan under the umbrella of various international wildlife conventions such as the Ramsar or Bonn Convention. The development of an Agreement on African-Eurasian Waterfowl under the latter offers particular opportunities should the Range States agree to such a course of action.

Government representatives at the Wexford Workshop discussed, and agreed in principle, a Memorandum of Understanding outlining ways in which the Range States could work more closely together in the implementation of the Conservation Plan. Although this has yet to be formally signed, it is to be hoped that it will not be too long before the governments formalise this important document.

One of the areas highlighted by the Plan has been the development of educational programmes, and the suggested development of formal links between sites in the flyway. On Islay, SNH have established an education programme of community involvement linking schools on this island with those in Greenland. Such activity has long-term benefits in educating tomorrow's farmers of the wider cultural values associated with the geese in other countries. Thus, Islay's "pest" geese can be recognised in their wider context of a resource, shared with, and valued differently by, other communities. The "twinning" of reserves throughout the flyway not only strengthens protection measures at any one site, but also enables the exchange of information (e.g. on habitat management) and establishes direct liaison between different countries and the people involved with White-front conservation. As the future conservation of the geese and their habitats will depend on human actions in all the countries concerned, any initiatives which develop the concepts of shared responsibility and understanding must ultimately benefit the geese.

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7 Lesser White-fronted Goose *Anser erythropus*

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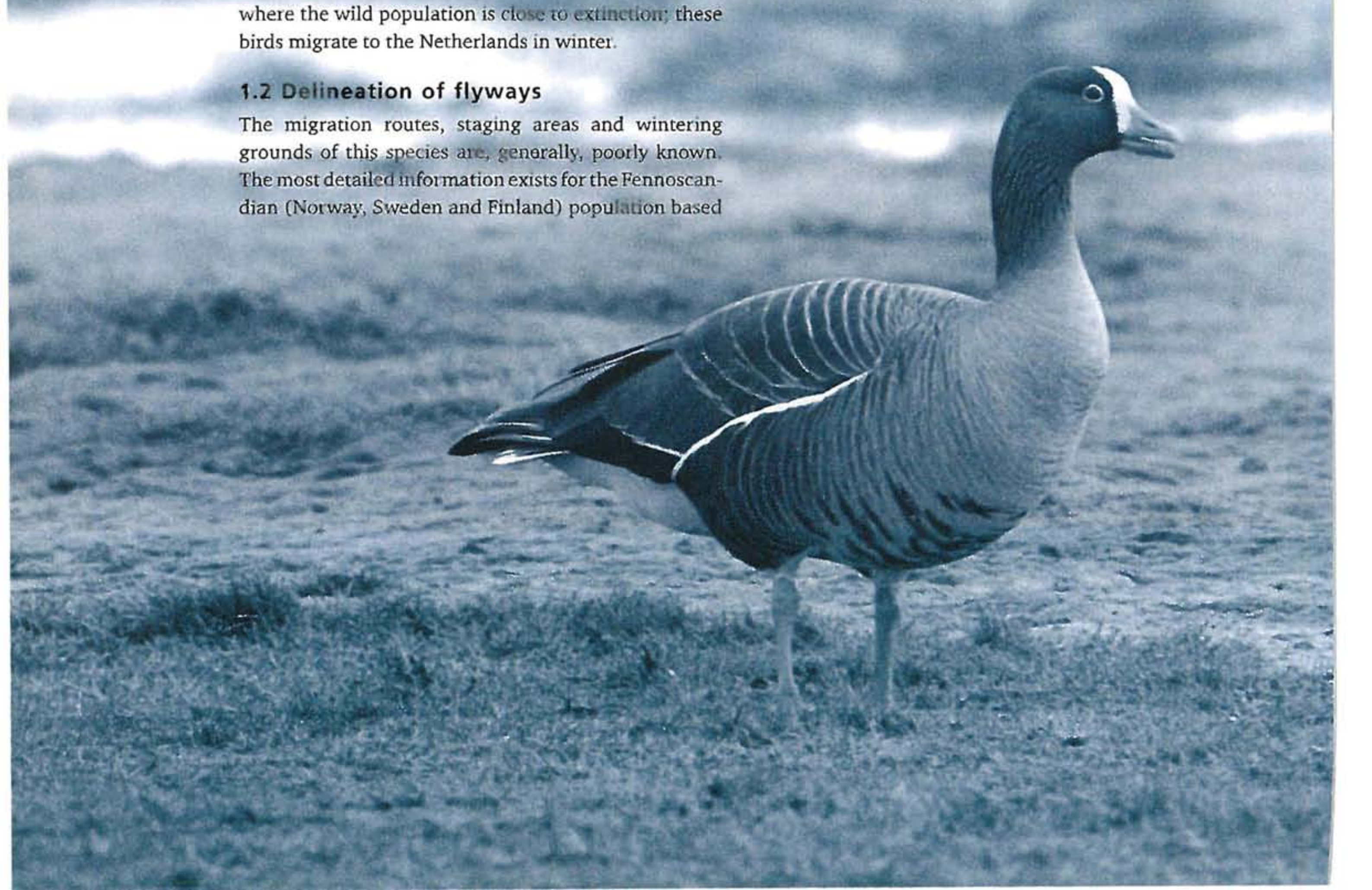
1. POPULATION REVIEW

1.1 Range

The Lesser White-fronted Goose breeds from northern Scandinavia to northeastern Siberia (Cramp & Simmons 1977, Vinogradov 1990, Morozov 1995, Syroechkovsky 1996). The breeding range has contracted during this century into four more or less distinct breeding areas (Fig. 7.1): northernmost Fennoscandia; an area from the White Sea to Ural/Yamal; southern Taimyr; and northeastern parts of Siberia. Part of the population winters in the Black and Caspian Seas and as far west as Greece but the main wintering grounds are probably in Azerbaijan (e.g. Cramp & Simmons 1977, Madsen 1996), Iran and Iraq. Early this century large numbers wintered in Armenia (Alphéraky 1905). The more easterly breeding birds migrate south and east to winter in central China and southeastern Russia. There is some evidence to suggest that the division between western and eastern migrating birds lies somewhere between the Pyasina and Kotuy Rivers in southern Taimyr (Rogacheva 1992) or in central Taimyr (Syroechkovsky 1996). A small number of Lesser White-fronted Geese have been reintroduced to Sweden where the wild population is close to extinction; these birds migrate to the Netherlands in winter.

1.2 Delineation of flyways

The migration routes, staging areas and wintering grounds of this species are, generally, poorly known. The most detailed information exists for the Fennoscandian (Norway, Sweden and Finland) population based on satellite transmitter studies carried out in 1995 (Lorentsen et al. 1998). Five geese were fitted with satellite transmitters; two were caught at Valdak, a staging area in the Porsangen Fjord, Norway, two were caught on moulting grounds in Norway, and another in a Finnish moulting and breeding area. In early September, all moved eastwards to the Kanin Peninsula where they staged for 3-4 weeks. Three moved southeast; one was shot in the Komi Republic on the west side of the Ural mountains; one was probably shot in the Sosnogorsky District in the Ob Valley on the eastern side of the Urals, while the third (the Finnish bird) was probably shot in Lake Sarykopa south of the Kustanay District of northwestern Kazakhstan. Two of the five ringed offspring of the Finnish bird were also reported shot in the Kustanay area in Kazakhstan. The two remaining Norwegian birds flew southwest to a staging area in eastern Germany before continuing to Hungary. One of the transmitters ceased operation at this time. In November, the last individual moved to Lake Kerkini and the Evros Delta in Greece, where it stayed until at least mid February 1996 when the transmitter signals stopped. This individual was observed at Valdak in Porsangen Fjord the following May (Aarvak et al. 1996).



There are two recoveries of Lesser White-fronted Geese ringed in Lapland, Sweden. One bird ringed 19 July 1953 was found 1 September 1957 on the shore of the Manych River system at Divnoje in Stavropol area north of the Caucasus and one ringed 22 July 1955 was found 7 February 1956 in Macedonia, Greece (Höglund 1960, 1962). A bird ringed as a gosling on the breeding grounds in Finland in 1994 was reported shot on the east side of the Azov Sea the following winter (Lahti & Markkola 1995). A bird ringed on the breeding grounds in western Taimyr was recovered south of the Caspian Sea, a bird from central Taimyr was recovered a year later on autumn migration south of the Tyumen Oblast, and one bird from eastern Taimyr was shot two years later on spring migration north of the Sea of Okhotsk (Borzhonov 1975, Syroechkovsky 1996).

Birds from European and west Asian breeding grounds winter mainly in wetlands around the Black and the Caspian Seas with the principal wintering grounds probably in Azerbaijan (Madsen 1996, Paynter et al. 1996), Iran and Iraq. More easterly breeding birds migrate south and east to winter in central China. Former important wintering grounds in central Asia have lost their importance, mostly due to human impact (Morozov 1995, Syroechkovsky 1996).

Reintroduced Swedish individuals winter in Zuid-Holland and Zeeland in the Netherlands (von Essen 1996).

1.3 Population trends

The world population of Lesser White-fronted Geese declined severely during the 1940s and 1950s and has continued to decrease afterwards. The species is now listed as "endangered" by Collar & Andrew (1988), and as globally threatened, i.e. considered to become extinct if the negative trend continues (Tucker & Heath 1994). During the same period, the breeding and wintering range has contracted considerably. The reasons for this decrease are unknown and probably caused by a combination of factors on the breeding (e.g. increased tourism and angling, habitat loss through damming and spread of the Red Fox *Vulpes vulpes* into the mountains, suggested for Fennoscandian breeding grounds) and wintering grounds (e.g. deterioration of feeding conditions through cultivation of land and over-exploitation through hunting) (Madsen 1996). Studies at staging and breeding areas in Fennoscandia have shown that breeding success is generally high (e.g. Aarvak et al. 1996) indicating that threats during summer may be of limited significance. Thus, the most likely causes of the decline are probably found on the staging and wintering grounds, such as heavy hunting pressure and loss of feeding habitats.

Merikkallio (1915) and Norderhaug & Norderhaug (1984) estimated the Fennoscandian breeding population to be more than 10,000 individuals early this century. Between then and the early 1980s, the population declined by 90-95%, and the breeding range decreased by 50% (Norderhaug & Norderhaug 1982). During the period 1980-1996, the population has continued to decrease and is now about 1% of that recorded at the beginning of this century, i.e. no more than 30-50 pairs (e.g. Øien et al. 1996). In Sweden the total breeding population in 1988 was estimated to be c. 10 pairs (von Essen 1991). The two last breeding records of the wild population were confirmed in 1989, and in 1994 this population was considered close to extinction (von Essen 1996).

Martynov (1983) estimated the Taimyr population to be 110,000 birds based on data extrapolated from questionnaires, although this estimate was considered to be too high by Rogacheva (1992). Later, Morozov (1995) estimated the total Russian population to be no more than 30,000-50,000 individuals. Even this new estimate has not been confirmed by winter counts and is considered to be too high (see below). The breeding range in Taimyr has decreased about 92% in comparison with the potential range of the 1950-1960 and

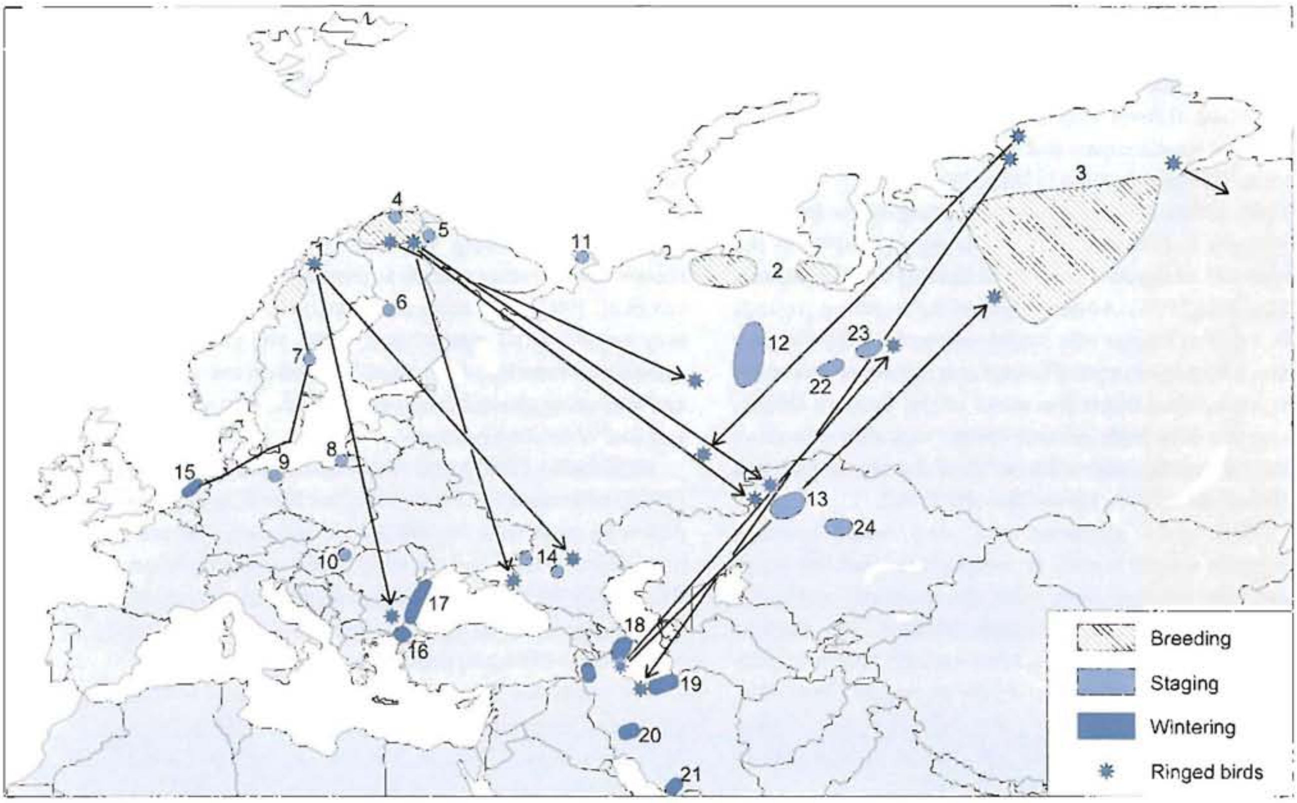


Fig. 7.1. Distribution of breeding, staging and wintering Lesser White-fronted Geese in the Western Palearctic. Breeding areas: 1. northern Fennoscandia, 2. Pechora Delta -Yamal, 3. Taimyr; staging areas: 4. Valdak, 5. Skjåholmen, 6. Hailuoto, 7. Hudiksvall, 8. Lithuania, 9. eastern Germany (Galenbecker See), 10. Hortobágy, Biharugra and Kardoskút, 11. Kanin Peninsula, 12. Ob Valley, 13. Naurzum Lakes (Tobol Ishim watershed), northern Kazakhstan, 14. Manych River valley, Manych-Gudilo Lake. Wintering areas: 15. The Netherlands, 16. Evros Delta, 17. Bulgaria/Romania, 18. Azerbaijan, 19. Caspian Coast of Iran, 20. Farz, 21. Flood plains of the Dez and Karun Karkheh, 22. Chanty-Mansijsk, 23. Surgut, 24. Tengiz-Kurgaldzhin. Source: IWRB Goose Research Group (1990a), Vinogradov (1990), Nankinov (1992), Øien & Aarvak (1993), Morozov (1995), this study. Stars and arrows indicate sites of ringed and recovered individuals. Staging and wintering areas 7 and 15 are probably used only by individuals form the Swedish re-stocking project.

about 80% compared with late 1970s - early 1980s (Syroechkovsky 1996, Aarvak et al. 1997).

1.4 Breeding success

Very little information on breeding success exists outside of Fennoscandia. Data on the percentage of young during autumn at Valdak in northern Norway has been recorded infrequently since 1981 and has always exceeded 50% (Fig. 7.2). However, since non-breeders may not occur at Valdak in autumn, the proportion of juveniles in relation to the potential number of breeders (i.e. the number of pairs present in spring) is somewhat less, normally below 40% (Fig. 7.2). As can be seen from Figure 7.2, breeding success in 1995 was very high. Brood size data indicate that productivity is high, although it varies considerably from year to year probably depending on the weather conditions during breeding (Aarvak et al. 1995, 1996, 1997).

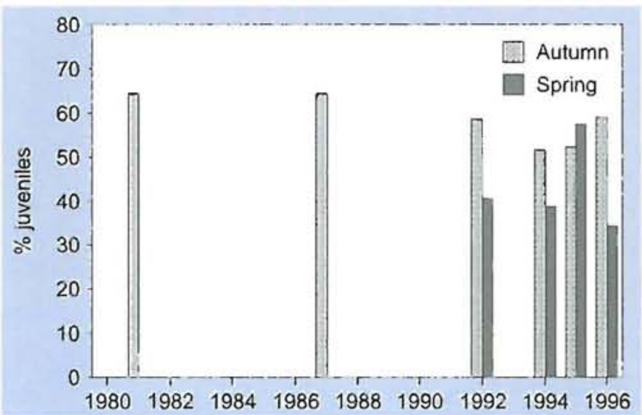


Fig. 7.2. The percentage of young (1Y) Lesser White-fronted Geese during autumn at Valdak in Finnmark County, northern Norway, in relation to the number of adults present in autumn (shaded bars) and to the potential number of breeding individuals (based on the number of adult, paired individuals present during spring, black bars). Data from Aarvak et al. (1995, 1996).

Vinogradov (1990) states that breeding success for the Yamal Lesser Whitefronts is high, indicating that the reasons for the population decline are not to be found on the breeding grounds. Furthermore, observations on the Taimyr Peninsula after 1990 indicate good productivity levels, with mean clutch and brood size of 5.3 and 4.6 respectively (data from Aarvak et al. 1997, Tolvanen et al. 1998).

The proportion of juveniles of well-observed Lesser White-fronted Geese in Kazakhstan in October 1996 was 33.3% juveniles (n=1734 individuals aged) (Tolvanen & Pynnönen 1998). In Azerbaijan 3% of well-observed Lesser Whitefronts in January 1996 were juveniles (n=1080) (Paynter et al. 1996).

The percentage of juveniles on autumn migration in Hungary during the period 1946-1982 has decreased significantly from 8.2% in the 1950s, to 4.4% in the 1960s and 1970s (Sterbetz 1986) (Fig. 7.3).

1.5 Mortality

In Norway, Aarvak et al. (1997) reported a juvenile mortality from autumn 1995 to spring 1997 of 78% (sd=9.9), most probably due to the high hunting pressure on migration and in the wintering areas (e.g. Lorentsen et al. 1998). Based on numbers of adults and first-year birds during spring, the mean mortality rate for adults was 16% per year in the period 1993-1996 (Aarvak et al. 1997). These estimates indicate that the mortality of adults is relatively low, whereas the mortality of immatures is very high.

The Lesser White-fronted Goose is protected throughout its range in the Western Palearctic, except in Lithuania (and Kazakhstan in the Central Palearctic), but is still shot due to confusion with other species, especially the White-fronted Goose *Anser albifrons*. At the breeding grounds in the polar Ural Mountain area (Morozov 1995) and Taimyr (Syroechkovsky 1996), as well as in many other breeding areas in arctic Russia, hunting regularly takes place during the whole summer season. Shooting may scare birds away from preferred feeding areas, reducing the area of suitable habitats (e.g. Madsen 1996). Hence, whilst we lack data on mortality rates for the main population, hunting remains one of the most important causes of population decline (e.g. Madsen 1996, Lorentsen et al. 1998).

2. BREEDING GROUNDS AND BREEDING ECOLOGY

2.1 Distribution

Range: Breeding Lesser White-fronted Geese prefer areas of wooded tundra or forest edges up to at least 700 m above sea level (Cramp & Simmons 1977, Vinogradov 1990, see also Morozov 1995 and Syroechkovsky 1996 for detailed information about breeding habitats in Russia). It breeds in various habitats, from mountain willow and birch woods to low-lying bogs and areas with many lakes and ponds extending from the northern limit of the taiga and northwards.

The number of birds breeding in the four different breeding areas shown on Figure 7.1 is uncertain. Estimates based on counts from adjacent staging areas indicate that the Fennoscandian breeding population numbers no more than 30-50 pairs (e.g. Øien et al. 1996). For the other breeding areas the estimates are very approximate. The Pechora Delta-Ural/Yamal population probably consists of no more than 500-1000 individuals (250-500 pairs) (V.V. Morozov pers. obs.) and the Taimyr breeding population probably about 1000-2000 pairs with an additional 3000-4000 moulting non-breeders (Syroechkovsky 1996, Aarvak et al. 1997). The easternmost breeding population probably

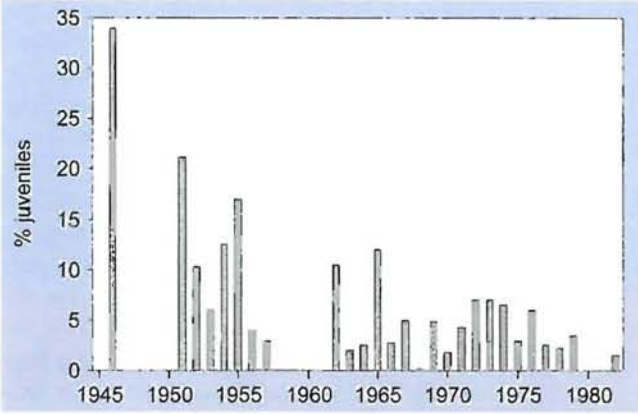


Fig. 7.3. The percentage of juvenile Lesser White-fronted Geese in Hungary during autumn migration 1946-1982. After Sterbetz (1986).

numbers no more than 1500-2000 pairs giving an estimated world population of c. 2750-4600 pairs. These estimates give an autumn population of c. 8000-13,000 individuals (assuming 40% juveniles), which is quite consistent with recent counts in staging and wintering areas (this study).

Habitat and feeding ecology: Former breeding sites in Nordland county, Norway, were often in areas with high calcium levels in the soil. No such relationship is found in Finnmark county where breeding occurs on tundra vegetation with small lakes surrounded by marshes and birch forest. The Lesser White-fronted Goose nests between dwarf shrubs, rough grasses or in boggy hollows. In Arctic Russia, Lesser Whitefronts breed mainly along river valleys on steep slopes or cliffs, often close to birds of prey (Morozov 1988, Mineyev 1989). It is strictly herbivorous, feeding on a variety of plants along lake shores, rivers and in marshes (e.g. Lorentsen & Spjøtvoll 1990).

2.2 Moult migration and moulting areas

In Fennoscandia non-breeders (and failed breeders?) move to higher altitudes to moult (Cramp & Simmons 1977). In Siberia (e.g. Taimyr and Yakutia), non-breeding birds migrate to areas north of the breeding range to moult (Rogacheva 1992, Syroechkovsky 1996). Introduced geese from Swedish breeding grounds have, since 1990, used the area outside the town of Hudiksvall on the Gulf of Bothnia (500 km south of the reintroduction site) to moult. Some of these birds have been observed in northeastern Finland indicating that they can go farther east to moult (L. von Essen pers. obs.). Also, recent results from a satellite telemetry study in Norway showed that non-breeders migrated from the breeding areas in late June/early July to coastal areas in western Russia (Norwegian Ornithological Society (NOF) LWFG monitoring programme, unpubl. data).

2.3 Research

Little research has been carried out on this species during the breeding season. The Finnish Lesser White-fronted Goose conservation group/WWF-Finland, and the Norwegian Ornithological Society have carried out surveys and vegetation mapping of breeding areas, behavioural and diet studies, studies on the effect of disturbance, and monitored clutch sizes and proportion of juveniles since 1984 and 1987, respectively. In Finland, phenology on breeding sites and studies on the effect of predators and interactions with Reindeer *Rangifer tarandus* have also been carried out. In Russia breeding sites in polar Ural, Taimyr, Yamal and Yakutia were surveyed in the 1970s and 1980s. From the mid 1990s, detailed inventories and studies on breeding biology have been started in Taimyr, Yamal and central Yakutia (Morozov 1995, Syroechkovsky 1996).

2.4 Protection and conservation

The species is protected throughout the breeding range but very few pairs nests within protected areas, at least in Fennoscandia. In Russia it is listed in the RSFSR Red Data Book and hunting is prohibited (Rogacheva 1992). However it is frequently confused with the White-fronted Goose, and thus shot. Results from Norwegian and Finnish satellite tagging and ringing projects indicate that hunting pressure in Russia and other parts of the former Soviet Union is very high (Lorentsen et al. 1998, E. Syroechkovsky, Jr. pers. obs.).

2.5 Reintroduction schemes

Sweden: In 1981, the Swedish Hunters Association and World Wildlife Fund launched a project to reintroduce the Lesser White-fronted Goose to former well-known breeding areas in Swedish Lapland. Geese were raised at Öster-Malma Wildlife Management School, and goslings were hatched by and imprinted on semi-wild Barnacle Geese *Branta leucopsis* which migrate to the Netherlands. It was assumed that this would be a safer wintering area for the geese than the areas used by the wild population.

Lesser White-fronted Goose broods are released, with their foster parents, in Lapland just before the goslings fledge. They are thus imprinted on the area. The foster parents guide the broods to their wintering grounds and in spring the Lesser White-fronted Geese return to Lapland to breed. A number of reintroduced geese have been observed in the breeding area.

Up until 1996, a total of 279 Lesser White-fronted Geese have been released in the Svaipa area. The first breeding record occurred in 1986 and since then (to 1996) 22 breeding records have been confirmed. Forty-three goslings fledged from 15 breeding pairs studied giving a mean of 2.9 per successful pair. In spring 1996 the population was estimated at 35 birds, and six breeding pairs. Whether the established population is large enough to increase and expand into the surrounding area is at present impossible to judge. Further annual release of a larger number of goslings will be necessary to achieve successful reintroduction (Larsson 1993).

Lesser White-fronted Geese reintroduced to Sweden migrate to the German North Sea coasts. They arrive at the Lauwersmeer (northern Friesland) in mid to late October. In December-February the geese are often found in Zuid-Holland and in Zeeland. Oude Land van Strijen, a pasture area where thousands of White-fronted Geese and Barnacle Geese graze is also an important area for the Lesser Whitefronts. Hunting is prohibited in part of this area. In early March they are usually back in north Friesland and the German coast, and in late April or early May they are back in Sweden. Reintroduced geese are marked with individual colour rings, to study their migration, survival, breeding success etc. (von Essen 1996).

Finland: A re-stocking project has been initiated in order to strengthen the existing population. Two farm stocks have been established (at Hailuoto and Koski) consisting of c. 80 birds of which c. 25 are adult females.

Up until 1996, 141 individuals with blue neck bands have been released close to the breeding area of the wild population (J. Markkola pers. obs.). Observations of mixed flocks, however, exist only from western Finland. Information about the re-stocking program has been distributed to more than a hundred authorities, organisations and journals concerned with ornithology, hunting and conservation in Europe and northwestern Asia. No observations from eastern or southeastern Europe have been recorded, but four goslings were shot in the Tulomajoki River area, Kola Peninsula, Russia, indicating a southeastern migration route. Some of the reintroduced geese have been observed in Sweden, Denmark, the Netherlands and England together with Bean Geese *Anser fabalis*. Mortality of released birds seems to be very high, c. 70-80% during their first winter (Markkola et al. 1993). Only 10% have returned to northern Finland and no breeding observations of the released birds have been confirmed (Markkola & Tynjälä 1993).

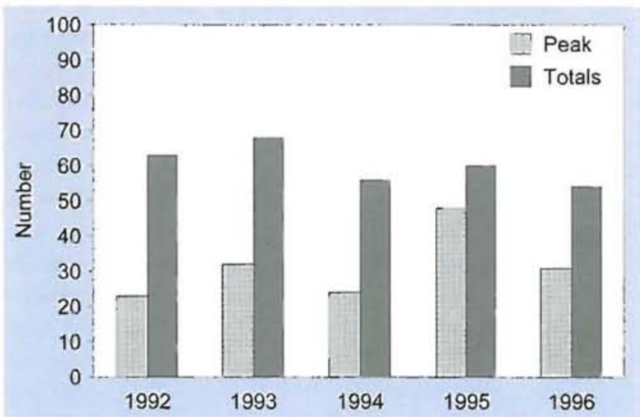


Fig. 7.4. The number of Lesser White-fronted Geese present at Valdak in Finnmark County, northern Norway during spring staging from 1992-1996. Shaded bars show the maximum number of individuals observed simultaneously and the black bars show the total number of individuals present based on individual recognition by belly patches. Data from Øien et al. (1996).

3. STAGING AREAS

3A. NORWAY

3A.1 Distribution

Range: Four staging areas are known in Norway. Two of these used to be used by the small and now probably extinct population in Nordland County. No Lesser White-fronted Geese have been observed here since the 1980s (Øien & Aarvak 1993). The remaining, important staging areas are both situated in Finnmark County. The classic staging ground is at the Valdak Marshes in the Porsangen Fjord, and a "new" staging area, Skjåholmen in Varangerfjord, was re-discovered in 1994 as a result of satellite tracking of geese from Finnish breeding sites (Lahti & Markkola 1995). Both areas are also used as post-moulting staging grounds for broods at the onset of autumn migration. Apparently, there is no exchange of birds between these two staging areas.

Habitat and feeding ecology: The Lesser White-fronted Goose feeds almost exclusively on *Puccinella phryganoides* during pre-breeding. However, in years with extraordinarily late snow melt, this traditional food plant may be covered by snow and ice, and the geese then change to *Hippuris tetraphylla*, which is available in small puddles and ponds of melted water. During late summer, they feed on the seeds of *Puccinella phryganoides, Festuca rubra, Agrostis stolonifera, Juncus gerardi, Eleocharis uniglumis* and *Elymus arenarius* (Aarvak et al. 1996).

3A.2 Abundance

Phenology: First birds usually arrive at the Valdak staging area around 15 May. Individual birds stage for four to eight days, depending on the snow conditions on the breeding grounds. Numbers peak between 20-25 May, and in the first week of June most geese depart to breeding areas (Øien et al. 1996). In the 1970s, the mass migration took place 1-2 weeks earlier with the first arrivals in the first week of May (e.g. Aarvak & Øien 1994). After the moult, broods reappear during 20-25 August, and depart during the first half of September.

Trends and numbers: Numbers of staging birds at Valdak Marshes have decreased severely in recent decades, although accurate information is only available from 1992 onwards, and these data show a slight decreasing trend (Fig. 7.4). Currently 25-30 pairs and 5-15 juveniles are present during pre-breeding at Valdak Marshes (Øien et al. 1996), while there are approximately 5-10 pairs at Skjåholmen in the same period (Aarvak et al. 1996). During late summer successful breeders take their broods to the same staging area as they used before breeding. Unsuccessful breeders and immature (second year) individuals probably use the same areas earlier in the summer.

3A.3 Research

Census: Since 1990, an annual monitoring programme has been carried out at the main staging area at the Valdak Marshes by the Norwegian Ornithological Society. During the pre-breeding period, individual identification of the staging geese using belly patch patterns has been developed to enable assessment of the number of individuals making use of the area (Øien et al. 1996). Since 1995, censuses have also been carried out during early autumn to provide information on annual productivity.

Ringing: No ringing programme exists. Thirty-nine individuals have been ringed in connection with satellite telemetry studies. Migration routes have been studied using satellite transmitters (Lorentsen et al. 1998).

Other: Studies on various aspects of behaviour, feeding patterns and disturbance have been carried out at the Valdak Marshes. Geese forage in pairs, utilising the outermost parts of the saltmarshes and, while feeding, males exhibit territorial and aggressive behaviour towards competitors.

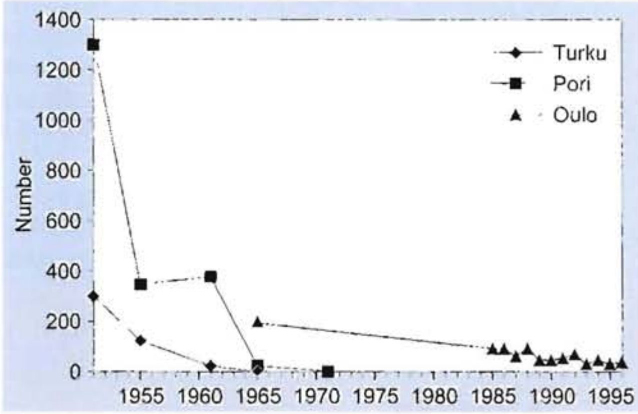


Fig. 7.5. Number of migrating Lesser White-fronted Geese in Finland from 1951-1996: Turku (from von Haartman et al. 1963), Pori (from Soikkeli 1973) and Oulu (from Merikallio 1915, WWF Finland unpubl., J. Markkola unpubl.).

3A.4 Protection and conservation

Hunting legislation: The Lesser White-fronted Goose is fully protected in Norway, and listed as endangered in the Norwegian Red List (Størkersen 1992). Before the population crashed, Lesser Whitefronts were shot during both the spring and autumn migration, but presumably the most influential method at that time was trapping during the moult by the locals and Sami people. This type of hunting was also a characteristic feature of the Russian hunting tradition (Nowak 1995), and could take the form of mass kills.

Site safeguard: The Valdak Marshes, the most important Norwegian staging area, was declared a nature reserve in 1983 (Stabbursnes Nature Reserve). It covers 16.2 km² of which 14.2 km² are tidal flats and water. All human traffic is prohibited from 1 May to 30 June. However, due to the disturbance by people picking Cloudberries *Rubus chamaemorus* in autumn, the geese spend most of their time on the adjacent islands where they could be subject to hunting. A proposal has been put forward to the environmental authorities to ban human traffic during the autumn as well, so that the geese can forage without disturbance. Helicopter traffic from a nearby airport also sometimes disturbs the geese. The Skjåholmen staging area in Finnmark county has, at present, no formal protection. During spring, traffic by people collecting gulls' eggs often disturb staging Lesser Whitefronts.

The breeding areas are partly within existing nature reserves and national parks although the core breeding area for the Lesser White-fronted Goose in Norway is not protected.

Agricultural conflict: Small to non-existent.

3B. FINLAND

3B.1 Distribution

Range: During the first decades of this century, the Lesser White-fronted Goose was common along the Finnish west coast and on the Karelian Isthmus during migration (Merikallio 1915). Up to the 1960s, Lesser Whitefronts visited the coastal meadows of the Turku (Åbo) area in southwestern Finland, the delta of the Kokemäenjoki River, the sandy shores of Yyteri-Preiviikinlahti north of Pori (Soikkeli 1973), and the shores of the Gulf of Bothnia near Oulu. In the 1960s, Lesser Whitefronts disappeared from the Turku Region, and around 1970 from Pori (Fig. 7.5). Since then, the only known Finnish staging area has been on the isle of Hailuoto (Karlö) (e.g. Markkola & Ohtonen 1996), and around the Bay of Liminganlahti (Markkola 1993). These areas have only been used during spring migration since the late 1960s.

Habitat and feeding ecology: Until the late 1960s, Lesser White-fronted Geese grazed *Empetrum* berries on the western sandy shore of the isle of Hailuoto (Virkkula 1930, Nyholm 1965). Studies carried out during spring-staging from the late 1980s and onwards show that Lesser Whitefronts now prefer brackish seashore meadows, often with salty patches, and feed on *Agrostis stolonifera, Calamagrostis stricta, Juncus gerardii, Carex mackenziei, C. paleacea, Triglochin palustris, T. maritimum* and *Puccinellia phryganoides*. In some years, open mud-flats with *Eleocharis uniglumis* are preferred. The diet consists mostly of underground organs of these plants. In spring, fields are visited only when the coastal meadows are ice-covered. The Lesser White-fronted Goose then prefer new, *Phleum* spp. fields, and not cereal fields (Markkola & Bianki 1995).

3B.2 Abundance

Phenology: The spring migration takes place between 5-23 May with peak dates 17-18 May. On autumn migration birds are seen only occasionally in Finland. Formerly, the migration took place between 20 August and the end of September, the peak being c. 15 September.

Trends and numbers: Sandman (1892) described "huge" flocks of Lesser White-fronted Geese visiting Hailuoto. Merikallio (1915) estimated numbers on Hailuoto and around Oulu in spring at 10,000 individuals. Even more may have visited the area during autumn. Before World War II, the Finnish (summer) population was estimated at 2100 individuals based on line transect censuses (Merikallio 1958). In 1955, Merikallio (1958) estimated 200 pairs without any proportions of breeders and non-breeders, although this may have been too high. During 1950-1965, the numbers of migrating individuals counted around Turku in southwestern Finland declined from c. 300 individuals to zero and around Pori from c. 1100 in 1950 to zero in 1970 (Soikkeli 1973) (Fig. 7.5).

From the early 1970s, the Oulu area, especially the isle of Hailuoto and the Bay of Liminganlahti, is the only spring staging area in Finland used by Lesser White-fronted Geese. The maximum number of birds seen at the same place during one day was c. 200 in the 1960s, c. 70 in the 1970s, c. 50 in the 1980s and c. 30 in the 1990s. In the late 1970s and early 1980s, the total number of staging birds near Oulu was estimated at 100-150. From 1985 onwards, the total number of geese visiting these areas has been counted as part of the Finnish-WWF conservation project. Birds have been identified individually using belly patches. During the period 1985-1988 the total number was quite stable at c. 95 individuals, whereas in the period 1989-1996 the mean number declined to 30-50 individuals.

3B.3 Research

Census: The spring staging population at Hailuoto and the Bay of Liminganlahti is monitored each year as is the breeding population in northeastern Finland.

Ringing: Reintroduced individuals are ringed with neck bands. Some individuals caught during the moult have been ringed with coloured leg and neck-bands.

Other: Potential isolation of the Fennoscandian subpopulation from the larger Russian-Siberian population and the risk of inbreeding depression is being studied by DNA techniques using blood, feathers and excrement samples. Migration routes and autumn staging sites are mapped using satellite transmitters.

3B.4 Protection and conservation

Hunting legislation: The species has been protected since 1969.

Site safeguard: The coastal meadows of the spring staging sites have been managed by cutting reeds in areas up to 40 hectares annually. Culling of Red Foxes is carried out in the breeding area.

Agricultural conflict: None.

3C. SWEDEN

3C.1 Distribution

Range of the native population: In spring the Swedish breeding population used to arrive from the Finnish side of the Gulf of Bothnia. There are several observations showing that flocks, after crossing the Gulf, used the green fields along the Swedish coast as staging sites until the breeding grounds were sufficiently free of snow and ice.

Range of the reintroduced population: By late August, Lesser White-fronted Geese leave the breeding area and some of them go directly to Hudiksvall on the Gulf of Bothnia, joining geese which have moulted there. They usually stay until late September. Scattered observations also exist from sites in southern Sweden. Spring migration occurs during the end of April and early May when some solitary birds are seen in the large flocks of Barnacle Geese on Gotland. The families are mostly seen along the eastern coast of Sweden. Hudiksvall has been an increasingly frequented staging site in spring too. By late May and early June, Lesser White-fronted Geese arrive at the reintroduction site in Lapland (von Essen 1996).

3C.2 Abundance

Phenology: Reintroduced geese stay in Hudiksvall from the end of August until the end of September and arrive back in Sweden late April-early May.

Trends and numbers: The native population has almost entirely disappeared from Sweden; only some scattered pairs may breed along the Norwegian border. The reintroduced population has increased (see section 2.5 above).

3C.3 Research

Census: The reintroduced population is censused every year in the breeding and wintering area.

Ringing: Reintroduced Lesser Whitefronts are individually marked with colour-rings.

3C.4 Protection and conservation

Hunting legislation: The species has been fully protected since 1964 and listed as endangered in the Swedish Red Data List (Ahlén 1975).

The reintroduction scheme is carried out within the Svaipa bird sanctuary.

3D. RUSSIAN FEDERATION

3D.1 Distribution

Range: The staging area on the Kanin Peninsula was re-discovered in 1994 (Vinogradov 1995) comprising c. 50 km² of annually flooded marshland between the mouths of the Mesna and Torna Rivers on the western coast of the Kanin Peninsula (68°01' N 44°20' E). The predominant vegetation is saltmarsh (locally called laidas) dominated by *Puccinella phryganoides, Carex subspathacea, Calmagrostis* spp. and *Plantago* spp. The area is separated from the White Sea by a narrow zone of sand dunes. The most important area for the Lesser White-fronted Geese seems to be directly south of the Mesna River close to its outlet (Tolvanen 1996).

There is a network of waterbodies within the Kuma-Manych Basin with steppe and agricultural lands on the coast. The Zapadny Manych River valley, Manych-Gudilo Lake, and the Tchograyskoye Reservoir and surroundings are used as stopover sites both in spring and autumn (Khokhlov 1989, Vinogradov 1990, Nankinov 1992). In the Nizheneye Dvuobye, within the borders of the Shuryshkarski District of the Tyumen Region, Lesser White-fronted Geese use the vast flooded meadows, floodplains and scrub along the Ob River during autumn. In Southern Transuralia the river valleys, banks of ponds and reservoirs in south Tchelyabinsk Region are used during spring migration (Korovin 1995). Staging areas are known from the eastern shores of the Sea of Azov.

Habitat and feeding ecology: Observations of feeding preferences on the Kanin Peninsula were made during a visit to the area between 24 August and 12 September 1996, where the geese were found to feed mainly on the stands of *Hippurietum tetraphylla, Puccinella phryganoides* and *Carex subspathacea* along the shores of numerous brackish pools. Unlike the other *Anser* species present, the Lesser White-fronted Geese spend all day grazing on the laida saltmarshes together with Barnacle Geese. Bean and White-fronted Geese were grazing on the surrounding palsa mires during daytime and roosting in the laida. In the Kuma-Manych Basin, Lesser Whitefronts feed mainly on winter crop fields, taking the green parts and seeds of wheat and barley (Khokhlov 1989).

3D.2 Abundance

Phenology: There is little information about staging phenology in the Kanin Peninsula area. In 1994, Lesser White-fronted Geese were seen between 31 May (when the observers arrived) and 8 June (Vinogradov 1995). On autumn passage in 1996, nine Lesser White-fronted Geese were present when the observers arrived on 24 August, numbers increased to about 100 on 12 September when the observers left (Tolvanen 1996).

In the Kuma-Manych Basin, birds arrive in late March and stay for a relatively short time. They are all gone by the end of April. In mild winters, they arrive at the end of February, but disappear again if the weather turns colder (Khokhlov 1989). In autumn, birds arrive at the end of October and stay until the last half of November. Maximum numbers are recorded in the middle of November. In Nizhneye Dvuobye, geese arrive in the first half of September and stage until early October (Vengerov 1970). In Southern Transuralia birds arrive in the last half of April or early May and stay until the middle of May. Maximum numbers are recorded at the end of April. In the Sea of Azov birds probably arrive in October and stay until late November/early December.

Trends and numbers: Satellite telemetry and marking programmes suggest that the Kanin Peninsula area may be the gathering place for the whole Fennoscandian breeding population (Lorentsen et al. 1998, Tolvanen 1996). According to local hunters, Lesser White-fronted Geese were common in this area in the 1950s (Vinogradov 1995). Current numbers of staging birds in autumn corresponds well with the Fennoscandian post-breeding population i.e. 100-200 individuals, depending on the yearly variation in breeding success (Aarvak et al. 1996). This area is most likely also used by Lesser Whitefronts from other breeding areas.

No censuses of the Kuma-Manych Basin have been carried out in the last 20 years. Normally, flocks of tens of birds are counted, up to a maximum of 600 individuals, in autumn at Tchograyskoye Reservoir and Eastern Manych (Khokhlov 1989). The number of birds has decreased markedly since the 1970s (Krivenko et al. 1978). Vinogradov (1990) reports a maximum of 60,000 individuals in former times, and Nankinov (1992) a maximum of 20,000.

No counts exist from the Nizhneye Dvuobye in the last 30 years. The fact that the habitats have not changed indicates that this area could still be used by Lesser White-fronted Geese. Many thousand individuals were recorded 30 years ago (Vengerov 1970).

In Southern Transuralia, flocks of 5-20 individuals have been recorded from different places. At one of the reservoirs, 500-800 individuals have been recorded during migration. The number of staging birds did not change during 1990-1993 (Korovin 1995).

3D.3 Research

Census: Current knowledge of the Kanin Peninsula staging area is derived from the Norwegian (Lorentsen et al. 1998) and Finnish satellite telemetry projects, one Russian expedition in spring 1994 (Vinogradov 1995) and one Finnish expedition in autumn 1996 (Tolvanen 1996).

No studies are being carried out at the other staging areas. No data have been published from the Nizhneye Dvuobye for the last 30 years, from the Kuma-Manych Basin for the last seven years, or from the Southern Transuralia from the last three years. New studies are planned within the framework of the activities of the Goose Study Group of Eastern Europe and Northern Asia.

Ringing: Little information exists on ringing activity in Russia. Some moulting individuals were ringed at Yamal during 1996 and 1997 (V. Morozov pers. obs., Tolvanen et al. 1998).

Other: In 1996 the Finnish expedition mapped the Lesser White-fronted Geese's use of the staging area, flock composition, feeding preferences and disturbance (Tolvanen 1996).

3D.4 Protection and conservation

Hunting legislation: The Lesser White-fronted Goose is included in the Red Data Book of RSFSR (1983) and therefore hunting and other utilisation of the species is prohibited. However, cases of illegal hunting are often recorded, mostly due to confusion with the White-fronted Goose.

Site safeguard: On the Kanin Peninsula, conservation measures were proposed in 1995 in order to protect a colony of 1000-2000 breeding pairs of Barnacle Geese. Based on the results from the satellite telemetry in 1995 and the expedition in 1996, which showed that Lesser White-fronted Geese occurred in significant numbers, the Shoininski State Nature Reserve was established in January 1997. The principal human activities at the site and in its vicinity are fishing, Reindeer breeding, trapping of Arctic Fox *Alopex lagopus*, hunting waterfowl and gathering eggs.

The Nyzhneye Dvuobye in western Siberia, within the Chanty-Mansijsk Autonomous District and some of the waterbodies in the Kuma-Manych Basin and Kuban River Delta (the Manych-Gudilo Lake, the Vesyolovskoye Reservoir (Western Manych River), and the Akhtaro-Grivenskoye Liman system of Eastern Priazovye) are included in the list of Ramsar sites according to the Governmental Decree of 13 September 1994.
Agricultural conflict: None known.

3E. KAZAKHSTAN

3E.1 Distribution

Range: Some 4000-10,000 birds rest and feed on Lakes Maibalyk, Tarangul, Shagly-Teniz, Aksuat and others (Drobovtsev 1972).

3E.2 Abundance

Phenology: Very little information exists. First Lesser White-fronted Geese and White-fronted Geese appear in northern Kazakhstan c. 23-25 April, while the main migration takes place in early May (Drobovtsev 1972). In autumn, first flocks arrive 18-23 September, but most occur in early October.

According to local people and hunters, the first flocks of White-fronted, Lesser White-fronted and Red-breasted Geese *Branta ruficollis* arrive in late September, and staging numbers normally peak in mid October. The geese leave the area before the lakes freeze in early November.

Trends and numbers: The number of Lesser White-fronted Geese observed during the Finnish expedition in 1996 was approximately 7900 individuals, i.e. c. 2.8% of all geese observed. This figure is based on c. 15,000 randomly sampled individuals (c. 5.4% of the total)(Tolvanen & Pynnönen 1998). Lake Kulykul, located c. 240 km southsoutheast of the city of Kustanay, is the most important roosting lake visited by the expedition. During 13-14 October 1996, approximately 120,000 geese roosted there, including c. 3400 Lesser White-fronted Geese. During May 1997, approximately 2000 Lesser White-fronted Geese were observed in the Kustanay Region (Markkola et al. 1998). According to local people, the number of staging Lesser White-fronted Geese has clearly declined.

3E.3 Research

During 4-15 October 1996, WWF-Finland arranged an expedition to Kustanay, northern Kazakhstan, to survey the satellite transmitter (PTT) locations pinpointed in October 1995 from an adult male, tagged in Finnish Lapland at the end of July 1995. From the place where the first satellite locations in Kazakhstan (Lake Koybagar) came from, two ringed juveniles (offspring of the PTT bird) were reported shot in mid October 1995. Six of the most important roosting lakes for geese in eastern and southern Kustanay Oblast were surveyed

(Tolvanen & Pynnönen 1998). The expedition was followed up by searches for geese during May 1997 (Markkola et al. 1998).

3E.4 Protection and conservation

Hunting legislation: The Lesser White-fronted Goose is not protected in the Republic of Kazakhstan, even though it is claimed to be in the Action Plan recently published by the Council of Europe (Madsen 1996). Lesser White-fronted Geese and White-fronted Geese are shot because hunters are not able to separate the two species. Therefore, effective protection of the Lesser White-fronted Goose would be difficult to put into practice even if the legislation were to be implemented. The species should urgently be protected by law in Kazakhstan.

According to local hunting inspectors, there are approximately 10,000 hunters in the Kustanay Oblast area, of which c. 2000 are more or less active. One permit allows a hunter to shoot four geese and ten ducks, and estimates of the total bag of geese during the autumn hunting season varied from c. 5000 to c. 60,000 individuals (P. Tolvanen pers. obs.).

The Finnish expedition observed 111 geese shot by hunters: 95 White-fronted Geese, six Lesser White-fronted Geese and 10 Greylag Geese *Anser anser*. No Red-breasted Geese were seen shot (Tolvanen & Pynnönen 1998).

Site safeguard: The most important roosting lakes for geese surveyed by the expedition (Lake Bis-Saigan, Lake Tjuntjugur, Lake Syptykul, Lake Babatkul and Lake Kulykul) are protected from hunting on the water area, but hunting is allowed along their shores.

Lake Naurzum in Kustanay Oblast and Lake Sarykopa in the Turgay area are probably very important roosting lakes for geese but were not surveyed by the Finnish expedition. Lake Naurzum is a *Zapovednik*, the highest level of state nature reserve where economic activity affecting the development of natural processes is prohibited (Wilson & Moser 1994).

Agricultural conflict: Not known.

3F. LITHUANIA

3F.1 Distribution

Range: Staging areas in Lithuania are in general poorly known, and it is assumed that Lesser White-fronted Geese may be overlooked in large flocks of other migrating goose species (Svazas 1996). In the 1960s large flocks were recorded in coastal areas, especially the Kuršiu Lagoon and Nemunas River Delta but only irregular observations have been made in this area in the 1990s. Also small flocks have been recorded almost annually in the Zuvintas Reserve during 1966-1986.

3F.2 Abundance

Phenology: Migratory passage takes place during March-April and late September-early October (Svazas 1996). In 1995, 200-230 individuals staged in the Nemunas River Delta for about two weeks (28 September-13 October).

Trends and numbers: There are no accurate census data but reports indicate that the species was more common during the 1960s than during the 1990s (Svazas 1996).

3F.3 Protection and conservation

The Lesser White-fronted Goose is not included in the Lithuanian Red Data Book, nor is it protected from hunting by law (Svazas 1996). Hunting associations have excluded the species from their lists of game species, but some geese are likely to be shot by mistake each year because of confusion with other goose species.

3G. GERMANY

3G.1 Distribution

Range: One staging area, the surroundings of the Galenbecker See and the Putzarer See in Mecklenburg-Vorpommern is known, but at present its significance is unknown. This site was discovered as a stopover site for Lesser Whitefronts breeding in Fennoscandia in 1995 by means of satellite-tracking (see Lorentsen et al. 1998). Lesser White-fronted Geese also used this area in 1996 (J. Mooij pers. comm.).

3G.2 Abundance

Phenology: In 1995, autumn staging occurred between 19 September and early October. It is not yet clear if this site is also used as a stopover site on spring migration.

Trends and numbers: In 1995 two satellite tagged individuals were observed at the site together with at least ten conspecifics (S. Krüger pers. comm.).

3G.3 Research

None known.

3G.4 Protection and conservation

Hunting legislation: The Lesser White-fronted Goose is fully protected in Germany but the general hunting pressure on geese in Mecklenburg-Vorpommern is huge. About 7000 geese, mostly White-fronted Geese, are shot in this area annually (J. Mooij pers. comm.). One of the satellite-tagged birds disappeared here in 1995 and was probably shot. In 1996, one Lesser White-fronted Goose was reported shot in Mecklenburg-Vorpommern (J. Mooij pers. comm.).

Site safeguard: Both Galenbecker See and Putzarer See are protected as nature reserves. Galenbecker See is also a Ramsar site, while Putzarer See is a wetland of national importance (Grimmett & Jones 1989). Hunting is not allowed inside the nature reserves but, as in most other cases, the geese are not protected during daytime while grazing on the surrounding fields. Buffer zones with a hunting ban around the roosting sites should be established as a minimum.

Agricultural conflict: Unknown.

3H. HUNGARY

3H.1 Distribution

Range: The Lesser White-fronted Goose occurs almost exclusively on the Great Hungarian Plain in the areas of Hortobágy, Biharugra and Kardoskút (Faragó 1995). Some observations exists from the salt lakes of the Kiskunság region.

Feeding ecology: Stomach contents from 100 individuals all contained fragments of the natural steppe vegetation dominated by *Festuca pseudovina* (Sterbetz 1978). Lesser White-fronted Geese did not utilise maize residues left over on stubble fields but persisted in the natural *Festuca* lowland steppe grassland. Geese foraged on natural steppe grassland in 67% of cases (total n=177), on fields of young grain for 17% and remained on water for 16% of the time. The species prefer feeding sites on open grassy lowland plains and roosting sites on salt lakes and on lowland fish-pond system units larger than 200 to 300 ha (Sterbetz 1982).

3H.2 Abundance

Phenology: First individuals normally appear in late September or early October (Sterbetz 1982). If food conditions deteriorate, the birds quickly move on but are sometimes followed by other arrivals in November. The latest birds to arrive often stay until snowfall. Monthly average numbers from October and through the winter suggest that the geese may move away during mid winter. Spring migration peaks in March (Sterbetz 1983).

Trends and numbers: Numbers of Lesser White-fronted Geese visiting Hungary have decreased considerably since the 1950s (Sterbetz 1982). Based on counts at Nagyszénás, Biharugra and Hortobágy during 1947 and 1951 Sterbetz (1982) concluded that 80,000-120,000 Lesser White-fronted Geese visited these areas. Twenty years later, in 1967, about 5000 individuals were counted in the same area. Since then numbers have decreased further to approximately 50-400 individuals (Faragó 1995, 1996).

3H.3 Research

Lesser White-fronted Geese numbers have been monitored throughout the wintering period (e.g. Sterbetz 1968, 1978, 1982, 1983, 1986, 1990, Faragó 1995); and samples have been collected for food analysis and habitat choice.

3H.4 Protection and conservation

Hunting legislation: Since 1982, the Lesser White-fronted Goose has been protected in Hungary (Faragó 1995). No statistics of misidentified geese shot are available.

Site safeguard: The Hortobágy area (52,000 ha) was declared a National Park in 1973 and a smaller area (12,500 ha) designated as a Ramsar site in 1978 (Faragó 1995). Waterfowl hunting is banned except at the Hortobágy fishponds, where Mallard *Anas platyrhynchos* and Coot *Fulica atra* can be shot in the period 15 August to 15 September. A potential threat to staging Lesser Whitefronts is the ongoing privatisation of the Hortobágy fish farms which may lead to increased hunting pressure and tourism (e.g. Aarvak et al. 1996).

The Fishponds at Biharugra (7909 ha) were declared a Landscape Protection Area in 1990 (Faragó 1995). Regulations impose important temporal and spatial limitations on hunting which, according to Faragó (1995), do not influence numbers of birds present.

Agricultural conflict: None known.

4. WINTERING AREAS

4A. AZERBAIJAN

4A.1 Distribution

Range: In winter, Lesser White-fronted Geese are most common along the shores of Kizil Agach bays in southern Azerbaijan, especially in the northwestern corner of Big Kizil Agach Bay. It also occurs in small numbers in southern Mugan on both sides of Lake Machmud Chala. Small numbers also occur in the Shirvan Steppe (near Lake Shorgel), Mil steppe (Lake Aggel, Sarasuy) and surrounding Karagan Semi Desert and Hadjinour Steppe (M. Patrikeev unpubl.).

Habitat and feeding ecology: Lesser White-fronted Geese concentrate in wheat fields and arable land outside the Kizil Agach Reserve. Until 1993, fields were sown with barley for geese wintering in the reserve (500 ha), and the numbers increased (Paynter et al. 1996). In the Mil Steppe, they regularly visit arable land around the lakes (M. Patrikeev unpubl.).

4A.2 Abundance

Phenology: The autumn migration through Azerbaijan starts in early October, and peaks in late October and early November. The Lesser White-fronted Goose usually migrates in small groups (20-50) within flocks of White-fronted Geese or Greylag Geese. Geese fly non-stop over northern Azerbaijan, crossing the Absheron Peninsula, to the Kizil Agach Reserve and Mil Steppe (M. Patrikeev unpubl.). Spring migration starts in mid March when flocks of 25-35 begin to appear in the Mil Steppe and Lake Sarasuy. They usually stay at this lake overnight, especially at the Beloie site where up to 250 individuals are recorded. In Kizil Agach Reserve, spring migration takes place in March, though in some years Lesser White-fronted Geese occur there until early April (M. Patrikeev unpubl.).

Trends and numbers: Recent counts have been carried out by helicopter, but these and earlier ground counts have often failed to distinguish between White-fronted and Lesser White-fronted Geese, although the latter species rarely constituted more than 10% of counts. In the following analysis, all counts refer to both species combined unless otherwise identified.

The total number of Lesser White-fronted Geese wintering in Azerbaijan probably varies between 1500 and 6000-7000 individuals (M. Patrikeev unpubl.). According to Skokova & Vinogradov (1986), 11,000 to 25,000 winter in Kizil Agach Reserve alone. This was not supported by the findings in January 1996, nor by interviews with local people and staff of the reserves, State Committee for Ecology and Academy of Sciences (Paynter et al. 1996). Counts done in the period 1979-1989 (E. Tkachenko unpubl.) show that the numbers of White-fronted and Lesser White-fronted Geese decreased from 17,000-25,000 to 5000-6000.

Numbers in the Kizil Agach area vary according to local hydrological conditions: over 13,000 Lesser White-fronted Geese wintered in the dry winter of 1952-53 compared with 1000 in the wet winter of 1953-54 when semi-desert areas were flooded. An average of no more than 900 of both species wintered between 1971-1976, attributed to conversion of steppe and semi-desert pastoral habitats into vineyards. In the late 1970s, the number of both species increased after barley was sown for geese wintering in the Kizil Agach Reserve. From 1979-1982, 6000 to 10,000-12,000 individuals of both species wintered in the Reserve. In the wet winters of 1982-84, 25,000 individuals of these species occurred in Kizil Agach Reserve, but Lesser White-fronted Geese were obviously in the minority (M. Patrikeev unpubl.). Numbers of both species fell from 17,000-25,000 to 5000-6000 during 1979-1989 (E. Tkachenko unpubl.), with 8000-15,000 geese wintering in the Reserve. In January 1991, 1520 individuals were counted in the Kizil Agach Area along with 2000 unidentified geese (Perennou & Mundkhur 1991). In January 1996, a total of 1080 Lesser White-fronted Geese were observed. Of these, only 3.0% were immatures (Paynter et al. 1996).

During 1961-1963, 2000-11,400 geese wintered at Lake Aggel (M. Patrikeev unpubl.). In recent years only a few hundred have been seen.

4A.3 Research

Census: Recent counts in Azerbaijan have been carried out by helicopter and are subject to the limitations of this method of censusing in terms of accuracy of species identification and numbers. Fauna & Flora International together with British Petroleum and the State Committee for Ecology have, since 1992, been working to re-establish effective operation of the country's nature reserves, and an annual count in wetlands of importance.
Ringing: No ringing programme exists.

4A.4 Protection and conservation

Azerbaijan became independent in 1991. Prior to its secession, 14 Zapovedniks and 18 Zakazniks had been designated in the Azerbaijan SSR covering 191,200 ha and 266,100 ha respectively, or approximately 2.2% and 3.1% of the territory. Wetlands have suffered severely with many being drained for agriculture. The hydrology of coastal wetlands was further altered by the fluctuating level of the Caspian Sea during the last 70 years. Insufficient funds and manpower to guard and maintain protected sites has meant that the country's protected area system has largely collapsed since independence. Pressure on the reserves has increased markedly, particularly from illegal hunting by neighbouring communities who view the land of the reserves as a common and free resource.
Hunting legislation: The Lesser White-fronted Goose is formally protected, but White-fronted Geese and Greylag Geese are legal quarry. Lesser White-fronted Geese are most likely shot both due to confusion with other species and to general hunting practice. Few hunters are able to differentiate between goose species.
Site safeguard: The Kizil Agach Nature Reserve (Zapovednik), which lies on the Caspian coast 170 km south of Bacu in the Lenkoran District, is the largest and oldest reserve in Azerbaijan, covering 88,360 ha and gazetted in 1929. It comprises the Big Kizil Agach Bay (Big Kirov Bay/Bolshoi Kizil Agach), associated islands, fringing coastal wetlands and adjacent low-lying semi-desert areas. The northern 5000 ha section of the adjacent Little Kizil Agach Bay (Little Kirov Bay/Maly Kizil Agach) is also included within the reserve. The southern part of this bay is partially protected as a Zakaznik (10,700 ha). This latter area is separated from the sea by an artificial dam and is less saline than Big Kizil Agach Bay.

Most of the geese located during the 1996 survey were found in an area to the northeast of the reserve boundary. Some were feeding on newly emerging winter wheat, but the majority were observed on very short, quite green steppe which was heavily grazed by large flocks of sheep and some cattle. Large areas had been ploughed and the formerly ploughed fallow areas were quite different in appearance. It was here that the main concentration of Lesser White-fronted Geese were located. Although apparently extensive and open, this habitat may actually be quite small in area and endangered by further ploughing. The exact extent should be mapped and steps taken to conserve it, i.e. include it within the boundary of the reserve and prevent ploughing and over grazing (Paynter et al. 1996). Major threats are pollution from pesticides, waste products from neighbouring cotton plantations and vineyards. The presence of fish farms has adversely affected the surrounding steppe by channels, dams and embankments.

The Shirvan Nature Reserve (25,800 ha) in the Salyan District was established in 1969 and is predominately dry steppe with a high diversity of grasses. There is a central 3500 ha wetland which forms the western part of the Lake Shorgel. The remainder of this wetland area is included within the contiguous 22,000 ha Bandovan Zakaznik.

The greatest current threat is overgrazing of the steppe and semi desert by domestic livestock owned by war refugees from the enclave of Nagorno Karabakh. Local farmers also play a major role and an estimated 50% of the substrate is now bare in some areas.

Lake Sarasuy in the Sabirabad District is a hunting reserve, covering 11,147 ha. The lake has not been included in land based counts recent years, partly be-

cause it is difficult to reach without vehicles. Unconfirmed information states that large numbers of geese occur on the southern side of the lake. Lake Machmud Chala is situated in the southern part of Mugan Steppe. The area has no conservation status.
Agricultural conflict: Unknown.

4B. IRAN

4B.1 Distribution

Range: The Lesser White-fronted Goose is a winter visitor, mainly in five areas along the northern parts of the Caspian Sea coast: marshes in central Gilan on the south coast of the Caspian Sea; the marshes and brackish lagoons of Gorgan Bay and Turkoman Steppe in Mazandaran; the wetlands of the Uromiyeh Basin in Azerbayjan; the flood-plains of the Dez and Karun Karkheh Rivers in Khuzestan; and the network of fresh and saline lakes in central Farz (Evans 1994).
Habitat and feeding ecology: Unknown.

4B.2 Abundance

Phenology: Winter visitor, and during autumn migration as early as October.
Trends and numbers: Lesser White-fronted Geese were observed regularly in Iran during 1967 to 1978 when it was estimated that 4500-7500 wintered, mainly in the Miankaleh Protected Region (Scott 1976) (Fig. 7.6). Unfortunately, the major feeding areas were flooded in the early 1980s as a result of the rapid rise in the level of the Caspian Sea and few have been seen since. Recent counts in Iran record 39 individuals in 1993 (Rose & Taylor 1993) and 35 in the Miankaleh Protected Region in 1989. The Dam Kaal wetland area in the southeastern corner of the Caspian Sea was visited early January 1996 and a group of 13 Lesser White-fronted Geese were observed (J. Alhainen, A. Miikkulainen, J. Rinne pers. comm.). A large number of hunters were netting waterfowl, especially Mallards. The Greylag Goose was the most common goose species, but some

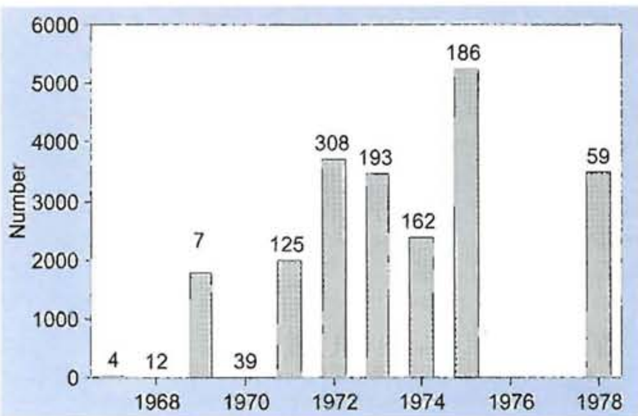


Fig. 7.6. Total numbers of Lesser White-fronted Geese in Iran in the years 1967-1978. No census data were available in 1976 and 1977. Numbers over columns indicate the number of sites counted. Data from Perennou et al. (1994).

hundreds of White-fronted Geese were also observed. Shooting in this area is allowed only during a short period just before and during the mass departure of the wintering waterfowl in spring.

Iran probably has a small but stable wintering population. In the 1970s, very small numbers of Lesser Whitefronts were encountered in Azerbayjan Province. Winter severity in the north Caspian area could lead to a redistribution of birds. However, irregular censusing and lack of knowledge about the mechanism behind cold weather movements, makes it virtually impossible to interpret the information.

4B.3 Research

Census: Censuses have been carried out irregularly since 1967.

4B.4 Protection and conservation

Hunting legislation: Unknown.
Site safeguard: Lesser White-fronted Geese have been recorded in 17 localities of which eight have formal protection. The most important sites in the 1970s with records exceeding 1000 individuals are Seyed Mohalli, Zarin Kola and Larim Sara area (unprotected), Miankaleh Peninsula and Gorgan Bay area (Ramsar site, Biosphere Reserve), Gomishan Marshes and Turkoman Steppe area (unprotected) (Evans 1994). The main threats to wetlands are hunting and the change in the water level of the Caspian Sea, which alters the flora in the exposed areas. Hunting pressure is generally very high.
Agricultural conflict: Virtually unknown.

4C. IRAQ

4C.1 Distribution

Range: The Lesser White-fronted Goose occurs in Mesopotamia in southeastern Iraq along the flood-plain of the Tigris and Euphrates Rivers with extensive areas of permanent or seasonal shallow lakes. Three sites are known to have Lesser White-fronted Geese, namely Haur Al Suwayqiyah, Haur Chubaisah Area and Haur Al Hawizeh (Evans 1994).
Habitat and feeding ecology: Little is known, but Lesser Whitefronts have been seen in the vicinity of three major lakes (marshlands), surrounded by steppe thickly vegetated with annual grasses, herbs and *Salicornia* flats after good rainfall. Grass and arable land fringe the area (Evans 1994).

4C.2 Abundance

Phenology: Winter visitor in November-December.
Trends and numbers: Formerly regular and sometimes numerous in winter. The Lesser White-fronted Goose is presently probably found in small numbers or even as a vagrant (Evans 1994). Known records date back to December 1914-1918 when a flock was recorded in Haur Al Suwayqiyah. The Lesser White-fronted Goose was common in this area in the winter of

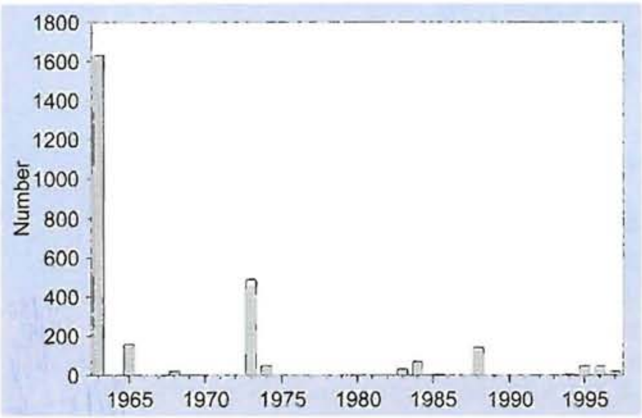


Fig. 7.7. Midwinter maximum numbers of Lesser White-fronted Geese counted at all Greek sites (1963-1997). Data from Handrinos (1991) and Wetlands International Goose Database.

1954/55 and occurred commonly at two other localities in the 1960s. In 1968, 126 individuals were counted in Iraq (Perennou et al. 1994). The most recent information dates back to before 1979, when 70 individuals were found in Haur Al Suwayqiyah in 1972.

4C.3 Research

Census: No counts have, as far as we know, been performed in Iraq since 1979. Between 1966 and 1979 some incomplete surveys were carried out, covering only a fraction of the enormous wetland area (Evans 1994). Various sources have, unfortunately, taken the lack of counts to mean that there are no wintering Lesser White-fronted Geese in the country. The current status is virtually unknown.

4C.4 Protection and conservation

Hunting legislation: Unknown.
Site safeguard: All three sites with records of Lesser White-fronted Geese are unprotected. There is apparently no legislation to protect sites for nature conservation, nor have any plans been developed or implemented. Iraq is a contracting party to the World Heritage Convention but has not designated any natural World Heritage Sites, nor has it signed the Ramsar, Biodiversity or Bonn Conventions (Evans 1994).
Agricultural conflict: Unknown.

4D. GREECE

4D.1 Distribution

Range: The Lesser White-fronted Goose occurs mainly in two areas in Greece: Lake Kerkini in northern Greece and the Evros Delta on the Turkish border, but is also known to occur at Lake Mitrikou (Handrinos 1991).

4D.2 Abundance

Phenology: Satellite-tracking of Norwegian Lesser Whitefronts showed that Lake Kerkini was used as a staging site for the birds wintering in the Evros Delta (arriving early-mid November at Lake Kerkini). In the Evros Delta, the same birds arrived the last week of November (Lorentsen et al. 1998). Lesser Whitefronts stay in the Evros Delta through December to January/early February.
Trends and numbers: Handrinos (1991) stated that records from the past suggest that Lesser White-fronted Geese could be fairly common (Fig. 7.7). January counts in the 1980s show numbers varying from one to 142 (Handrinos & Goutner 1990). In recent winters a small but stable wintering population of up to 140 birds has been established in northern Greece (H. Jerrentrup & G. Handrinos pers. comm.). The flock of Fennoscandian breeding birds visiting Lake Kerkini and the Evros Delta during the winter 1995-96 numbered 43 birds. On 5 January 1997, 21 Lesser Whitefronts were observed in the Evros Delta (Y. Tsougrakis pers. comm., Birdnett), and on 1 March 1997, 63 (Lampila 1998).

4D.3 Research

Census: A mid January waterfowl census has been carried out annually since 1982.
Ringing: No birds have been ringed in Greece.

4D.4 Protection and conservation

Hunting legislation: Protected.
Site safeguard: The Evros Delta is a nature reserve where hunting is prohibited. However, in adjacent areas hunting pressure on waterfowl is considerable, and some illegal hunting inside the protected zone is still occurring. Drainage by farmers and overgrazing by cattle has until recently deteriorated the Evros Delta as a goose habitat.

4E. BULGARIA

4E.1 Distribution

Range: Wintering Lesser White-fronted Geese have been found at Lake Durankulak (a brackish to freshwater lake with some reedbeds) and the Shabla-Ezteretz complex (two lakes connected by an artificial canal and separated from the Black Sea by a sand bar. Both lakes have indented shorelines with *Phragmites*). Lesser Whitefronts are also known to occur at the Ovcharitsa Reservoir, where concentrations of more than 1000 individuals have been recorded. Small flocks and single individuals have also been recorded in northwestern Bulgaria, near Lake Srebarna (a freshwater lake with emergent vegetation dominated by *Phragmites* close to the Danube on the Romanian border), and near the lakes around the city of Burgas, where up to 500 Lesser Whitefronts have been observed. Similar numbers have also been reported from the Varna coastal waters (Timmerman et al. 1976).

Lesser Whitefronts are known to occur in the Thracian Valley, and along the valleys of the Strouma and Mesta Rivers (Nankinov 1993). One of the satellite-tagged birds from Norway was recorded in the Strouma Valley on its way from Lake Kerkini to the Evros Delta

(Lorentsen et al. 1998). A new wintering site was discovered in 1991 near the village of Morava, where more than 1000 individuals were feeding on winter wheat (Nankinov 1993). Later visits have failed to confirm the regular use of the site (P. Iankov, T. Michev, I.J. Øien, T. Aarvak pers. comm.).

Habitat and feeding ecology: Lesser Whitefronts forage on short grassy vegetation and winter wheat.

4E.2 Abundance

Phenology: Lesser Whitefronts arrive in late November and usually remain until December. In January they are presumably absent, as usually only a few individuals are recorded during the mid January waterfowl census. Numbers occurring in February are thought to be increasing.

Trends and numbers: The observed numbers of 500-1000 individuals apparently occur only occasionally (most recently the winter 1991-92). This may be due to low observation activity, or to the fact that the occurrence of Lesser Whitefronts depends on weather conditions. During mid January censuses in 1993, 80 Lesser Whitefronts were found, and in 1994, 17 were found in the whole country. In 1995, only two individuals were reported in Bulgaria during winter. The varying numbers probably also reflect problems with identification of the species in huge flocks of White-fronted Geese. In November-December 1996, 10 Lesser Whitefronts were observed in Bulgarian wetlands known to hold the species. Based on proportions in mixed flocks, the total number of Lesser White-fronted Geese in the country was estimated at 30-40 individuals (P. Iankov, T. Aarvak, I.J. Øien pers. obs.).

4E.3 Research

Census: As well as annual mid January waterfowl censuses, goose counts are carried out every second week during October-February in the southern Dobrodja Region (Shabla Durankulak). In November-December 1996 a joint survey organised by the Norwegian Ornithological Society and the Bulgarian Society for the Protection of Birds was carried out and all potential sites used by Lesser Whitefronts visited.

Ringing: No birds have been ringed in Bulgaria.

4E.4 Protection and conservation

Hunting legislation: The species is protected by Act 342 (1986) and is listed in the Red Data Book of Bulgaria (Boev 1985).

Site safeguard: Lake Srebarna (Silistra) is a Nature Reserve, a Ramsar site, Biosphere Reserve and a World Heritage Site. Lake Burgas, a brackish/freshwater site close to Burgas is unprotected. Lake Durankulak is a protected landscape (Ramsar site) with little human activity. The Shabla-Ezeretz complex has recently been designated as protected, and action is being taken to ensure better protection and habitat management of this site. Hunting is prohibited here, but is still a problem in the surrounding area. Ovcharitsa Reservoir is unprotected, but proposed as a Natural Monument (Grimmett & Jones 1989). Goose hunting is forbidden at all Ramsar sites.

Agricultural conflict: Unknown.

4F. ROMANIA

4F.1 Distribution

Range: Most records of Lesser Whitefronts are from the Dobrodja Region (over 1000 individuals observed in 1989), but small numbers also winter inland. There are no recent records from Transylvania (Munteanu et al. 1991). Also found in the Danube Delta and Razelm-Sinoie complex; 2 individuals in 1982, and other counts include maximum 500 in the part areas Lacula Istria, Lacul Nuntasi and southern Lacul Sinoie (Grimmett & Jones 1989).

4F.2 Abundance

Phenology: The species is both a migrant and winter visitor.

Trends and numbers: The Lesser White-fronted Goose occurs in very small numbers and is usually associated with White-fronted Geese. The mid January censuses gave the following numbers: 270 in 1988, 1155 in 1989 and 343 in 1990 for the whole of Romania (IWRB Goose Research Group 1990b). In 1991 and 1995, 11 and 31 Lesser Whitefronts were observed respectively. In January 1992, a total of 900 individuals was estimated for Romania (D. Munteanu pers. comm.). During the mid January censuses in 1992, 96 individuals were counted and in 1995, 31 individuals. As in Bulgaria, the censuses probably does not account for all Lesser Whitefronts present due to identification problems.

4F.3 Research

Census: Mid January Waterfowl census each year.

Ringing: No birds have been ringed in Romania.

4F.4 Protection and conservation

Hunting legislation: Protected.

Site safeguard: In December 1995 the Romanian Parliament adopted a new law for protection of the environment. This makes it possible to designate important bird areas (IBAs) as statutory protected areas. The law also stipulates that a Romanian Red List of plant and animal species and a catalogue of protected areas and nature monuments are published and kept up to date (BirdLife International 1996). The Danube Delta and the Razelm-Sinoie complex (Tulcea, Constanta) form a Biosphere Reserve consisting of several nature reserves where hunting is forbidden. However, some parts of the area remain unprotected and hunting is carried out on the feeding sites outside the protected areas.

5. DISCUSSION

Population status: The world population of the Lesser White-fronted Goose has declined severely since the beginning of this century. Counts indicate that the population experienced a rapid and considerable reduction in the 1940s or early 1950s, perhaps especially during World War II. A number of suggestions have been put forward to explain this population crash including heavy hunting pressure, cold winters and serious droughts in the wintering areas. At the moulting areas in Fennoscandia and Russia, hunting pressure may have been heavy during the moult. There is a considerable lack of information regarding the situation along the migration routes and in the wintering areas during these years. Thus, the reasons for the rapid decline are unknown.

The causes of the large and rapid decline of the population during the 1940s and early 1950s are not necessarily linked to the causes preventing recovery from the decline. Recent studies show that breeding success and juvenile production are comparable to other goose species, indicating that conditions for breeding are quite good. The species is protected in all countries where it breeds (Norway, Sweden, Finland and Russia), and potentially negative factors are probably less important during the breeding season. Nevertheless, human disturbance at breeding sites, predation by foxes and over-exploitation of the vegetation by Reindeer herds may influence breeding success in some areas, at least in Fennoscandia. In Russia, any negative factors affecting breeding are less known. Studies indicate that juvenile mortality during migration and wintering is considerable (e.g. Aarvak et al. 1997, Lorentsen et al. 1998, see above), probably mostly due to hunting. Expeditions to staging and wintering sites e.g. in Kazakhstan, Azerbaijan, the Azov Sea and Iran indicate heavy hunting pressure mostly due to confusing this species with the White-fronted Goose. Agricultural patterns have changed in many of the countries used during migration and winter, making fields previously used less preferable, or even unusable, for the Lesser White-fronted Goose. Deleterious factors during migration and winter are, thus, the most probable causes of the lack of recovery after the population decline during the 1940s and 1950s.

The ease with which the Lesser White-fronted Goose could be hunted due to its "irrepressible curiosity" was described by Alphéraky (1905). Even in huge flocks on migration, Lesser Whitefronts approached noise made by hunters who took advantage of this behaviour and shot many. The same behaviour is typical both during spring staging at Valdak, northern Norway, as well as on the breeding grounds (I.J. Øien & T. Aarvak pers. obs.), and may be one of the reasons why the Lesser White-fronted Goose is extremely vulnerable to hunting. In northern Russia, the geese arrive when only small areas are free of snow cover. This facilitates the hunters since the geese are forced to gather in small, predictable patches.

Conservation issues: The Lesser White-fronted Goose is protected within its breeding range but illegal hunting still occurs. It is not protected against human disturbance during breeding. Many of the sites used during migration and winter are also protected but hunting does still occur in some of these areas (e.g. in Azerbaijan). Protection of the sites used is, however, not in itself enough as large areas previously used have been drained and converted to agricultural land not used by feeding Lesser Whitefronts. Also, in almost all protected wetlands the boundaries are limited to the water surface and fringing reedbeds. Lesser Whitefronts use the protected areas only for roosting and are hunted on their flights to and from their grazing areas as well as on the grazing areas. Securing the surrounding areas, e.g. by establishing buffer zones where hunting is prohibited, is vital to ensure effective protection.

Despite the current protection of the species and some of the sites it uses at different times of year, the population is still declining. An Action Plan has recommended the following priorities at a European level: locate and assess key areas; reduce the hunting pressure; prevent further losses of habitat; and monitor the remaining populations (Madsen 1996). In late 1995, Wetlands International established a Lesser White-fronted Goose Working Group which identified five important tasks in an Urgent Action Plan: i) search for wintering geese in Azerbaijan, ii) search for wintering geese in the Azov Sea area, Russia, iii) search for summering geese in Taimyr, Russia, and satellite tracking of individual geese, iv) assess autumn staging areas on the Kanin Peninsula, Russia, and v) follow-up on staging areas located in Germany, Hungary and Greece. All of these tasks except iii) have been carried out during December 1995-November 1996, and are partially reported here. Amongst other actions, a search for geese in Yamal and Taimyr, and satellite tagging are planned for 1997.

The world range of this species creates huge problems for its conservation, despite its protected status in most countries regularly used during the annual cycle. The political and economic situation in many eastern European countries makes efficient protection extremely difficult as geese and ducks are, to a large extent, exploited as an important source of food. Also, many hunters do not know the difference between the White-fronted Goose, which may be hunted, and the Lesser White-fronted Goose, which is protected in many countries, or they simply do not know that the latter is protected and even endangered.

The status of the Lesser White-fronted Goose is worrying. The world population in autumn is estimated at c. 8500-17,000 individuals (assuming 40% juveniles) and is still decreasing. Counts from Fennoscandia indicate a 99% decrease during this century. It is unknown whether the decline has been as severe for the other breeding populations. There is, however, no doubt that there has been a significant decline in all of its range.

Given the range of the species, international action is the only way to save the Lesser White-fronted Goose from extinction. The Action Plan for the Lesser White-fronted Goose should be implemented by as many countries as possible as quickly as possible. Participants at the Wetlands International Goose Specialist Group meeting in Poland in December 1995 agreed that in order to save the species from extinction the negative trend must be reversed within ten years.

Future research needs: Future research needs have been listed in both the Action Plan (Madsen 1996) and the Urgent Action Plan (see above) and it is important that these are carried out. It is especially important to continue the monitoring which is carried out in Fennoscandia, and extend it to other areas as well. The breeding population in Russia should be mapped and it is important to map and monitor geese at the wintering sites. Lesser Whitefronts, especially those from Russian breeding grounds (Yamal and Taimyr), should be equipped with satellite transmitters to obtain information about migration routes and wintering areas. This is necessary in order to direct protection measures to the most important sites used outside the breeding season.

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8 Greylag Goose
Anser anser: Iceland

Authors:
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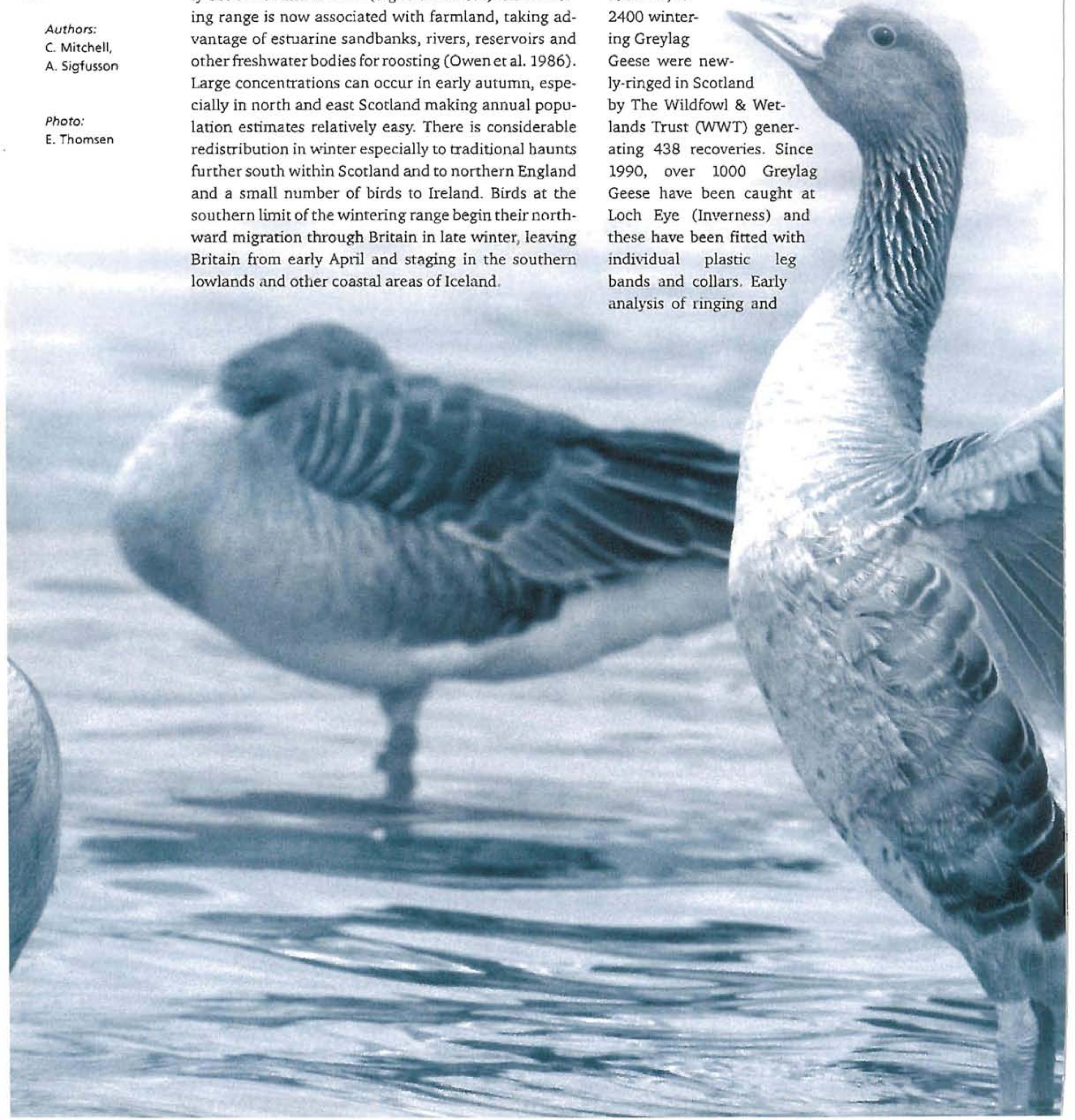
1. POPULATION REVIEW

1.1 Range

The Greylag Goose breeds in lowland areas of Iceland, and in early autumn, birds migrate to winter exclusively in Britain and Ireland (Fig. 8.1 and 8.2). Its wintering range is now associated with farmland, taking advantage of estuarine sandbanks, rivers, reservoirs and other freshwater bodies for roosting (Owen et al. 1986). Large concentrations can occur in early autumn, especially in north and east Scotland making annual population estimates relatively easy. There is considerable redistribution in winter especially to traditional haunts further south within Scotland and to northern England and a small number of birds to Ireland. Birds at the southern limit of the wintering range begin their northward migration through Britain in late winter, leaving Britain from early April and staging in the southern lowlands and other coastal areas of Iceland.

1.2 Delineation of flyways

Autumn ringing in Britain in the 1950/60s (Boyd 1958), together with ringing in northern Scotland since 1990, underpins our knowledge of the migration routes, phenology and winter distribution. During 1950-66, c. 2400 wintering Greylag Geese were newly-ringed in Scotland by The Wildfowl & Wetlands Trust (WWT) generating 438 recoveries. Since 1990, over 1000 Greylag Geese have been caught at Loch Eye (Inverness) and these have been fitted with individual plastic leg bands and collars. Early analysis of ringing and



recovery data has confirmed movements within and between winters in Britain (Boyd 1958). Studies in Iceland have also provided a basis for understanding of patterns of occurrence there in spring (Fox et al. 1992). Ringing has confirmed the discreteness of the Iceland population from other Greylag Goose populations in the Western Palearctic (Fig. 8.1), although a very small number of individuals marked in northern Britain have been recorded in Norway.

1.3 Population trends

It seems that wintering Greylag Geese were uncommon in east and south Scotland throughout the 19th century (Berry 1939) and that a steady increase in the middle of the 20th century occurred, especially so in the 1950s. The number of wintering Greylag Geese seemed, in the 1930s, to be greatly in excess of those recorded fifty or more years previously although a decline in numbers on Islay since the latter half of the 19th century was noted (Berry 1939). In the 1930s, the Greylag Goose was still the commonest winter grey goose of the Solway area and on the Firth of Tay, however, excessive shooting, chiefly over decoys, resulted in the disappearance of the vast flocks from the Tay Estuary. In November 1961 and 1962, about 36,000 were counted, probably the largest numbers to have occurred in Britain in the 20th century (Atkinson-Willes 1954).

Regular autumn counts are available from Britain since the early 1950s (Fig. 8.3) although systematic roost counts from other periods during the winter have not been carried out on a regular basis. The censuses provide an accurate assessment and suggest that the population has increased from c. 20,000-30,000 birds in the 1950s to c. 100,000 individuals in the early 1990s. The increases are attributable to a decline in overall mortality as a result of domestic site safeguard of important winter roosts and improved winter feeding conditions (Fox et al. 1989). During the 1990s, however, the population has declined from c. 100,000 to 80,000 (autumn 1997)(WWT unpubl. reports).

During the early autumn, 90% of the population can be counted on as few as 30 roost sites (e.g. Mitchell 1996), although Greylag Geese tend to occur in many more smaller flocks throughout northern Britain than Pink-footed Geese *Anser brachyrhynchus*. Dramatic increases in the number of geese using some roosts have mirrored the general population increase (e.g. Dinnet Lochs, Loch Eye and Loch of Skene).

In Ireland, Merne (1986) described a population increase from about 1000 birds in the 19th century to per-

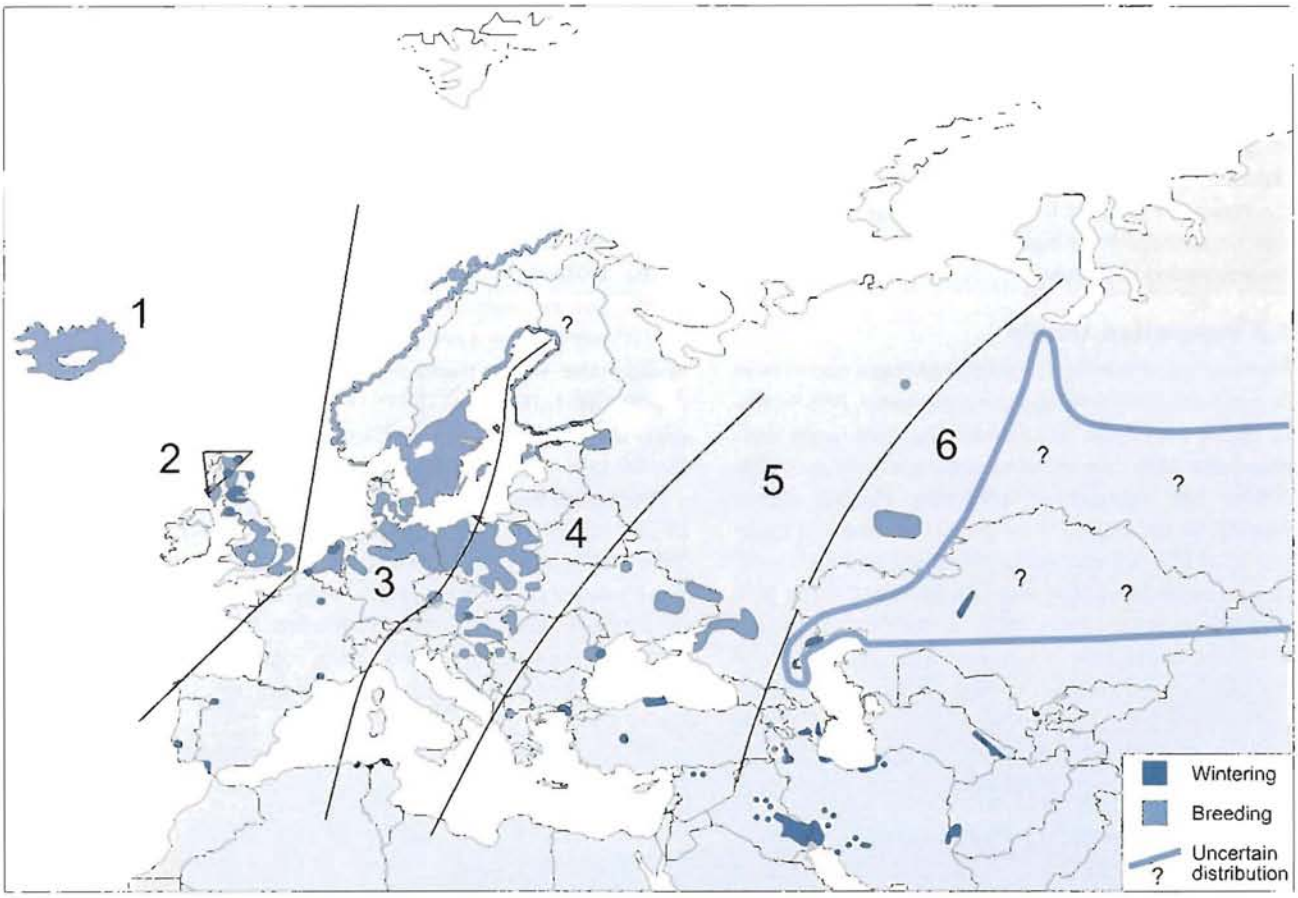


Fig. 8.1. Populations of Greylag Geese in the Western Palearctic: 1. Iceland; 2. Scotland; 3. Northwest Europe; 4. Central Europe; 5. Black Sea; 6. Southwest Asia. Breeding distribution includes feral geese (source: Hagemeijer & Blair 1997). Solid lines indicate well-known population boundaries, dotted lines indicate uncertain boundaries.

haps 6000 geese, mainly at the Wexford Slobs, by 1949. The population declined in the 1950s and 1960s to c. 700 in 1967 (Cabot 1967) before increasing again to c. 3800 in March 1988 (Merne 1986). The count in January 1995 in the Republic was 3859, which, added to the Northern Ireland total in January 1993/94 of 805 birds gives a current all-Ireland count of c. 4700 wintering Greylag Geese (Delany 1996).

1.4 Breeding success

The long term (1970-1995) mean for the proportion of young in the autumn population is 17.7% (±1.15 s.e.) (Fig. 8.3; Table 8.1) and there has been no significant trend (F_{25}=0.36, P=0.56) in breeding success during the last 26 years. Breeding success has been variable in this population; between 1957, when recording began, and 1995, the proportion of juveniles in the autumn population varied between 45.5% and 5.9%. However, prior to 1970, sample sizes were small (often less than 1000 birds aged), and since that year, the percentage young in autumn flocks has only exceeded 25% in four years. Over 50% of the variation in breeding success was related to meteorological variables on the wintering grounds in spring prior to departure and on the nesting grounds (Fox et al. 1989). There has also been no significant trend in mean brood size during the same period (2.24 ±0.05 s.e., F_{34}=1.88, P=0.18; Fig. 8.4; Table 8.1).

Greylag Geese wintering in different parts of the autumn range in Britain can exhibit different levels of breeding success although annual patterns are correlated (a good breeding season means a high proportion of young in all areas, whilst a poor season is reflected in low productivity - as in 1992). It has been important to obtain estimates in the field of the proportion of young geese in as many different areas as possible, although the significance of the differences has not been fully examined.

1.5 Mortality

The Greylag Goose is legal quarry throughout its range. Crude adult survival rates based on age ratios and census data (after the method of Ogilvie & Boyd 1976) suggest a relatively stable adult survival rate over the period (Table 8.2, cf. Iceland/Greenland Pink-footed Geese in Mitchell et al. this volume).

The levelling off of the population size (c. 1981-

Table 8.1. Five year mean breeding success of Icelandic Greylag Geese, 1970-1994.

	Mean % young	Mean brood size
1970-74	17.8	2.0
1975-79	14.0	2.2
1980-84	19.4	2.3
1985-89	17.4	1.8
1990-94	17.7	2.3

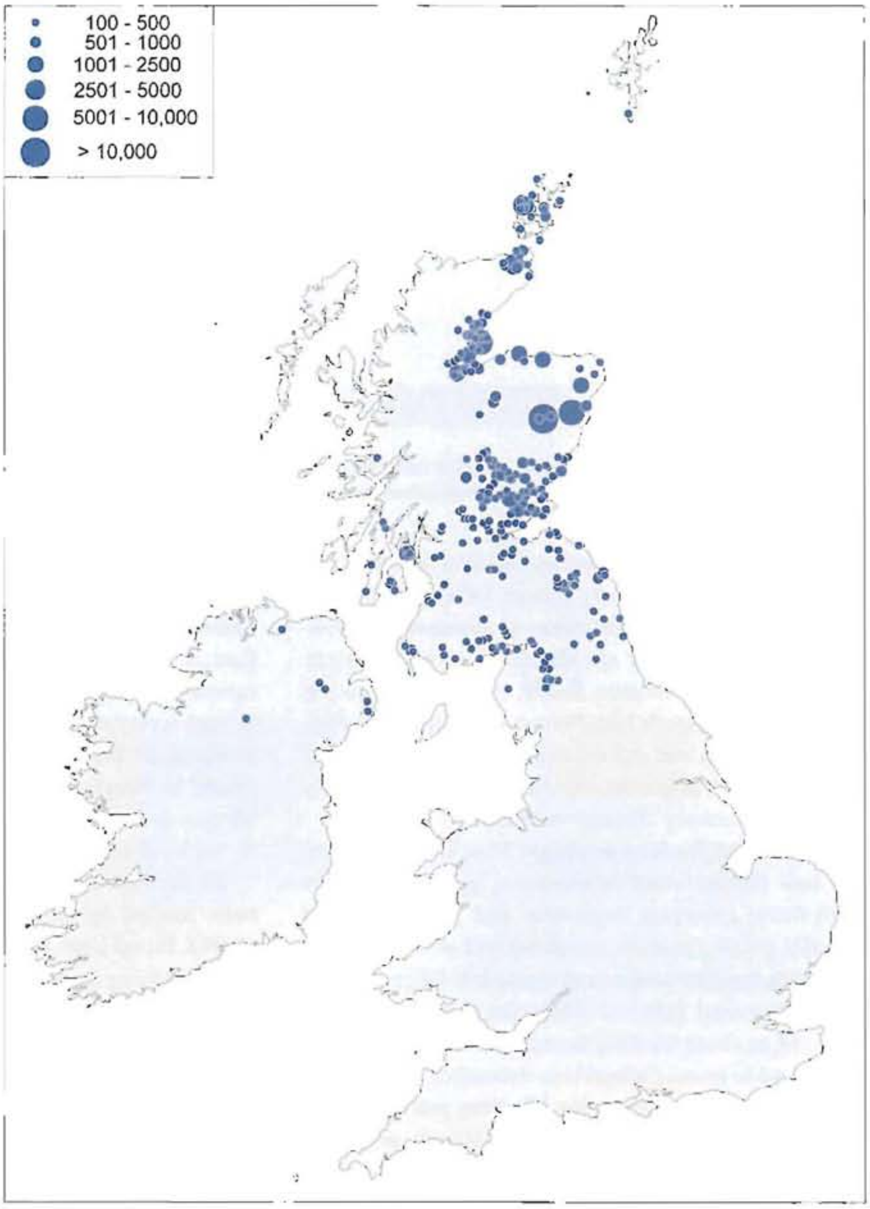


Fig. 8.2. The distribution of Icelandic Greylag Geese in the Britain and Ireland based on 5-year means, 1991-96.

1995) is considered to have been brought about by stability in the underlying survival rate rather than any variation in breeding success. Thus, annual recruitment

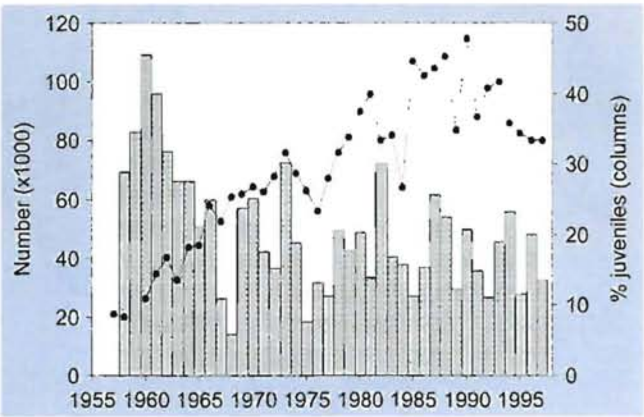


Fig. 8.3. The increase in the population of Icelandic Greylag Geese since 1957 and changes in breeding productivity (% juveniles in autumn flocks) since 1958. Samples sizes before 1970 were small (often less than 1000 geese aged).

largely kept pace with survival. Since 1995, the Icelandic Institute of Natural History (IINH) has collected bag statistics from hunters. During the period 1995-1997, c. 35,000 Greylags were bagged annually. Hunting mortality appears to have increased and seems to be the major factor causing the recent population decline.

2. BREEDING GROUNDS AND BREEDING ECOLOGY

2A. ICELAND

2A.1 Distribution

Range: Greylag Geese breed in wetlands where inaccessible swamps and lake islets offer security. The dependence on a combination of secure aquatic and open grassland habitat has resulted in a patchy distribution (due to human impact and Arctic Foxes *Alopex lagopus*) over much of the lowland coastal rim of Iceland (Fig. 8.5). During the 30-40 years up to 1970, Greylag Geese

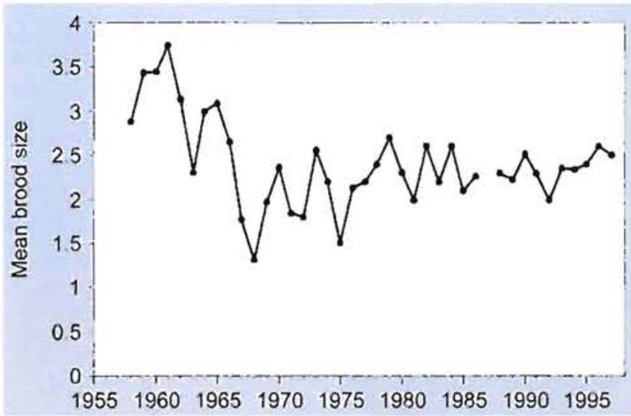


Fig. 8.4. Changes in mean brood size since 1958 of Icelandic Greylag Geese. Samples sizes before 1970 were small (often less than 50 broods).

increased in number and had spread into several unoccupied parts of the country (Rooth 1971) and this has continued in more recent times (Johannsson & Gudjonsdottir 1995). They are absent from the northernmost parts of the western fjords, probably due to the presence of the Arctic Fox. Part of the restricted breeding range which was still evident in the 1950s may have been the result of human exploitation during the early part of this century (Einarsson 1983).

Habitat and feeding ecology: Most breeding areas are now characterised by extensive, open freshwaters with dense emergent vegetation and ready access to suitable grazing pasture, meadows and wetlands. After hatching, families tend to aggregate into larger groups, often of several hundred when the young are 10-20 days old, at about the time the adults become flightless. They tend to remain gregarious thereafter. Non-breeders tend to separate from the breeding pairs, forming loose flocks. Non-breeders and immatures gather to moult in June and July and after the flightless period they, and the breeding birds, disperse to feed on surrounding farmland. Greylag Geese eat plant material accessible from the ground or water surface including roots and tubers, green leaves and stems, flower heads and fruits. They feed from marshes and lake margins and farmland, including pasture. The green leaves and other soft material is clipped off with the side of the bill, but pieces from large roots and tubers are scraped off with the terminal nail of the upper mandible. Feeds mainly by grazing on land, but also while floating on water, occasionally up-ending to pull up submerged material.

The main foods include the roots of *Potamogeton, Sparganium, Glyceria, Equisetum,* and *Phalaris*. On farmland Greylag Geese eat various agricultural grasses, including *Lolium, Phleum, Poa, Festuca* and *Bromus*, and less frequently the leaves, roots, or seed-heads of *Polygonum, Stellaria, Chenopodium* and other weeds. Potatoes are taken by pulling at the tops to expose the roots, and turnips, kale and seed-heads from ripening crops are eaten (Kear 1967). Other summer foods recorded occasionally include the fruits of *Vaccinium* and *Rubus*, and leaves and shoots of *Eriophorum*.

Table 8.2. Mortality rates of Icelandic Greylag Geese based on winter samples of productivity and annual autumn census.

1960-69	1970-79	1980-89	1990-94
15.5%	15.3%	15.8%	15.4%

2A.2 Moult migration and moulting areas

Most Greylag Geese seem to moult close to the breeding areas. There is no evidence of a moult migration although some large gatherings of moulting non-breeding birds have been recorded but little has been published. These include Breiðafjörður, Húnaflói, and Lake Miklavatn (Skagafjörður) where c. 5000 non breeders have been recorded (Skarphéðinsson & Gudmundsson 1990), Axarfjörður and Lagarfljót. Numerous lakes and coastal areas support large concentrations of moulting Greylag Geese.

2A.3 Research

There have been very few Greylag Geese ringed in Iceland. A few hundred, mostly sedentary geese have been rounded up during the summer moult in Reykjavík, although a very small proportion have been recovered in Scotland. In 1996, 125 Greylag Geese were caught and ringed in Húnavatnssysla, Skagafjörður and the Lake Myvatn area. All the adults (35) were fitted with plastic neck collars (Mitchell et al. 1997).

Interaction of Greylag Geese with agriculture has been studied by Kear (1967) and Fridriksson et al. (1976). Brood sizes were measured just after hatching, before fledging and after fledging in south and northeast Iceland in 1987 and post-fledging brood sizes were measured in 1988 (Patterson & Giroux 1990). In 1995, a research project was started at The Icelandic Institute for Natural History focussing on the effects of hunting on goose populations. The project includes studies of population parameters, examination of wings from the hunting bag and analysis of bag statistics (Sigfusson 1996).

2A.4 Protection and conservation

The Icelandic Government is signatory to the Ramsar

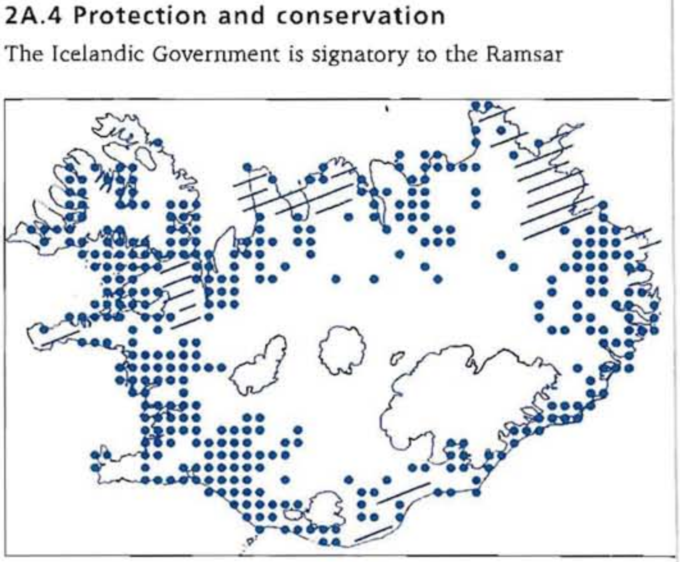


Fig. 8.5. The breeding distribution of Greylag Geese in Iceland based on a 10 km grid (hatched areas indicate insufficient coverage). Data from the forthcoming Icelandic Breeding Bird Atlas, kindly provided by K.H. Skarphéðinsson.

Convention, but there are only two sites in Iceland declared as Ramsar sites, neither of which support Greylag Geese. Although no areas are protected specifically for Greylag Geese, they breed on a number of sites protected by the Nature Conservation Act. Lake Miklavatn, important for both moulting and non-breeders is one such site. Safeguard of Breiðafjörður (1995) gives protection to important habitat for breeding birds and non-breeders.

3. STAGING AREAS

3A. ICELAND

3A.1 Distribution

Range: Analysis of spring ringing recoveries, resightings and counts of Greylag Geese shows major concentrations in the southern lowlands of the country (c. 17-21° W) and at other coastal localities especially near Egilsstaðir in the east.

Habitat and feeding ecology: Observation in 1989-92 (Fox et al. in press) and in 1995 (Stefánsson in litt.) showed that prior to movement to the nesting grounds locally, Greylag Geese fed mainly on intensively managed grasslands (e.g. *Phleum pratense* and *Deschampsia caespitosa*).

3A.2 Abundance

Phenology: Greylag Geese arrive in Iceland from early April, with occasional early arrivals in late March, with numbers peaking during the middle of April (Stefánsson in litt.). There is little evidence of staging in Iceland lowland areas in autumn en route to Britain. Departure from lowland Iceland begins as early as late September, with major arrivals in Britain in mid to late October (Mitchell 1995).

Trends and numbers: There are no accurate census data for anywhere in Iceland. The geese pass through the lowland areas (especially in the south and east) in spring and autumn over a vast area which makes accurate counting difficult. At least 10,000 Greylag Geese are thought to occur in late April near Egilsstaðir (maximum count 8330 in 1995, Stefánsson in litt.), and its seems likely that there is some turnover at key sites before dispersal to local breeding quarters. In autumn, the dispersed nature of this hunted species makes assessment of numbers even more difficult.

3A.3 Research

There has been relatively little published research on the Greylag Goose in Iceland, although during April and May 1989-92, fieldwork was carried out to study their distribution, abundance and staging time (Fox et al. in press) by WWT in conjunction with local ornithologists.

3A.4 Protection and conservation

Hunting legislation: The main legislation in Iceland relating to the geese is the Bird and Mammal Protection Act of 1994. Under this legislation, annual hunting licences are granted only on submission of a record of the number and species taken in the previous year. There are over 20,000 gun licences issued in Iceland, and in 1995, when hunting licences were required for the first time, 11,200 hunting licences were issued (12,200 in 1996). Although the geese are protected in spring there may be considerable numbers killed illegally at this time. There is no limit to the hunting bag at present, but bag statistics are available from 1995 onwards so the size and extent of the kill each year may be assessed. Due to the habit of remaining in the relatively accessible lowland areas in the autumn, the Greylag Goose bag is the highest of all species of geese shot in Iceland (c. 35,000-37,000 in 1995-1997, cf. Iceland/Greenland Pink-footed Geese in Mitchell et al. this volume, Sigfusson 1996 & unpubl. data).

Agricultural conflict: Although unlikely to cause significant agricultural damage most of the complaints from individual farmers are about Greylag Geese. In the last decades less than ten licences have been issued annually to shoot Greylag Geese for the purpose of preventing damage to cultivated land before 1 May. In 1995-96, the number of licences issued has doubled although there is no evidence of increased damage.

4. WINTERING AREAS

4A. UNITED KINGDOM/IRELAND

4A.1 Distribution

Range: A complete census of the Iceland population is attempted in early November each year and our knowledge of distribution relies heavily on these counts. In November the birds are concentrated, feeding on stubbles largely in northeast and central Scotland. Thereafter they are more dispersed, but information is not complete (see Mitchell 1995). Thus the distribution is biased towards main autumn roosts and shows a less dispersed pattern than the mid winter and spring average.

The present range of the species has changed somewhat since the review of Boyd (1958). The autumn distribution is still essentially northeast and central Scotland (Fig. 8.2). However, a northward contraction of range on the wintering quarters from the early 1900s to the early 1960s had occurred (with Greylags no longer wintering in Lancashire and south Cumbria for example) and, since the early 1960s, there have been some equally marked shifts in distribution. Most notable is the increase in importance of north and northeast Scotland at the expense of east central Scotland, which formerly held two thirds of the stock, and southwest Scotland (Fig. 8.6). A number of principal autumn roosts are now far more important than in former times (e.g. Dinnet Lochs, Loch Eye, Loch of Skene) in terms of actual numbers and the proportion of the total population they support.

Resightings of individually marked birds show late

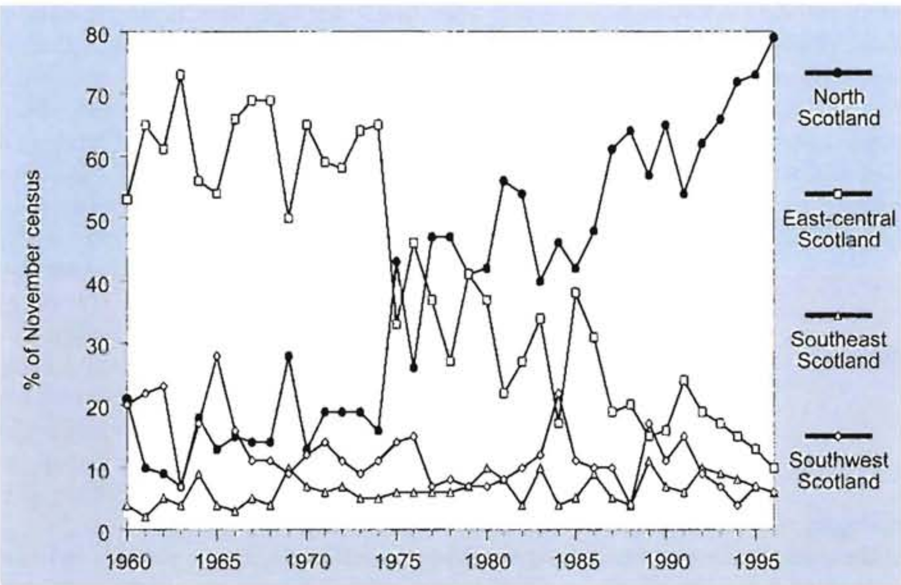


Fig. 8.6. The proportion (%) of the Icelandic population of Greylag Geese in different parts of Britain between 1960 and 1996, as indicated in the November census results. Southwest Scotland contains a few sites in northwest England and southeast Scotland contains a few sites in northeast England.

autumn dispersal from northern Scotland into traditional winter haunts further south within Scotland and a smaller number of birds to northern England and to Ireland. Birds at the southern limit of the wintering range begin their northward migration through Scotland in late winter (Mitchell 1995), leaving from early April for Iceland.

Habitat and feeding ecology: The main winter habitat is thought to have been saltmarsh and coastal Scirpus beds (Owen 1976), but in Britain little of this habitat remains and the inland fens and marshes have also largely been drained for agriculture. Increasingly, from the end of the last century the species has moved inland to feed on arable farmland and improved pastures, taking advantage of reservoirs, other freshwater bodies and estuaries for roosting (Owen et al. 1986). Grass is used throughout the winter although, typically, cereal stubbles are used in autumn, followed by potatoes, swedes and carrots if available in mid winter (e.g. Bell 1988). In spring, sown grass and to a lesser extent permanent pasture and winter-sown cereals are important. The vast majority feed by day, mostly in flocks of up to 100 birds (Newton & Campbell 1973).

4A.2 Abundance

Phenology: Greylag Geese generally start to arrive in mid to late October, especially at the major sites, building in early November. The arrival is pronounced at well-defined staging areas before late autumn dispersal, especially in the Moray Firth and northeast Scotland (e.g. Mitchell 1996); 36,000 Greylag Geese were counted at Dinnet Lochs in November 1995 (the five year mean 1991/92-1995/96 is 27,373), constituting a third of the population at this one site. Peak numbers occur at major sites generally in the middle of November with up to 90% of the whole population counted on as few as 30 sites (Mitchell 1996). There is considerable redistribution in winter especially to sites further south (e.g. to south Scotland). Greylag Geese start to move north again as early as February, with numbers building to pre-migration peaks in Orkney and Caithness in March (Mitchell et al. 1995). The return passage to Iceland starts in late March to early April. The first arrivals in eastern Iceland have been recorded from the first week of April, continuing into that month (Fox et al. in press, Stefánsson in litt.).

Trends and numbers: Since the 1950s, the total population has increased four-fold from c. 20,000-25,000 to 80,000-100,000. The numbers of Greylag Geese counted during the annual autumn censuses show a steady increase up to the early 1980s since when there is some suggestion of stability and, recently, a decline in numbers (Fig. 8.3, see also Mitchell 1996).

4A.3 Research

Census: In 1956, The Wildfowl Trust (now WWT), was instrumental in putting together a reliable system for estimating the size and distribution of the population on its winter grounds. Cooperation with a volunteer counters network together with professional reserve wardens ensures regular and simultaneous coverage of the species range throughout Scotland and England in the autumn. Additional organised counts during the spring have been undertaken annually since 1982, and more recently organised mid winter counts have been undertaken. The network of daytime counts of waterfowl undertaken throughout Britain (WeBS) provides some additional monitoring of individual site use, although the counts need to be carried out at dawn or dusk as birds fly to or from the roost.

Detailed roost counts have been carried out at some individual sites for many years (e.g. monthly roost counts at Loch Leven since 1966; almost daily roost counts at Dinnet Lochs since 1989). Some local feeding and distribution studies have involved detailed roost monitoring throughout the winter months (e.g Hearn & Mitchell 1995, Bell et al. 1988, Bell & Newton 1995, Stenhouse 1996).

Ringing: WWT undertook extensive ringing during the 1950s based mainly on catches made in the autumn.

Between 1950 and 1959, over 2400 Greylag Geese were ringed (generating 438 recoveries) and knowledge of the movements and population dynamics of the species was greatly advanced. Since 1990, Greylag Geese have been caught in smaller numbers at Loch Eye (Inverness) and these have been fitted with plastic leg-rings and/or plastic neck-collars.

Other: Local feeding studies have demonstrated seasonal changes in the diet of Greylag Geese apparently responding to, and in part driven by, seasonal changes in the habitats available (e.g. Newton & Campbell 1973; Bell 1988). Clipping experiments to measure yield loss in fields which support Greylag Geese, together with measuring goose grazing levels from dropping densities were carried out in northeast Scotland in the late 1980s (Patterson 1991, Patterson et al. 1989). There was evidence that goose grazing was associated with significant loss of yield, but there was great variability in the degree of loss suffered at any given level. Keller (1989) looked at the feeding distribution of Greylag Geese in northeast Scotland in relation to disturbance.

Examinations of shot Greylag Geese at Loch Leven showed that the proportion of young in the bag was much higher (approximately double) than the corresponding percentages found in observations of flocks (Wright & Boyd 1983).

4A.4 Protection and conservation

Hunting legislation: The Greylag Goose is listed on Annex II/1 of the EU Birds Directive; Schedule 1, part II (in the Outer Hebrides, Caithness, Sutherland and Wester Ross) and Schedule 2, part 1 (elsewhere in Britain) of the Wildlife and Countryside Act (WCA) 1981 (may be shot outside the shooting season); Appendix III of the Berne Convention; Appendix II of the Bonn Convention. In Britain, the WCA permits an open season for Greylag Geese during 1 September - 1 February. An estimated 15,000-25,000 are shot each year, but no accurate bag statistics are available (Reynolds & Harradine 1994, 1996). Inland goose shooting, with the use of decoys, tends to be associated with larger organised parties, often from abroad, and involving a 'goose guide'. This type of shooting can provide an attractive source of income to some farmers (see Iceland/Greenland Pink-footed Goose in Mitchell et al. this volume).

Site safeguard: The Special Protection Area (SPA) network provides for a variety of different requirements, including roost sites and staging areas. The SPA network holds approximately 66% of the population (assessed using the November WWT goose census data). The national and international proportion of the population protected is difficult to calculate precisely owing to within-winter movements between different parts of the range. Sites are largely nocturnal roosts. Feeding areas (especially farmland) are not significantly represented within the SPA network and require complimentary measures such as designation as Environmentally Sensitive Areas (ESA).

Of the 27 roost sites which support more than 1% of the population (Table 8.3), ten are Ramsar sites (eight are proposed Ramsar sites) and ten are SPA (eight are proposed SPAs).

Agricultural conflict: With the increase in overall population size there has been a growing tendency for the geese to feed on intensively managed grasslands which brings them into direct conflict with farmers. Although this change in habitat may have been forced on the geese, they have fared well on farmland. Pastures are heavily fertilised and provide palatable and digestible forage. It was probably not until the 1960s that Greylag Geese began to pose problems for farmers. On autumn stubbles and waste potatoes they do no harm, but they graze pastures throughout the winter, and on occasions, especially in spring, graze winter wheat and barley. In the latter part of April and in early May farm stock are being let out onto specially prepared 'spring bite' grassland, expensively managed and fertilised. Greylag Geese prefer this young grass to older leys and they congregate on these pastures, competing directly with stock for forage. Greylag Geese are frequently accused of damaging growing winter and spring-sown cereals, but clipping studies showed that the effect was slight (Kear 1970), although studies do suggest that damage from grazing and puddling of the soil can occur in waterlogged conditions on heavy soils.

Recent studies have revealed great variability in the effects of goose grazing (Patterson et al. 1989, Patterson 1991). The variability is so great because yield is affected by a complex interaction of factors which influence the response of the vegetation to grazing. These factors include time of year, type of crop, spring weather, crop growing conditions and management and grazing intensity. Spring is the most critical time of the year since goose grazing late in the season causes greatest losses in yield.

5. DISCUSSION

Population status: At current population levels the Greylag Goose is considered at a favourable conservation status (a classification which is consistent with those used in international agreements). This Greylag Goose population showed a period of expansion since the 1950s, reaching a plateau of c. 100,000 individuals in the late 1980s, and since then declining to c. 80,000 (1997). Changes in legislation in Britain, beginning with the 1954 Protection of Birds Act, reduced the number of ways in which Greylag Geese could be taken or shot, and at the same time a national network of protected roosts was established. Also during the same period, Greylag Geese began to take advantage of the higher quality herbage available on improved grasslands and more recently, on autumn sown cereals. These changes occurred concurrently during the same decades and the net affect has been to reduce winter mortality, so increase the population size. It is not possible to disentangle the relative importance of the different factors because of their complexity. For example,

Table 8.3. Mean winter maxima of Icelandic Greylag Geese at principal resorts, based on counts from 1991/92 to 1995/96 (from Cranswick et al. 1997) and current site conservation status.

Site	Peak	Average	Ramsar	SPA
Dinnet Lochs	Autumn	27,373	p	p
Loch Eye/Cromarty Firth	Autumn	11,321	Yes[1]	Yes[1]
Loch of Skene	Autumn	10,840	Yes	Yes
Caithness Lochs	Autumn	6880	p	p
Loch Spynie	Autumn	6276	Yes	Yes
Orkney	Winter	4433	(p[2])	(p[2])
Haddo House Lochs	Spring	4320		
Inner Moray Firth	Winter	4224	p	p
Tay/Isla Valley	Autumn	4218	p	p
Lower Bogrotten	Autumn	3600		
Drummond Pond	Autumn	3200	p	p
Findhorn Bay	Winter	3179		
Loch of Lintrathen	Winter	3098	Yes	Yes
Stranraer Lochs	Autumn	2532		
Isle of Bute	Winter	2395		
Holburn Moss	Winter	2150	Yes	Yes
Lindisfarne	Spring	1698	Yes	Yes
Loch of Strathbeg	Winter	1577	Yes	Yes
Loch Garten	Autumn	1471	Yes[3]	Yes[3]
Dornoch Firth	Winter	1418	Yes[1]	Yes[1]
Carlhurlie Reservoir	Winter	1399		
Ballo Reservoir	Autumn	1313		
Loch Fleet	Autumn	1254	Yes[1]	Yes[1]
Corby Loch	Autumn	1193		
Fincastle Loch	Autumn	1136		
River Spey	Winter	1115	Yes	Yes
Kilconquhar Loch	Winter	1088		
Hoselaw Loch	Winter	1074	Yes	Yes
Eden Estuary	Winter	1060		
Gadloch	Autumn	1007		

Notes:
SPA Site classified as Special Protection Area under EU Birds Directive
Ramsar Site listed as wetland of international importance under the Ramsar Convention
p Proposed (in Stroud et al. 1990)
1 Moray Basin, Firths and Bays SPA contains Cromarty Firth, Findhorn Bay, Dornoch Firth and Loch Fleet
2 Loch of Harray pSPA and Loch Stenness pSPA are within Orkney
3 Abernethy SPA contains Loch Garten

in different parts of Scotland geese may variously have switched to feeding on farmlands from their traditional coastal or wetland feeding areas because the latter were reclaimed for agriculture, or became less attractive to geese because of the cessation of traditional grazing by cattle and sheep; or moved inland because of shooting pressures; or moved simply because higher quality food was available. However, it is unclear what potential impact current hunting levels reported from Iceland may have on the population. In the mid 1990s, 35,000-37,000 Greylag Geese were reported as being shot in Iceland (Sigfusson 1996 & unpubl. data). This represents at least c. 25% of the post-breeding population and is at a level higher than for Pink-footed Geese shot in the same country. In addition, Greylag Geese encounter further hunting pressure in Britain and Ireland during the winter months. The long term impact, particularly on overall numbers and the demographic make-up of the breeding population warrants detailed monitoring and analysis.

Conservation issues: Conservation measures for Greylag Geese in Britain fall into two categories: the general species protection measures under the WCA (1981); the protection of suitable roosts using site based mechanisms (Sites of Special Scientific Interest (SSSIs), SPA etc.) under the Wild Birds Directive, and Ramsar sites under the Ramsar Convention on Wetlands of International Importance. Site protection in Iceland is limited, however Greylag Geese do benefit from some of the protected sites (e.g. Miklavatn) which are protected for other reasons. Its current reliance on farmland for feeding while in Britain means that very large areas of potential habitat are available. However, human disturbance at traditional roosting sites is a persistent problem.

Management options for Greylag Geese have recently been proposed for consideration by the Scottish Office (1996). These include traditional means of dealing with goose grazing, i.e. scaring and shooting; opportunities for offsetting any losses through income from organised hunting; extending the shooting season; easing of present restrictions on the sale of dead wild geese and actions by other countries and international cooperation including the restriction of breeding success by the destruction of eggs/chicks on the breeding grounds.

Agricultural conflict: While farmers have tolerated the geese for years, concern has been growing, particularly where numbers are high, with rising numbers of complaints of agriculture damage. There have been a number of complaints from farmers about loss of yield due to goose grazing on grass and cereal crops. In addition to reduced yields, there have been other agricultural effects of goose grazing such as reduced stocking densities, uneven ripening of crops, increased weediness of crops, puddling of ground and delays in turning out livestock. There are currently no goose management schemes operated by Scottish Natural Heritage in Scotland specifically for Iceland Greylag Geese.

Future research needs: There is an urgent need to understand the population processes underlying the increase, stabilisation and decline in numbers and the changes in distribution which have occurred in the last 40 years. Continued monitoring through census, especially in Iceland, assessment of breeding success, and monitoring of movements and mortality patterns through individual marking are all basic requirements for the immediate future. There is an urgent need in Britain to quantify the distribution and scale of alleged agricultural damage.

International conservation: The world range of this population of Greylag Geese is restricted to three countries: Iceland, Britain and Ireland. This would enable the development of a flyway conservation plan for the population to guide national and international conservation and management actions, since this would involve relatively few governments and organisations.

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9 Greylag Goose *Anser anser*: Scotland

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1. POPULATION REVIEW

1.1 Range

The Greylag Goose used to breed in the wild in the East Anglian fens, Lancashire, the Lake District and probably many other parts of Britain before the reed-marshes and fens were reclaimed for agriculture in the 19th century (Owen et al. 1986). By the early 20th century the species was restricted to northwest Scotland, but between 1930 and 1970 flocks were re-established in many parts of the country, especially in England. Most of the indigenous birds are now restricted to the Uists, Harris/Lewis, Coll/Tiree, and the northern and westernmost areas of mainland Scotland and associated coastal islands (Fig. 9.1 and Fig. 8.1 in Mitchell & Sigfusson this volume). Greylag Geese also breed in Shetland and Orkney although there is little evidence that these birds form part of the indigenous population (E. Meek & D. Okill pers. comm.).

1.2 Delineation of flyways

Ringing on the Uists and in Sutherland has shown that the geese are largely sedentary, with most birds making only relatively short seasonal movements between breeding and wintering areas (often <30 km on the Uists). A very few Greylag Geese have dispersed to wintering areas >100 km from the breeding quarters.

1.3 Population trends

At the end of the 19th century, the Greylag Goose bred in considerable numbers in Scotland in the northwest Highlands, the Outer Hebrides, the northwest coast and Caithness (Berry 1939). It was, however, subjected to almost continuous persecution - for many years it appears that few nests escaped destruction, and birds were killed both in and out of season. A dramatic decrease in numbers and a contraction in range occurred during the latter half of the 19th century and the first 30 years of the 20th century. The chief cause was the systematic persecution in all seasons by crofters, whose corn and oats the geese damaged, especially in autumn. Increasing motor traffic, egg collecting and the popularisation of summer trout fishing on previously undisturbed lochs and, in the 1930s, an increase in the numbers of Great Black-backed Gulls *Larus marinus* (which have been seen to kill whole broods of young geese) may also have contributed to the reduction in numbers. Certainly by 1920, the species had ceased to breed on North Uist, and Berry (1939) reported that '..in Scotland as a whole, the Greylag appears in danger of extinction as a breeding species..'.

Counts were undertaken on the Uists in 1968-72 and the population was estimated at c. 700-800 individuals (Newton & Kerbes 1974). Numbers increased to 1676-2000 by 1982 and the number of breeding pairs increased from about c. 140 (Sharrock 1976) to c. 200-300 over a similar period (Thom 1986). Regular post-breeding (August) and post-hunting (February) counts are available from the Uists since 1986 (Table 9.1). These provide an accurate assessment of the population size and suggest that it has increased from at least c. 1600 birds in the

mid 1980s (Paterson 1986) to c. 3300 individuals in 1996 (R. MacDonald pers. comm.). This is thought to be partly due to greater breeding success and recruitment, resulting from an increase in the quality and quantity of improved pasture in the Uists since the 1960s (Paterson 1991).

Counts from other areas have not been carried out on a regular basis. Winter numbers on Coll/Tiree appear to have increased from c. 670-920 individuals in 1985-87 (Stroud 1988) to c. 2900 in August 1995 (Scottish Natural Heritage (SNH)/Royal Society for the Protection of Birds (RSPB)). Summer counts in Caithness/Sutherland have not achieved full coverage, although numbers there appear to have been stable at c. 2500 for the last ten years (F. Symonds pers. comm.). On Harris/Lewis a small but increasing dispersed group probably numbers over 100 individuals (P. Cunningham pers. comm.). Small numbers of Greylags breed on other Hebridean Islands (e.g. 25 adults and seven young on Colonsay in 1995; six broods on Mull in 1995). In total, these may account for a further 100-200 birds.

Thus, the 1994/95 total population estimate was approximately 9000. In summer 1997, a total count of 10,000 individuals including young was made (C. Mitchell, WWT unpubl.). Hence the trend, since the mid 1980s, is one of increase (c. 12% per annum).

The Greylag Goose is considered an uncommon breeding species on Orkney and Shetland. There are no historical records of Greylag Geese breeding or summering in either set of islands, and nesting was first recorded in the mid 1980s. There is little evidence to suggest that these birds originate from the indigenous population, and it seems that very small numbers of Icelandic Greylag Geese have recently over summered here, and these have been augmented with a few birds deliberately released for hunting (E. Meek pers. comm.). However, two Greylag Geese marked in Sutherland in July 1996 were recorded on Orkney in winter 1996-97, indicating that there may be some, albeit modest, connection between the mainland and Orkney. Summer counts (1993-1994) suggest c. 50 pairs (and c. 200 non-breeding birds) on Orkney and c. 200 birds in total on Shetland.

1.4 Breeding success

Age assessments have been carried out on the Uists since 1986. The mean for the proportion of young in the autumn population (since that year) is 26.8% (Table 9.1) and there has been no overall trend ($F_7=2.61$, $P=0.16$, excluding a small sample in 1993). Breeding success is less variable than in the Icelandic population of Greylag Geese (see Mitchell & Sigfusson this volume) which winters in other parts of Scotland. The mean brood size during the same period (3.68 overall, Table 9.1) has also shown no trend since 1986 ($F_8=1.45$, $P=0.27$). Data on the mean brood size and annual breeding success have not been collected regularly from other areas.

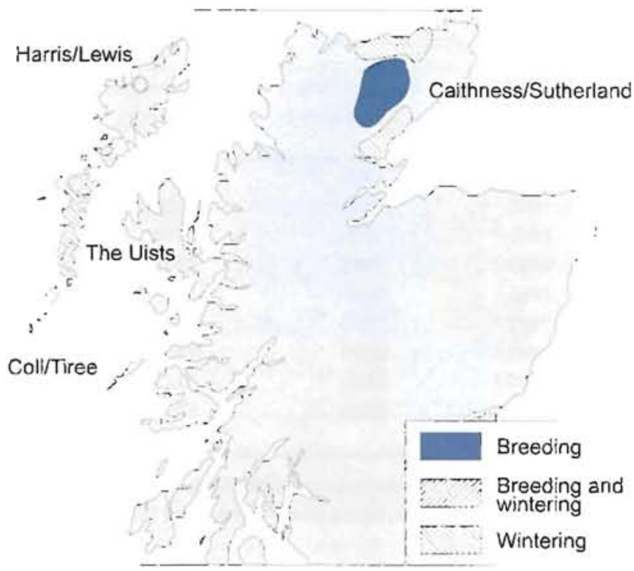

Fig. 9.1. The distribution of indigenous Scottish Greylag Geese.

1.5 Mortality

The Greylag Goose is legal quarry throughout its range. Crude adult survival rates based on age ratios and census data (after the method of Ogilvie & Boyd 1976) from the Uists suggest an adult survival rate of c. 79% over the period (Table 9.1, cf. Icelandic Greylag Geese, Mitchell & Sigfusson this volume). Bag statistics (provided by local estates and hunting clubs) are available from the Uists and are shown (also expressed as a proportion of the post-breeding population) in Table 9.1. In some years (e.g. 1994), hunting may account for up to 41% of the estimated post-breeding population.

2. BREEDING GROUNDS AND BREEDING ECOLOGY

2.1 Distribution

Range: Indigenous Greylag Geese now breed on the Outer Hebrides (North and South Uist, with smaller numbers on Harris/Lewis), Coll/Tiree, and in parts of Caithness/Sutherland. Small numbers breed on other Hebridean Islands (e.g. the Summer Isles, Mull and Colonsay), and on coastal areas of Wester Ross. The dependence on a combination of habitats - a close wetland, moorland (for breeding) and open grassland or cereal (for winter feeding) - has resulted in a somewhat patchy distribution (due largely to human impact) throughout the range.

Habitat and feeding ecology: Most Greylag Geese on the Uists breed on coastal sites in Heather *Calluna vulgaris* (77%), grass/*Juncus* spp. stands (15%) and low scrub (7%) (Paterson et al. 1990). The mean nesting density for the Uists in 1986 was c. 3 km^{-2}, Paterson et al. 1990). A nesting density of 9-13 km^{-2} was recorded at Loch Druidibeg (on South Uist) in 1968-72 (Newton & Kerbes 1974).

Most breeding areas are now based on extensive open waters (coastal or inland) with dense vegetation,

Table 9.1. Annual census counts, proportion of young, brood size, bag statistics and relative survival rates of Greylag Geese on the Uists, Scotland (1986-94).

Year	Post-breeding census (August)	Post-hunting census (February)	% young	Mean brood size (sample size)	Estimated bag (% of post breeding census)	Estimated survival rate (%)[4]
1986 [1]	1295	1424	29.6	3.50 (49)	129 (10%)	-
1987 [1]	1617	1409	28.5	3.44 (27)	63 (4%)	89
1988 [1]	1496	1270	30.0	3.97 (74)	266 (18%)	65
1989 [2]	1581	1338	32.0	3.22 (18)	336 (21%)	72
1990 [2]	1999	1993	28.8	3.96 (74)	488 (24%)	90
1991 [2]	2101	1737	20.5	2.97 (47)	530 (25%)	84
1992 [2]	2249	2130	32.2	3.41 (102)	783 (35%)	73
1993 [2]	2512	2165	20.6 [3]	4.40 (49)	887 (35%)	89
1994 [2]	2165	2254	19.3	4.21 (32)	890 (41%)	70
Mean			26.8	3.68	486 (20%)	79

Notes: 1. from Paterson et al. (1990); 2. from Mitchell et al. (1995); 3. based on small sample size in February 1994 (excluded from analyses); 4. based on Ogilvie & Boyd (1976), calculated using August population counts.

such as heather, and ready access to suitable grazing pasture and wetlands. After hatching, families tend to aggregate into larger groups, sometimes of 30-50 individuals when the young are 10-20 days old, at about the time the adults become flightless. After hatching, most broods are led off breeding sites to areas of better feeding (often to areas of *machair* on the Outer Hebrides). The geese tend to remain gregarious thereafter. Non-breeders tend to separate from the breeding pairs, forming loose flocks. Non-breeders and immatures gather to moult in June and July and, after the flightless period, they, and the breeding birds disperse to feed on surrounding farmland.

Greylag Geese eat plant material accessible from the ground or water surface including roots and tubers, green leaves and stems, flower heads and fruits. They feed from marshes, loch margins and farmland, including pasture. Greylag Geese feed mainly by grazing on land, but also while on water, occasionally up-ending to pull up submerged material. In late summer, geese on the Uists feed on areas of ripening cereals (especially rye and oats) when available, or stubble (Paterson 1991). The main foods are chiefly various grasses, but in summer also include marsh plants including the roots of *Scirpus*, the leaves of *Lemna* and *Equisetum*, and various moorland plants, including foliage and stem bases of *Eriophorum* and certain sedges (Newton & Kerbes 1974). On Coll/Tiree, Greylag Geese have been recorded feeding on the stem bases of *Eriophorum, Juncus bulbosus* and *Menyanthes*. In most areas the geese move onto managed grasslands soon after moulting.

2.2 Moult migration and moulting areas

Most Greylag Geese moult close to the breeding areas. There is no evidence of a moult migration on the Uists. Large numbers of non-breeding Greylag Geese are known to moult at Loch Loyal (Sutherland) and smaller numbers from Coll/Tiree moult on Gunna, a small offshore island (e.g. 160 recorded in 1986, C. Mitchell pers. obs.). Other small moult gatherings may occur in remote upland areas.

2.3 Research

Census: Counts of the number of breeding pairs of Greylag Geese on Coll/Tiree were carried out by the then Nature Concervancy Council in 1986-87 (Shepherd et al. 1988, Stroud 1988), and by SNH/RSPB from 1995. Counts of clutch and brood sizes and annual breeding success have been carried out in the Uists since 1986 (Mitchell et al. 1995), as has a post-breeding census. Counts of summering birds (involving an incomplete aerial survey in 1994) began in 1994 in Caithness/Sutherland.

Ringing: There have been few Greylag Geese ringed in Scotland during the summer. Small numbers were caught at Loch Druidibeg in 1968-72, generating 13 recoveries - all were shot within 28 km of the reserve. Ian Paterson, Paul Boyer and The Wildfowl & Wetlands Trust (WWT) undertook intensive ringing during 1987-93 based mainly on catches of moulting adults and goslings on sea lochs off North Uist. Over 500 Greylag Geese were colour-ringed (generating 53 recoveries) and knowledge of the movements and population dynamics of the species was greatly advanced. Observations of colour-marked individuals, and birds followed by radio telemetry, revealed local patterns of movements after moult. In July 1995 and 1996, 54 and 300 Greylag Geese were caught, respectively, at Loch Loyal (Sutherland). Most were fitted with plastic neck-collars, and follow up observations were undertaken thereafter.

Other: The breeding biology of Greylag Geese was studied at Loch Druidibeg in 1968-72 (Newton & Kerbes 1974). Information was gained through routine visits to nests and annual counts of broods, and included data on predation of eggs. The main finding was that annual variations in the nesting success of the population were associated with annual variations in the timing of egg-laying.

2.4 Protection and conservation

The Scottish breeding population is vulnerable to land use changes, such as the widescale afforestation of the

Caithness/Sutherland peatlands. The geese are particularly vulnerable during the moulting period. The Site of Special Scientific Interest (SSSI) network protects the population during both the breeding and moulting seasons from the impacts of damaging land-uses (Stroud et al. 1990). Many of the indigenous Greylag Geese occur within the SSSI (and proposed Special Protection Area (SPA)) network, largely in the Uists, Caithness/Sutherland and Coll/Tiree. Loch Druidibeg (South Uist) is a National Nature Reserve.

3. WINTERING AREAS

3.1 Distribution

Range: The present range of the species has not changed greatly since the review of Berry (1939), and despite an approximate doubling in numbers since the early 1970s, the distribution of Greylag Geese in Scotland has remained congruent with earlier years. The winter distribution is relatively close to the breeding range (see above).

Resightings of individually marked birds show dispersal from breeding areas to wintering areas within the Uists involving local movements usually of up to 30 km. Of over 500 Greylag Geese ringed on the Uists, five have been recovered away from the islands; one to Iceland (a presumed Icelandic bird that had summered in the Uists); three to Coll (118 km south-southwest) and one to Lewis (79 km north-northeast).

Individually marked birds from Loch Loyal (Sutherland) have been recorded wintering in Caithness (to the northwest) and along the southeast coast of Sutherland (c. 50 km from the summering grounds), a pattern not dissimilar to that reported in the 1930s (Berry 1939). Observations of marked birds suggest that migratory flocks of Icelandic Greylag Geese will join flocks of indigenous birds in feeding areas, but the reverse is infrequent (F. Symonds pers. comm.). Migratory Icelandic Greylag Geese do not regularly winter on the Uists or Coll/Tiree.

Habitat and feeding ecology: The main winter habitat is thought to have been saltmarsh and coastal *Scirpus* beds (Owen 1976), but in Britain little of this habitat remains and many of the inland fens and marshes have been drained for agriculture. The species switched to feed on arable farmland and improved pastures many centuries ago (McKay 1980). Grass is used throughout the winter although typically, cereal stubbles, oats and ryes are used in autumn. In spring, sown grass and to a lesser extent permanent pasture are important. Grass, including some clover *Trifolium* spp., is apparently the principal food in spring during the pre-breeding period. Moorland vegetation is especially important during the June/July moult period (Newton & Kerbes 1974, F. Symonds pers. comm.). Greylag Geese roost on estuaries, coastal sandflats and freshwater lochs and mires.

3.2 Abundance

Phenology: Greylag Geese generally start to move from the breeding grounds soon after breeding (July onwards) gathering in flocks which can number over 300 birds. There is redistribution in winter and flock sizes generally decrease. The return to the breeding quarters can start as early as February, with most geese laying eggs in April.

Trends and numbers: Since the mid 1980s, the total population has increased from c. 3800 to c. 10,000 (see above). The numbers of Greylag Geese counted during the annual autumn censuses on the Uists reflect this overall steady increase. Numbers of Greylags in Coll/Tiree have doubled in the last ten years, although in Caithness/Sutherland numbers appear to be rather stable.

3.3 Research

Census: The status and distribution of Greylag Geese on the Uists were investigated in the mid to late 1980s (Paterson 1991). Cooperation with a volunteer counters network together with professional reserve wardens ensures regular and simultaneous coverage of the species range throughout the Uists in August and February. Irregular counting has taken place on Coll/Tiree (now biannual) and Caithness/Sutherland. A countrywide population census took place in 1997.

Ringing: Indigenous Greylag Geese have not been caught and ringed outside the summer moulting period.

Other: Local feeding studies have demonstrated seasonal changes in the diet of Greylag Geese apparently responding to, and in part driven by, seasonal changes in the habitats available. From 1985-1990, the feeding ecology of and damage to crops by Greylag Geese was investigated by Ian Paterson as part of a population study (Paterson 1991).

3.4 Protection and conservation

Hunting legislation: Annex II/1 of the EU Birds Directive; Schedule 1, part II (in the Outer Hebrides, Caithness/Sutherland and Wester Ross) and Schedule 2, part 1 (elsewhere in Britain) of the Wildlife & Countryside Act 1981 (may be shot outside the close season); Appendix III of the Berne Convention; Appendix II of the Bonn Convention. An estimated 500-800 are currently shot each year on the Uists (Table 9.1) and c. 800 were shot on Tiree between December 1995 and October 1996 (C. McKay pers. comm.) but no accurate bag statistics are available for other areas. Applications for licenses to shoot Greylag Geese have been granted in spring in Caithness/Sutherland. This is primarily in response to large numbers of migratory Icelandic Greylag Geese feeding on 'spring bite' (see Mitchell & Sigfusson this volume), yet indigenous birds have been shot at this time too (F. Symonds pers. comm.).

Site safeguard: The majority of the known wintering population is currently located within the SPA network in the Outer and Inner Hebrides (Stroud et al. 1990), including some known nocturnal roosts. Feeding areas, which cover a range of habitats including farmland, are not significantly represented within every SPA.

Agricultural conflict: In Britain, the main wintering habitat is cereal and pasture farmland. Although this change in habitat may have been forced on the geese, they have fared well on farmland. Pastures are heavily fertilised and provide palatable and digestible forage. They graze pastures throughout the winter, and especially in autumn, feed from ripening heads of cereals (oats and rye), and take grain from stooks and ricks, as well as from stubbles. In crofting areas, tolerance to the geese is low, especially to larger flocks. Conflict is highest in spring, especially in Caithness/Sutherland, when Greylag Geese feed on grassland areas where lambing occurs. Crofters can view the geese as a threat to their livelihoods and believe that the goose problem should be dealt with by some agency (e.g. landlord, Scottish Office Agriculture, Environment and Fisheries Department or SNH). A view expressed by some crofters is that they should be allowed to return to traditional methods of culling the population during the moult (described by Beveridge 1918).

In the Uists, there was evidence that goose grazing was associated with significant loss of yield, but there was great variability in the degree of loss suffered at any given level of grazing pressure (Paterson 1991).

4. DISCUSSION

Population status: The Greylag Geese population has shown a period of gradual increase since the early 1970s and is currently at c. 9000. Changes in legislation in Britain, beginning with the 1954 Protection of Birds Act, reduced the number of ways in which Greylag Geese could be taken or shot, and at the same time a number of protected areas were established (e.g. Loch Druidibeg). Also during the same period, Greylag Geese began to take advantage of the higher quality herbage available on improved grasslands. These changes occurred concurrently during the same decades and the net effect has been to reduce winter mortality, so increasing the population size. It is not possible to disentangle the relative importance of the different factors because of their complexity.

The geese do not undertake a lengthy migration to northern latitudes and spring weather conditions favour early breeding attempts in Scotland. Consequently, the proportion of young in autumn flocks does not vary as greatly as in other grey geese which winter in Scotland but breed in higher latitudes (cf Icelandic Greylag Geese, Mitchell & Sigfusson this volume).

Conservation issues: The primary conservation issue surrounds the status of these isolated groups of non-migratory Greylag Geese under the terms of African Eurasian Waterfowl Agreement (which specifically deals with migrating populations).

There is a large and increasing feral population of reestablished Greylag Geese in Britain (c. 22,000, see Mitchell & Fox this volume). The largest of the feral groups is in southwest Scotland, established around 1930 by the release of young hatched from eggs brought from Loch Druidibeg. Attempts to establish the Greylag Goose as a breeding bird into parts of its former range involved translocation of goslings and adults, and removal of eggs from the Uists and incubation at release sites (see Sedgwick et al. 1970, Atkinson-Willes 1963). Many released geese were derived from indigenous stock and small numbers of geese from the Uists were also released in areas close to the existing range of indigenous birds in Wester Ross and Sutherland (Sedgwick et al. 1970).

In the late 1960s and early 1970s, more than 1000 Greylag Geese, chiefly from eggs taken in southwest Scotland, were released by wildfowling clubs in many other areas of Britain, although the numbers and distribution of the releases are not well understood. Reestablished birds have increased in number in most areas and the policy of widespread release is not now encouraged, chiefly because of complaints of damage to agricultural crops (Owen et al. 1986).

Thus, the status of the indigenous population needs to be fully examined in light of the various reestablishment schemes carried out from the mid 1930s.

The true "native" population is now so close to the "re-established" population that there is a virtually continuous breeding population in Britain. In future, it is going to be difficult to justify treating them as two populations in conservation terms.

There are frequent, yet localised, conflicts with agricultural interests (see below). A discussion document produced by The Scottish Office (1996) aims to develop management options for goose populations in Scotland, including indigenous Greylag Geese, although management prescriptions for these geese are not proposed.

Agricultural conflict: Attempts by crofters to keep Greylag Geese away from their autumn cereal crops have been noted since the 18th century (McKay 1980). Agricultural conflict in the past led to considerable persecution and the threat of the extermination of the Greylag Goose as a breeding species in north Scotland (Berry 1939). In recent years, concern has been growing, particularly where numbers are high, with rising numbers of complaints of agriculture damage. There have been a number of complaints from farmers about loss of yield due to goose grazing on grass and cereal crops. In addition to reduced yields, there have been other agricultural effects of goose grazing such as reduced stocking densities, uneven ripening of crops, increased weediness of crops, puddling of ground and delays in turning out livestock.

There are currently two goose management schemes in Scotland (operated by local Goose Management Committees on the Uists and on Tiree) specifically for indigenous Greylag Geese. The objective of the Uist scheme is to protect the population of Greylag Geese and alleviate conflict between crofters and geese. The mechanism involves scaring the geese from sensitive areas during certain times. On Tiree a different approach has been adopted - two control officers have been employed to shoot Greylag Geese during September/October.

Future research needs: There is an urgent need to understand the population processes underlying the increase in numbers which has occurred in the last 30 years. Continued monitoring of numbers through census and annual assessments of breeding success are basic requirements for the immediate future. The status of the indigenous stock needs to be examined in light of the various reestablishment schemes. The monitoring of movements (especially between breeding areas) and mortality patterns through individual marking is a high priority. There is an urgent need to determine the distribution and scale of agricultural damage caused by Greylag Geese in Scotland.

International conservation: The range of this population of Greylag Goose is restricted to three discrete areas of north Scotland. This would enable the development of a conservation plan for the population to guide national conservation and management actions, since this would involve relatively few organisations.

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10 Feral Greylag Geese *Anser anser*: United Kingdom

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1. POPULATION REVIEW

1.1 Range

The Greylag Goose is the only native breeding goose species in the British Isles, where it was formerly widespread, but habitat destruction and human persecution have steadily reduced the breeding range over the last few centuries. A population survived in the East Anglian Fens until these areas were drained last century, and the population in the Western Isles and other parts of north and west Scotland has persisted to the present (see Fig. 8.1 in Mitchell & Sigfusson this volume, and Mitchell this volume).

The feral Greylag Goose population in Great Britain has arisen as a deliberate scheme of reintroduction co-ordinated by wildfowling interests which started mainly in the 1930s, with birds set out in southwest Scotland and East Anglia (Atkinson-Willes 1963). During the 1960s, there were more widespread reintroductions of some 1300 Greylag Geese by the then Wildfowlers Association of Great Britain and Ireland (WAGBI, now the British Association for Shooting and Conservation). These birds were mainly taken from the Scottish population and either released directly into the wild or bred in captivity for further dispersal. The organised WAGBI scheme was disbanded in the early 1970s. By the mid 1980s, substantial self-supporting flocks had become established at more than 30 sites (but see Owen & Salmon (1988) for a full account of the history of the reintroductions and the spread in Britain and Ireland).

The first full national survey of feral geese in the United Kingdom (UK) was organised by The Wildfowl & Wetlands Trust (WWT) in the summer of 1991, and found a total of 19,501 (including goslings) at 447 sites in 320 10-km squares, a mean density of 44 individuals per site and 61 per occupied 10-km square (Delany 1993). Most are concentrated in southwest Scotland, the east Midlands and East Anglia, but large concentrations occur on gravel pits and reservoir complexes along many of lowland Britain's major river systems.

1.2 Delineation of flyways

The majority of the breeding groups are highly sedentary, but there is little published data relating to move-

ments of ringed birds. The flock subject to study by the Game Conservancy at Great Linford in Buckinghamshire had a total range of some 20-30 km (Giles 1992), but some flocks breeding in the uplands of the Lake District and Yorkshire migrate longer distances to the lowlands or coasts in winter (Owen & Salmon 1988).

1.3 Population trends

The population was estimated at 22,000 in 1991 by Delany (1993) and trend analysis of national Wetland Bird Survey count data (which does not cover the entire population) suggested a 50% increase up to 1996 (Cranswick et al. 1997). The index value for 1995-96 indicated an average annual increase of circa 15% in the 25 years since 1970-71 (Cranswick et al. 1997), which compares favourably with the rate of 13% given in Owen & Salmon (1988).

1.4 Breeding success

Greylags lay eggs from early April and incubate clutches of 2-9 eggs (mean 5.9), much as the wild populations (Wright & Giles 1988, Giles 1992). The species tends to select sheltered sites, especially on islands; the Great Linford study showed that, of the 95 of nests on the mainland, 75% were predated, compared with 13% on islands (Wright & Giles 1988). Major predators of terrestrial sites are Foxes *Vulpes vulpes* which are disinclined to cross water, but even on islands, lowland gravel pits offer little protection from crow predation which may be a major source of egg loss (Wright & Giles 1988). Human disturbance can also depress breeding success (Giles 1992). Fledging success at Great Linford was 88-93% overall during 1984-1987 (Wright & Giles 1988).

There is little evidence of inter-specific competition between species of feral geese: at the Great Linford gravel pit complex, both Canada Geese *Branta canadensis* and Greylags co-exist in high densities. Both species experienced high nesting success and showed increasing trends during 1974-1987, although gosling mortality was higher amongst Canada Geese than Greylag Geese (Wright & Giles 1988). During the 1991 national survey of feral geese, Delany (1993) found higher levels of young amongst Greylag Goose flocks (30%) than amongst Canada Geese (23%). The limited information suggests that breeding success is relatively high. For example, in 1991, there was a mean brood size of 4.0 (Cranswick et al. 1992).

1.5 Mortality

Although originally introduced with the intention of providing quarry geese for shooting in areas where they did not occur, the reintroduced Greylags have not been considered attractive sport. Inland geese fly little and low, and are often rather tame. However, in some areas, the species is shot, as around Great Linford, where the bag was considered to amount to 4-28% of the maximum winter Greylag Goose count there (Giles & Street 1990). That study found that whilst the local population was less than c. 200 birds, hunting had an effect on the subsequent breeding population - the higher the percentage shot in winter, the fewer geese nested in the following spring (Giles & Street 1990).

The most recent assessment of the Greylag Goose bag estimates c. 7800 are shot annually south of Cumbria/North Yorkshire (Reynolds & Harradine 1996), which potentially represents 35% of the estimated 22,000 birds currently thought present. The precision of both the bag and the present population size may both be subject to some error, however.

2. BREEDING/WINTERING GROUNDS

2.1 Distribution

Range: The sedentary populations of introduced Greylag Geese have shown little sign of major spread, nor of the development of moulting areas remote from the breeding/wintering complexes, although some annual changes in distribution inevitably occur. The major concentrations in England are to be found in Norfolk where up to 1400 have been reported from the Norfolk Broads and over 500 from Holkham Park in the north of the county. More occur in adjacent areas of eastern England, notably Buckinghamshire, Northamptonshire, Bedfordshire and Cambridgeshire (Cranswick et al. 1992). Large numbers were also found in Dumfries & Galloway, centred on Castle Loch where over 1000 have been counted (Owen & Salmon 1988). More than 500 have also been counted at Bolton-le-Swale (Yorkshire) and Tophill Low Reservoirs (Humberside)(Cranswick et al. 1995). Concentrations also occur in Cumbria, Angelsey and southeast England. Introduced Greylags have become established at Strangford Lough and in County Fermanagh (Owen & Salmon 1988), with more recent establishment of groups elsewhere and in the Republic of Ireland. More than a thousand Greylags have been counted in northern Ireland in recent years, although some are of Icelandic origin.

Habitat and feeding ecology: Greylags are perhaps amongst the most adaptable of European goose species and the feral populations have proved themselves versatile in adapting to a range of food items. The great majority feed on agricultural land: on stubble and potato waste in autumn and early winter, changing to grass and sprouting cereals in winter and spring. They will eat turnips, kale, beans, carrots and newly-sown grain (Giles 1992).

2.2 Moult migration and moulting areas

Greylag Geese generally moult in the vicinity of the breeding and wintering areas, few long-distance moult migrations are known.

2.3 Research

Agricultural and amenity conflict caused by Canada Geese is rather longer established and more widespread geographically than those caused by the more recently arrived feral Greylag Geese. For this reason, the Greylag Goose has attracted relatively less attention, and where conflict has arisen, management options for solving local problems have relied on information relating to Canada Geese. For this reason, the feral Greylag populations have been very little studied in Britain.

The one notable exception is the programme of research to study the breeding biology of feral Canada and Greylag Geese carried out by the Game Conservancy at the Gravel Pit Research Centre at Great Linford in the 1980s (e.g. Heywood 1988, Wright & Giles 1988). This work was extended to look at the relative merits of different control measures as effective management techniques to limit population size (e.g. Giles & Street 1991, Wright & Phillips 1991, Giles 1992). Unfortunately, this research facility was closed in the early 1990s and the activity has ceased.

2.4 Protection and conservation

Hunting legislation: Breeding Greylag Geese are protected under the Wildlife and Countryside Act 1981 and subsequent amendments, but they may be killed or eggs/nests destroyed under Department of the Environment or Ministry of Agriculture, Fisheries and Food licence. Such a licence may be granted to "conserve wild birds; protect any collection of wild birds; preserve public health or public or air safety; prevent serious damage to livestock, foodstuffs for livestock, crops, vegetables, fruit, growing timber or fisheries". The extent of control is not known. The species is legal quarry in the open season (September 1 - January 31).

Public awareness: The Greylag Goose, along with the Canada Goose, has become very popular with the general public, since both species will become very tame, especially at sites where the public feed waterfowl. Such close encounters with large "wild" birds has encouraged feral geese to become tame and enter urban areas. The Game Conservancy has produced material providing advice on how to control population size in feral goose populations (see Giles 1992).

3. DISCUSSION

Population status: It would appear that the estimates of some 22,000 feral Greylags in Britain at the present are correct, based on the 1991 count of nearly 20,000 (Owen & Salmon 1988, Delany 1993).

Conservation issues: There are no apparent conservation issues linked to the growth of the feral Greylag population in the UK. Claims of interference with other native waterfowl species have not been substantiated, but there are political demands for control on the basis of agricultural/amenity damage and public health risk. Clearly discussion and resolution of similar conflict caused by Canada Geese are of relevance here (modified to take account of appropriate species' differences).

Agricultural conflict: The scale of damage in the UK has not been assessed and is of far lesser extent than that of Canada Geese. The Game Conservancy has developed a set of recommendations which offer a range of options and measures to reduce conflict and damage.

Future research needs: If the population of Greylags in the UK continues to grow, there may be future needs to develop appropriate management techniques. Clearly, continued monitoring is an essential first step to assessment of the size of the population and the relative rate of change in different parts of its range. This can be achieved under the Wetland Bird Survey (WeBS, organised by the British Trust for Ornithology, Royal Society for the Protection of Birds and the Joint Nature Conservation Committee) which provides especially good cover of the lowland waters most used by wintering feral Greylag Geese. Since this can never achieve complete coverage, future national surveys should be a priority (to calibrate indices of population change generated by WeBS) along the lines of the 1991 survey. To gain some insight into changes in population parameters, local monitoring of breeding success (by assessing numbers of young in discrete flocks) would be appropriate. Generally, field studies of most aspects of habitat selection, carrying capacity of sites, factors affecting population regulation and management options for local resolution of conflict are lacking, relying on conventional wisdom from the studies of Canada Geese.

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11 Greylag Goose *Anser anser*: Northwest Europe

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1. POPULATION REVIEW

1.1 Range

The Northwest European Greylag Goose population breeds from Finnmark in northern Norway, south along the entire coast of Norway, in Denmark, southern Sweden and along the Swedish Baltic coast to the Gulf of Bothnia, northern Germany, Poland, the Netherlands and Flanders in Belgium (Fig. 8.1 in Mitchell & Sigfusson this volume). The southern parts of the breeding range also include important staging areas and support wintering geese, although the important wintering areas extend the range to southwestern Spain and Morocco in northern Africa.

1.2 Delineation of flyways

The general opinion has long been that European Greylag Geese use two different flyways on route to their wintering quarters (see Fig. 8.1 in Mitchell & Sigfusson this volume): 1) the Atlantic flyway, used by the Northwest European Goose population (this chapter), and 2) the Central European flyway treated by Dick et al. (this volume). However, in addition to this division, the Northwest European Greylag Goose population can in fact be further divided into two groups which follow two different migratory corridors: one from Norway to staging areas in Denmark and later to the Netherlands, and the other from late summer/early autumn concentrations in the southern Baltic to staging areas in the Netherlands. Some geese from both groups winter in the Netherlands and others migrate further to winter quarters in southwestern Spain. The flyway is very well established on the basis of tens of thousands of neckband readings from projects in the Nordic countries, eastern Germany, the Netherlands and Spain. Greylag Geese breeding in parts of Poland may follow either the Atlantic or Central European route to their winter quarters, as is the case with Greylag Geese from parts of Finland. For further discussion of these borders see Dick et al. (this volume).

1.3 Population trends

All the available data show that a marked increase has occurred in the Greylag Goose population in north-

western Europe during recent decades. Madsen (1987) summarised the data up to the early 1980s. In the winter 1967/68, 19,000 Greylags were reported to winter in the Guadalquivir Marismas in southwestern Spain (Bernis & Valverde 1972), although Rooth (1971) gives a figure of 25,000 for the same winter, out of a total Northwest European population at that time of c. 30,000. The population remained at this level in the early 1970s. In the mid 1970s, a dramatic increase started and the population reached more than 130,000 in the winter of 1983/84 (Madsen 1987). Based on information from September counts, Madsen (1987) estimated the early autumn population to be 93,000-112,000 in the late 1970s/early 1980s. By 1991, the total number of Greylag Geese counted in September had reached almost 200,000, probably higher as it is difficult to achieve simultaneous coverage of all sites.

1.4 Breeding success

Breeding success amongst a neck-banded population in southernmost Sweden has been followed for a number of years (Nilsson & Persson 1994) and has shown that productivity is related to a number of factors. One such factor was choice of winter area, Greylag Geese wintering in the Dutch Delta being significantly more productive than geese wintering in the Guadalquivir Marismas in Spain. In a more detailed analysis (Nilsson & Persson 1996), annual changes in productivity were related to conditions in the wintering areas; in the Marismas this mainly relates to rainfall. Moreover, favourable conditions at the staging areas on spring migration could compensate for bad conditions in the wintering areas. Overall, the breeding population in Scania in southern Sweden produced on average 5.36 eggs, the mean post-hatch brood size being 4.60 and 3.14 at fledging. The production of eggs in Norway varies from an average of 5.32 eggs in Rogaland County in the south to 4.20 in Finnmark County in northern Norway (A. Follestad unpubl. data).

Data on breeding success have also been published from studies in Germany. From Schleswig-Holstein, Knief & Struwe (1991) reported 4.1 small young per family and an overall breeding success of 2.0 young per breeding pair, whereas Rüger (1982) reported 4.3 young per successful pair. From other parts of Germany, 4.5 (Bruns 1989), 4.0 (Wonneberger 1996) and 3.8 (Naacke 1982) young per successful pair have been reported. At the Oostvaardersplassen in the Netherlands, brood size after hatching was 4.2 small young over the period 1973-1994 (M. Zijlstra unpubl. data). After severe winters, brood size was slightly reduced.

1.5 Mortality

Amongst the neck-banded population in southwestern Sweden, annual mortality rate (based on resighting frequency) was 24% for first-year birds, 26% for subadults and 17% for adults over the seasons 1985/86-1991/92 (Nilsson & Persson 1993). The survival rate was significantly higher among birds wintering in the Dutch Delta than among birds wintering in southwest-

ern Spain. Earlier mortality estimates based on ringing recoveries were presented by Paludan (1973), who estimated annual mortality rates of 32% for adults and 41% for young. In the 1980s, the survival rate for the Greylag Geese from eastern Germany was similar to those observed in southwestern Sweden (Zijlstra et al. 1991).

2. BREEDING GROUNDS AND BREEDING ECOLOGY

2.1 Distribution

Range: The Northwest European Greylag population breeds along the Norwegian coast, in Denmark, southern Sweden (extending along the east coast to the northernmost part of the Gulf of Bothnia), northern Germany, Poland, the Netherlands and Flanders, Belgium. It is uncertain whether the small numbers of Greylags breeding along the Murman coast belong to this population or not (Follestad & Golovkin 1998).

Breeding numbers in Norway are estimated to be 7000-10,000 pairs, probably closer to 10,000 (Follestad 1994b). Similar numbers breed in Sweden. Nilsson (1982, cf also Fog et al. 1984) estimated the number of pairs in 1980 to c. 2000. It has not been possible to census the population in recent years but, judging from the increase in numbers of staging Greylag Geese in Sweden in September, the breeding population should also have increased three to four fold, i.e. to 6000-10,000 pairs. In a study area in southwest Scania, the population increased from 120 pairs in 1985 to more than 500 pairs in 1994 (Nilsson 1995). Jørgensen et al. (1994) estimate recent Danish breeding numbers at 3200-3500 pairs compared with 2850-3000 in the late 1970s and early 1980s (Fog et al. 1984). Numbers in eastern Denmark seem to have been relatively stable since the mid 1980s but in Vejlene in northwest Jutland, breeding numbers have increased from c. 300 in the 1980s to 700-800 pairs in the 1990s.

Greylag Geese breeding in Germany were estimated to number about 1000 pairs during the 1960s, c. 2500 pairs during the 1970s, 4500 pairs in the 1980s and at 8000-10,000 pairs in the early 1990s. The main breeding areas are in the northern federal states of Niedersachsen, Schleswig-Holstein, Mecklenburg-Vorpommern and Brandenburg, but there are breeding groups of Greylag Geese spread all over Germany (Mooij 1995a, Mooij & Naacke 1997). Knief & Struwe (1991) estimated that there were 850-1300 pairs in Schleswig-Holstein in the late 1980s. The number of breeding pairs in the Netherlands was estimated at 1150-1200 in 1990 following a marked increase (van den Bergh 1991); in the 1970s there were an estimated c. 500 pairs. A number of feral groups are spread throughout the country (Loonen & DeVries 1995).

In Belgium, the introduction of Greylag at the Zwin Reserve, Knokke, in the mid 1950s was followed by an increase in the feral population which has been expanding its regional range. The original introductions at Zwin were of *Anser anser rubrirostris* which later hybridised with *A.a.anser* and gradually the *rubrirostris* characteristics disappeared from this breeding group. However, a great number of the *rubrirostris* sightings along the Atlantic flyway in the 1960s and 1970s were of Zwin birds. An increasing number of wild Greylags were attracted to winter in the Zwin area (see section 4B. below) and from the mid 1970s many stayed to breed. Lippens & Wille (1972) reported 21 Greylags ringed as breeders at Knokke and recovered between 1956 and 1971 in Denmark (8), the Netherlands (5), France (5), Sweden (2) and Germany (1), showing that this breeding group has become less stationary. Since the early 1980s, the Knokke breeding group gradually expanded and several new nesting 'colonies' were established without any further introduction in small marshes and wetlands at Damme, Hoeke, St. Laureins, Assenede, Zeebrugge and other places in Northwest Flanders, totalling at least 200-250 pairs. It is clear that this increase will continue, also further south in Belgium. Release from captivity should be stopped. At the same time, the adjacent Zeeuwsch-Vlaanderen region in the Netherlands was colonised for breeding (Devos & Anselin 1996, Kuijken & Devos 1996). The Greylag Goose tends to become tame and thus frequently hybridises with farm geese.

Some Greylag Geese following the Atlantic flyway also breed in western Poland. These Greylags, together with those following the Central European flyway, are treated by Dick et al. (this volume).

Habitat and feeding ecology: Greylag Geese breeding in the southern Baltic area mostly occur on inland lakes with extensive areas of reed, and nests are constructed either in reed beds or on small islands (Knief & Struwe 1991, Nilsson & Persson 1994, Nilsson 1995). Along the east coast of Sweden the Greylag Goose breeds on the outer islands in the archipelago. Greylags breeding along the Norwegian coast mainly nest on islands, usually in heather, willows or young spruce plantations. In northern Norway, Greylags also use old crows' nests (K.-B. Strann pers. comm.).

In the breeding areas, Greylags feed on various grassland areas close to the breeding lakes, lakes with grazed shores being a preferred habitat. In Norway, however, they mainly feed on natural vegetation or cultivated areas close to the shoreline before fledging. In a study area in southwestern Scania, survival rates for young birds up to fledging were higher at lakes with good grazing opportunities (Nilsson et al. 1997).

2.2 Moult migration and moulting area

Immature non-breeding Greylag Geese and unsuccessful adult breeders gather at a number of moulting sites established in different parts of the range; some of these are only used for a few years, others for longer. Today, Oostvaardersplassen in Flevoland Province, the Netherlands, is the most important moulting site and was probably established as a moulting site as early as 1968. From 1973 to 1992, the number of moulting geese increased from 1100 to about 62,000 (Zijlstra et al. 1991, Dubbeldam & Zijlstra 1996). In recent years numbers have been lower because the water level in the reed beds has been lower during the moulting period, and the number moulting in 1996 was only about 12,000. Oostvaardersplassen attracts moulting geese from large areas around the southwestern Baltic and a large number of observations of neck-banded Greylags from southwestern Scania have formerly been obtained from here (Nilsson 1992, unpubl. data). The Greylags from Germany (with the exception of most feral birds) also moult in the Oostvaardersplassen as shown by observations of neck-banded birds (Voslamber et al. 1993). Most feral birds moult at or in the direct neighbourhood of their breeding area.

Formerly, Greylag Geese moulted on the northeastern shore of Lake IJselmeer, where a maximum of 6000 moulters were recorded in 1964 (Lebret & Timmerman 1968). Moreover, Greylag Geese have moulted in the Haringvliet area, with a maximum of 11,000 in 1969 (Ouweneel 1978). In recent years, several small moult concentrations have been established in the Netherlands by local breeding birds, e.g. De Gelderse Poort and the Middenlimburgse Maasplassen. In the Haringvliet area, the numbers of moulting Greylag Geese has risen again to 1250 in 1992 (G.L. Ouweneel unpubl. data). Local breeding populations in North Flanders, Belgium, mostly moult within the area.

Recently, new moulting places have also been reported from Schleswig-Holstein in Germany. There has been a build up in numbers during the 1990s and in 1996 about 5000 were present in Hauke Haien Koog on the west coast and Grosser Plöner See (B. Struwe-Juhl in litt.). Greylag Geese marked in Scania have been found moulting in Hauke Haien Koog.

The Norwegian coast is also an important moulting area for Greylag Geese, comprising a series of moulting sites scattered throughout the outer archipelagos, mainly between Möre and Nordland. Up to 22,000 Greylags moult here (Follestad et al. 1988) and neck-banding has shown that, in addition to the Norwegian breeding birds, Greylags breeding in southern Scandinavia and possibly even further away, such as in the Czech Republic, may migrate to the Norwegian coast to moult.

In Sweden, a number of small islets around Gotland have long been known as important moulting sites for the Greylag Goose (von Essen & Beinert 1982), reaching a maximum of 5400 moulters in the years 1974-79. Here too, moulting birds originated from widely different areas including some from central Europe. At present, the number of moulting Greylags has fallen to about 2000 (Andersson 1992). Recently 1000-2000 moulters have been recorded at Tåkern. No other large moulting sites are known from Sweden, although smaller moulting flocks have been found on a number of lakes in southern Sweden and the Stockholm archipelago.

In Denmark, Vejlene on Jutland was formerly an important moulting site, but its importance has decreased since the early 1960s and only 500 were found in 1992 (Jepsen et al. 1993). Other known sites with moulting birds are Maribosøerne (Jørgensen et al. 1994) and Saltbækvig (Jepsen et al. 1993). In recent years an important new moulting site was found on the island of Saltholm between Sweden and Denmark, where 9100 Greylags were counted in 1994 (Fox et al. 1995), 10,400 in 1996 and about 13,000 in 1997. The Greylag Geese from southwestern Scania, which formerly moulted mostly in Oostvaardersplassen in the Netherlands have changed their moulting habits and are now mostly found on Saltholm (L. Nilsson & J. Kahlert unpubl.).

2.3 Research

Ringing: Neck-banding of Greylag Geese in the Northwest European population has been undertaken in the Nordic countries since 1984, mainly concentrated in southwest Scania, Södermanland Province in south-central Sweden and along the coast of central Norway. Neck-banding of breeding Greylag Geese has also been undertaken in eastern Germany since 1976, in the Netherlands since 1990 and in Poland since 1987.

Other: In southwestern Scania, intensive studies on population dynamics and breeding biology has been an integrated part of the neck-banding study (Nilsson & Persson 1994, 1996). Similarly, population studies etc. are an integrated part of the Norwegian neck-banding study. Research projects are being carried out in several parts of Germany on local breeding groups, e.g. since 1968 around Dümmer in Niedersachsen, since 1969 in Brandenburg (especially Gülper See), since the end of the 1960s in the Lower Rhine area in Nordrhein-Westfalen and since the 1970s in Schleswig-Holstein. A study of genetic differences between groups of Greylags within this flyway is in progress both using DNA techniques and cross-breeding experiments (M. Loonen pers. comm.). Intensive studies on moulting Greylag Geese are undertaken on Saltholm, Denmark (A.D. Fox, J. Kahlert pers. comm.). In Belgium, the introduction of Greylags caused confusion through mixing of feral and wild birds in an expanding population; the situation is monitored on regional basis.

2.4 Protection and conservation

In all breeding range states, the Greylag Goose is protected in spring and summer. In several countries, however, licences for shooting geese in July may be granted if the geese damage crops. In Norway, licences may even be granted in April, May and June. In the Netherlands, there is increasing conflict with agriculture close to breeding areas as a result of the population increase. In case of conflict, hunting is allowed outside nature reserves. At several sites, the breeding population is also controlled by destroying (part of) clutches.

Moulting sites in Denmark are protected areas with some restrictions on human access (European Union Special Protection Areas (SPAs), Ramsar sites). Oostvaardersplassen in the Netherlands is also protected as are some of the smaller moulting sites in other countries. In Belgium, Greylag Geese may be hunted at one locality (Knokke) only, in order to reduce feral population expansion (see also section 4B.4 below).

3. STAGING AREAS

3A. NORWAY

3A.1 Distribution

Range: Staging geese may be seen throughout the Norwegian coast during the autumn migration period, as the breeding distribution extends all the way from southernmost Norway to Finnmark County (Follestad 1994a, b, Follestad & Golovkin 1998). However, as the autumn migration may now start already in early August, there are no staging areas where large numbers of breeding or non-breeding birds gather from nearby breeding areas before departure. Flocks reported during September counts are mostly small, with the largest flocks numbering up to 900 birds. The majority are found in the Møre/Trøndelag region and at a few localities in southern Norway, although flocks of up to 200 geese have been recorded as far north as Finnmark County (Follestad 1992). The few remaining Greylag Geese wintering in Norway are found mainly at two sites in the southwestern corner of the country: Lista and Jæren.

During spring, Greylag Geese from southern and central Norway apparently move directly from staging areas abroad to the breeding sites, where they occur mainly as single pairs or in small groups. Greylags from Troms and Finnmark may, however, stopover at coastal sites in central and northern Norway before moving on to the breeding sites. The location and function of these sites are, however, only poorly known. Later in spring, flocks of up to several hundred immatures and failed breeders gather at pre-moult sites close to the main moulting sites in central Norway, before moving to the moult sites in the outer archipelagos in early June.

Habitat and feeding ecology: In late summer after the breeding season, the Greylags mainly graze on grassland, or they may feed on a variety of plants in the heather or bogs, including berries. In central Norway, both breeding and non-breeding Greylags have been observed feeding on Crowberries *Empetrum nigrum* from the end of July. In Troms County, Greylags have been accused of eating large quantities of Cloudberries *Rubus chamaemorus*, and many land owners therefore eliminated the Greylag on their properties in former times (Soot-Ryen 1941). At night or during daytime when disturbed, Greylags may rest on small islands, along the sea shore, in bogs, heather or on lakes with good views of the surroundings.

In September, the Greylag Geese feed on grassland and stubble fields. The most important September staging areas in central Norway are all located in areas where the geese can feed on stubble fields, usually after the harvest of barley.

3A.2 Abundance

Phenology: At the end of July, after the breeding season in central Norway, most Greylag Geese gather in flocks at the breeding sites, or move a short distance from the outer archipelagos to feed on cultivated grassland, on populated islands or on the nearby mainland. These flocks may include non-breeding geese which have returned from the moult at other sites, but only rarely do flocks exceed 500-600 birds. In areas close to moulting sites, peak numbers are normally reached at the end of July or in early August (Follestad 1994a). This is probably caused by some moulting birds proceeding to their breeding areas and, in recent years, by some breeding as well as non-breeding birds departing for the autumn migration.

Greylags from southern and central Norway, including the coast of Helgeland, have changed the timing of their departure in autumn from September/October (until the end of the 1980s), to early or mid August. This change is believed to be caused by intensive hunting in Norway (Follestad 1994a). There is now so great an overlap between the return migration from moulting sites and the autumn migration that it may be difficult to distinguish between these two events. Most geese from southern and central Norway, at least north to Lofoten, have left their breeding areas during August, and appear to do so at the time when both the adult breeding birds and their young have just completed growth of their new primaries. A number of birds may rest for some days at Jæren before they continue to Denmark or the Netherlands, where Norwegian Greylags have been recorded in considerable numbers on staging areas from mid August. In northern Norway, however, Greylags still seem to migrate mainly during September and October, and relatively high numbers stage at certain localities in southern Norway.

This change in the timing of the migration will strongly influence the trends found in the September counts. Before the end of the 1980s, many Norwegian Greylags were still present in Norway in September and, as no mid September count was organised in Norway at this time, they were not included in the European mid September counts. The change in the timing of their departure from about 1990 onwards means that most of the Greylags from southern and central Norway would have been present in countries conducting mid September counts and were probably, therefore, only recorded in these counts from 1990 onwards.

Trends and numbers: During the mid September counts in Norway in 1991-1996, 2800-5000 Greylags were counted at the different sites (Fig. 11.1). However, considering the gaps in coverage, both from year to year and in northern Norway where many birds remain in September, numbers may reach at least 5000-6000 individuals in normal years. In some years there may perhaps be an additional one or two thousand individuals. As the mid September counts in Norway are carried out after the main migration period (within the migration period for the northernmost birds), these counts alone will probably not reflect the overall trend in the numbers of Greylag Geese in Norway.

Only small numbers of Greylag Geese winter in Norway, usually a few hundred individuals, with a recorded maximum of 400-500, although in some years hardly any Greylag Geese remain in Norway.

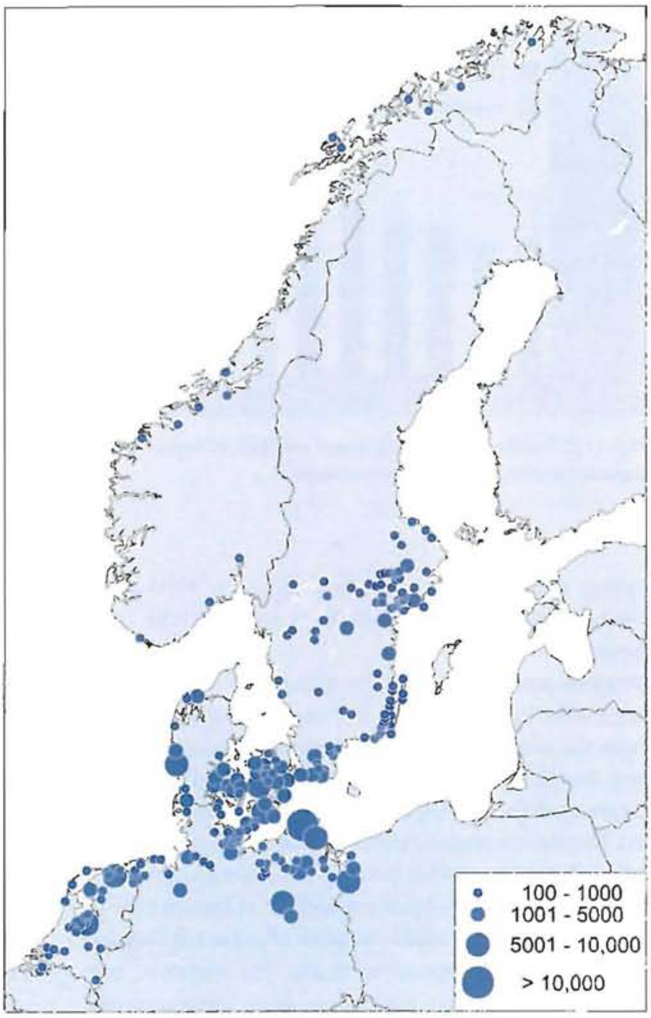

Fig. 11.1. September distribution of Greylag Geese in Northwestern Europe. Data: Sweden, mean 1984-96 (L. Nilsson unpubl. data); Denmark, mean 1984-1992 (Jørgensen et al. 1994); Germany (Jørgensen et al. 1994); Netherlands, mean 1985/86-1993/94 (SOVON Vogelonderzoek Nederland unpubl. data, Koffijberg et al. 1997).

3A.3 Research

Census: A special Greylag Goose count has been organised annually since 1991, but there has not been full coverage of some important staging sites in southern Norway and in many breeding areas in northern Norway. Greylag Geese are also counted in the goose counts in January on Lista and Jæren.

Ringing: A neck-banding programme has been operating in Norway since 1986. Marking of breeding birds has been undertaken at several sites in central and northern Norway and of moulting geese on some of the important moulting grounds in central Norway (Follestad et al. 1988). Intensive, almost daily checks for marked geese have been organised on Vega (the main marking site in Norway), from arrival in spring to departure in late summer.

Other: Data on habitat selection, activity patterns etc. have been collected, and a project has been carried out on the effect of different hunting regulations on the timing of the autumn migration for both breeding and non-breeding individuals.

3A.4 Protection and legislation

Hunting legislation: There has been an open season for the Greylag Goose in southern Norway from 10 August to 31 October, from 15 August to 31 October in central Norway and from 21 August to 31 October in northern Norway. During the first part of the season (until 21 August), hunting was only allowed before 1100 h. Hunting has also been permitted from the birds' arrival in spring and all through the breeding season in order to protect crops. During the hunting season 1993/94, 9500 Greylags were bagged in Norway (Direktoratet for naturforvaltning 1996).

Site safeguard: The majority of the main September roosting sites in southern and central Norway are situated in nature reserves. However, feeding occurs almost entirely outside protected areas.

Agricultural conflict: The Greylag Goose causes serious damage to crops (pastures) in central Norway during the breeding season (Follestad 1994a). As most Greylags now leave the breeding areas in this region during August, little damage is reported in September. In spring and on pre-moulting sites they may cause serious damage on newly grown grass.

No compensation has been paid for goose damage, but hunting has been allowed to protect pastures. A new management plan for geese in Norway aims to provide basic guidelines for the development of regional and local management plans to alleviate the conflict with agricultural interests (Direktoratet for naturforvaltning 1996).

3B. SWEDEN

3B.1 Distribution

Range: During late summer and early autumn, flocks of Greylag Geese are found at several localities in southern Sweden (Fig. 11.1) at least north to the river Dalälven. The largest flocks generally comprise up to a few thousand geese (maximum 7000-8000) but many flocks are smaller. With the spread and increase in numbers of the Greylag Goose in Sweden, new sites are regularly found. Flocks occur both on inland lakes and in coastal areas. Relative to the rest of southern Sweden, flocks of Greylag Geese are more common in the southernmost province, Scania.

During spring, Greylags mostly move directly to the breeding sites, where they gather in small flocks, but there are no larger gatherings as in late summer and autumn. In southernmost Sweden some flocks stage at coastal sites while the inland lakes remain frozen. Later in spring, flocks of up to several hundred individuals (immature and failed breeders) gather at some sites in the breeding areas before they leave on moult migration in mid or late May.

Habitat and feeding ecology: Roosting sites are found both in inland and coastal areas (Nilsson & Persson 1992). In most areas, they prefer roosts where they can graze on shore meadows during the day. The geese make feeding flights in the morning and late afternoon, feeding on fields relatively close to the roost, but also flying 10 km or more to a good feeding site. During 1985-87 (Nilsson & Persson 1992, Persson 1989) they did not normally fly more than five kilometres to feed. Later, marked changes in land-use occurred in the main study area and geese regularly extended their feeding flights up to 10-15 km (Nilsson & Persson 1998). When suitable crops were once more available close to the lakes in 1996, the geese reverted to feeding close to the roost (L. Nilsson & H. Persson unpubl.).

In late summer after the breeding season, the Greylags mainly feed on grassland, either grazing and/or collecting ripe grass-seed. As soon as peas are available the Greylags feed on these, later shifting to stubble fields after the harvest of wheat and barley (Nilsson & Persson 1992, 1998). In the inland study area in southwest Scania, geese left the area when the stubble fields were ploughed, but remained longer on the coast. In coastal Scania, Greylags started to utilise sugar beet, feeding on this until the frost makes it unavailable, whence the geese leave. In other areas, Greylag Geese are also known to feed on other crops such as potatoes. During the last ten years, marked changes have occurred in agriculture; large areas of set-aside have become available and are frequently used by the geese. In some areas Greylag Geese also feed on unharvested cereals and sugar beet (Nilsson & Persson 1998).

In spring, the geese mostly graze on pastures or winter cereals close to the breeding areas. Pre-moult flocks are mostly also found on winter cereals, although nonbreeding flocks were also feeding on newly sown grain.

3B.2 Abundance

Phenology: After the breeding season, Greylag Geese gather in flocks at the breeding sites. These flocks are augmented by returning geese from the moult at other sites. During July and early August these smaller flocks gather into larger flocks at a number of sites. Peak numbers in the autumn are generally reached in September (thus a mid September count was introduced), although in some recent years with mild and early springs (and breeding seasons) a number of geese had already left by that time. Greylags generally leave inland southern Sweden during October, but several large flocks remain at some sites and are recorded in the mid October count. Thus, in October 1995, 25,000 Greylag Geese were still present in southern Sweden. By November, most Greylag Geese have left Sweden and in most recent years c. 2300 remain, compared to a September maximum of more than 50,000. In December very few Greylags are left in Sweden.

Wintering Greylag Geese are rare in Sweden except in southernmost Scania, where a flock has remained in winter during the recent mild winters. In such years, spring arrival is early, e.g. in January, but normally the first arrivals in Scania occur in February, and by March most breeding birds are back. Few concentrations of

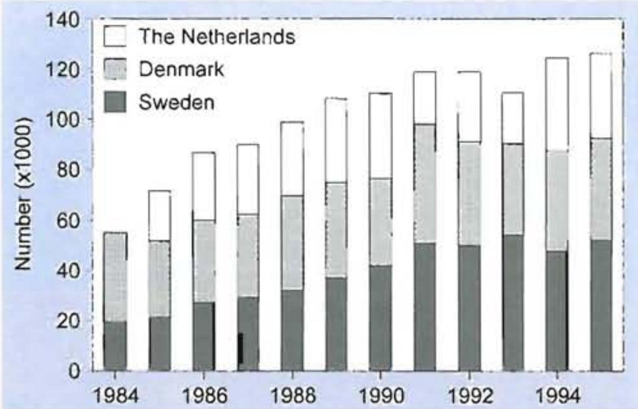

Fig. 11.2. Numbers of Greylag Geese counted in September in Sweden, Denmark, and the Netherlands.

spring staging birds are noted except in mild years when small flocks gather on the coast before the lakes became ice-free.

Trends and numbers: The number of staging Greylag Geese in Sweden has increased markedly, in line with the overall population increase. Censuses of Greylag Geese have been undertaken annually in mid September since 1984, when about 19,000 were recorded. Numbers increased steadily to about 50,000 in 1991 (Fig. 11.2), after which more or less stable numbers of Greylag Geese have been counted. It is known that in some years an appreciable number of geese left Sweden before the mid September count. For example, one year, in Scania alone, 6000 more geese were recorded in a count conducted two weeks prior to the national census. In recent years, as numbers have increased, a number of newly established sites may have been overlooked. It is estimated that September numbers in 1995 totalled at least 60,000 Greylag Geese.

Considerable numbers of Greylag Geese have also been counted in October, no less than 25,000 in 1995, but coverage in October is not good enough to allow calculation of national totals. These counts show the same general increase in numbers. January numbers are much lower and, before 1989, less than 100 were counted in Sweden in the mid winter counts, mostly single individuals or small groups together with other goose species. The mild winters between 1988 and 1995 led to an increase in the wintering number and a maximum of 657 was recorded in 1995.

3B.3 Research

Census: A special Greylag Goose census has been organised annually since 1984 with the aim of covering all localities of importance for the species. Greylag Geese are also included in the general goose counts in October, November and January, but these counts do not attain full coverage for the species. More intensive counts are undertaken at some important staging areas.

Ringing: A neck-banding programme has been operating in Sweden and the other Nordic countries since 1984. Marking of breeding Greylag Geese has been undertaken in Södermanland Province, on Gotland (moulting) and in southwestern Scania. Intensive checks for the marked geese have been organised.

Other: Habitat selection, activity patterns etc. of Greylag Geese during late autumn and summer were studied in southwestern Scania during 1985-1987 (Nilsson & Persson 1992, Persson 1989). In 1994-1996, this study was repeated in order to elucidate possible changes related to changes in land-use during the intervening period. Long-term population dynamics and breeding studies on marked Greylag Geese in southwest Scania have been undertaken since 1984 (L. Nilsson & H. Persson).

3B.4 Protection and conservation

Hunting legislation: There is an open season for Greylag Geese in southern Sweden (south of the provinces Dalarna and Gästrikland) from 21 August to 31 October on the coast and from 11 August inland. In the southernmost part hunting is not allowed after 1100 h during October. On the island of Gotland the open season is from 20 July to 15 September. Along the coast of Norrbotten, the open season for Greylags is from 25 August to 12 September. Moreover, hunting is allowed to protect crops inland from 20 July to 10 August and in coastal areas from 20 July to 20 August. During the hunting season 1990/91, 3900 Greylags were bagged in Sweden, and the bag is increasing (Bergström et al. 1992).

Site safeguard: Some of the roost sites are situated in nature reserves or Ramsar areas, but no areas are specifically set aside for the protection of Greylag Geese. Feeding almost exclusively occurs outside protected areas.

Agricultural conflict: The Greylag is reported to cause damage to crops during autumn staging, especially in the period before the harvest of wheat and other cereals when they can cause damage by feeding on (and trampling) peas. There have also been reports of Greylags causing damage to seed-grass cultivations, unharvested cereals, sugar beet and oilseed rape. The latter food source is relatively new, being related to the introduction of new, more palatable varieties of rape. Locally Greylags cause damage to standing unharvested cereals, especially close to set-aside fields. In spring they cause conflict when feeding on newly sown grain and sprouting spring cereals.

No compensation is paid for goose damage, but hunting is allowed to scare the geese away from crops. At Tåkern, and some other sites, experiments aimed at encouraging the geese to use specially sown goose-crops have been undertaken with some success (von Essen 1990).

3C. DENMARK

3C.1 Distribution

Range: From late July to late October, Greylag Geese occur widely, with 24 roosts regularly supporting more than 1000 geese (Fig. 11.1). Neck-banding has shown that the majority of geese staging in the eastern part of the country are of Danish breeding origin, whilst geese staging along the Danish west coast are mainly of Norwegian breeding origin (Jørgensen et al. 1994).

Habitat and feeding ecology: During August-September, most Greylag Geese feed on waste grain on stubble fields, supplemented by grass and to some extent unharvested peas and waste potatoes. In October, Greylag Geese in southeastern Denmark feed largely on waste sugar beet and locally on winter rape and newly sown winter cereals (Madsen 1986, H.E. Jørgensen in litt.). During August and September, the geese usually feed during relatively short periods in the morning and evening, spending the night and most of the daytime at the roosts. Later in autumn, they increasingly spend more of the daylight hours on the feeding grounds.

3C.2 Abundance

Phenology: In autumn, peak numbers are observed from mid August to late October in the eastern part of Denmark, whereas in western Denmark the peak is of shorter duration, from late August to mid September, reflecting the stopover of Norwegian birds before continuing towards autumn staging grounds in the Netherlands (Jørgensen et al. 1994). In early December, very few Greylag Geese remain. In mild winters, 2000-3000 geese remain, and in cold winters, none. Danish breeding birds arrive on the nesting grounds from mid February to mid March; in mild winters some may arrive in late January. In western Jutland, e.g. Tipperne, a small peak in staging numbers in March-April reflects the passage of Norwegian birds.

Trends and numbers: Systematic countrywide September counts were initiated in 1981 (effective from 1982 onwards). From 1981 to the 1990s, numbers have increased from approximately 25,000 to 40,000 (Fig. 11.2). This doubling in numbers, however, reflects large regional differences in trends. The eastern Jutland-Fyn group has remained stable (6000-8000) and has even decreased in recent years; on Sjælland, Lolland, Falster and Møn, numbers have increased slightly from 15,000-17,000 to c. 25,000. The large overall increase is primarily due to a recent upsurge in numbers in western Jutland: from less than 5000 to c. 15,000 (in September 1996: 40,000) (Madsen 1986, Jørgensen et al. 1994, National Environmental Research Institute (NERI), Denmark, unpubl. data). These differences in trends indicate that the breeding population in the eastern part of Denmark has remained almost stable since the early 1980s and that the Norwegian group stopping over in western Jutland has increased considerably. In January, numbers have increased from a few hundreds to 2000-3000. This may be a combined effect of a series of mild winters in the 1990s and the general population increase.

3C.3 Research

Census: Since 1981, countrywide censuses of Greylag Geese have been carried out in September and January (in January with a gap in coverage from 1984 to 1986).

Ringing: A ringing programme using plastic leg-rings has been carried out on the breeding group at Utterslev Mose in Copenhagen for 30 years (N.O. Preuss, Zoological Museum, Copenhagen). Small numbers have been neck-banded in conjunction with the Nordic Greylag Goose programme.

Other: Since 1994, goose shooting has only been allowed until 1000 h (since 1997 until 1100 h). NERI is studying the effects of the regulation on the behaviour, distribution and numbers of autumn-staging Greylag Geese. In conjuction with the construction of the Fixed Link between Copenhagen and Malmö in Sweden, NERI, in collaboration with University of Lund in Sweden, is undertaking an impact assessment study on the moulting Greylag Geese on Saltholm, an island in Öresund. In Vejlerne, a study of the breeding numbers and factors affecting nest success was carried out during 1994-1995.

3C.4 Protection and conservation

Hunting legislation: Greylag Geese have an open season from 1 September to 31 December and can only be shot between 1.5 h before sunrise to 1000 h (1994-97; since 1997 until 1100 h). In July and August, geese can be shot under licence where they do damage to crops. The annual bag of Greylag Geese has increased from c. 4000 in the mid 1960s to c. 11,000 in the early 1990s (Madsen et al. 1996).

Site safeguard: The majority of roosts and some of the adjacent feeding areas holding substantial numbers of Greylag Geese are SPAs and Ramsar sites. On most roosts, there is a ban on shooting (either due to wildlife refuge regulations or private regulations), whereas in most feeding areas, shooting is allowed.

Agricultural conflict: Locally in autumn, Greylag Geese can cause damage to newly sown winter cereal or winter rape fields by eating the seed and to unharvested pea and potato crops. During summer and early autumn, geese can also damage unharvested cereal crops (Jepsen & Madsen 1992, NERI unpubl.). No compensation is paid for goose damage; the opportunity of shooting geese is regarded as compensation.

3D. GERMANY

3D.1 Distribution

Range: During late summer and autumn, migratory Greylags from Sweden, Finland, the Baltic States, Russia, Belarus, Poland and Germany gather mainly along the German Baltic coast and the lakes in northeastern Germany (Fig. 11.1). From the middle of August, increasing numbers of Greylags gather in northern Germany. In other federal states, groups of local non-breeders and families occur. These local groups are mainly the result of reintroduction projects, mostly started during the 1960s and 1970s. Most of these birds are sedentary. Greylags migrate from northern Germany to the Netherlands, continuing on to the wintering grounds mainly in Spain. Small numbers winter in Germany.

Habitat and feeding ecology: During the breeding period German Greylags are mainly found in bogs, marshes and around shallow eutrophic lakes and oxbows with emergent vegetation, reed beds and open grassland, mostly feeding on floating vegetation, fresh reed plants and grasses. If cereal fields are close to water, these are also used by feeding Greylags.

During summer and autumn most of the Greylags are found on agricultural land, mainly feeding on unharvested crop remains (e.g. sugar beet, maize, cereals). In some places, geese cause considerable damage to cereals by feeding on standing crops shortly before harvest. In winter, geese feed on grassland, stubble, winter cereals and winter rape. At a number of sites in early spring Greylags visit cereal fields although most Greylags feed on grassland in spring.

Except during the breeding season, Greylags roost along the edges of shallow water at night and fly to the surrounding fields to feed during the day. Feeding flights can extend to distances of 10 km.

3D.2 Abundance

Phenology: Non-breeders leave the breeding sites during April for the moulting sites at Oostvaardersplassen in the Netherlands, probably followed in June by failed breeders. Most feral birds gather in small groups to moult in the vicinity of the breeding sites. During August most birds move to traditional gathering sites along the German Baltic coast. Here they mix with Greylags from western Poland and Sweden and reach peak numbers during September of 50,000-75,000 birds. In the second half of September, Greylag numbers in northern Germany decline and most birds migrate to the Netherlands, a few even moving directly to Spain.

During autumn and winter, 5000-10,000 Greylags are counted annually in Germany, mainly in the western part of the country: Schleswig-Holstein, Neidersachsen (Dollart) and Nordrhein-Westfalen (Lower Rhine). A considerable proportion of these wintering birds belong to the feral population. From the end of January, the Greylags start to return to the breeding areas and at the end of February most breeding sites are occupied again (Gerdes 1994, Mooij 1995a, Mooij & Naacke 1997, Naacke 1993, Rutschke 1987, 1997, Voslamber et al. 1993).

Trends and numbers: During September, some 50,000-60,000 Greylags gather in northern Germany, mainly in the federal states of Mecklenburg-Vorpommern (20,000-50,000), Schleswig-Holstein (c. 15,000) and Brandenburg (c. 10,000). Thus during autumn migration, 16-22% of the Northwest European Greylags may thus stage in Germany at one time.

Since the second half of the 1980s, September numbers have been stable (disregarding a low count in 1994) at a slightly higher level than those of the 1970s, when an average of 40,000-50,000 were counted in September (Mooij 1995a, Mooij & Naacke 1997, Naacke 1982, 1993, Rüger 1982).

3D.3 Research

Census: Regular goose counts have been made since the middle of the 1960s, until 1989 with two central coordination points, one in the former German Democratic Republic (GDR) and one in the former Federal Republic of Germany (FRG), and since 1989 coordinated by the Zentrale für Wasservogelforschung und Feuchtgebietschutz in Deutschland (ZWFD), a voluntary union of the former coordinators for eastern and western Germany.

As part of the international goose counts, an annual Greylag Goose census is organised in September. Part of the feral population and some localities where introductions have been made are not counted during this census.

Ringing: A marking project for Greylag Geese was started in the former GDR around Lake Gülpe (Brandenburg) in 1976. Since 1976, 2140 Greylags have been marked and, since 1991, a further 1627 geese have been neck-collared in the course of this programme. Since the 1960s, feral geese have been marked in different parts of Germany in connection with various introduction projects.

Other: There is a long tradition of research on the status, ecology and management of goose populations as well as on goose damage. Research projects are being carried out in several parts of Germany on local breeding groups, e.g. since 1968 around Dümmer in Niedersachsen, since 1969 in Brandenburg (especially Gülper See), since the end of the 1960s in the Lower Rhine area in Nordrhein-Westfalen and since the 1970s in Schleswig-Holstein.

3D.4 Protection and conservation

Hunting legislation: In Germany, the Greylag Goose is a game species and, according to Federal Hunting Law, has a hunting season in August and between 1 November and 15 January. Under this Law, the federal states can shorten or cancel the hunting season for all game species or extend the hunting season for particular species in specific regions under certain conditions. At present, there is no hunting season for the Greylag Goose in the federal states of Baden-Würtemberg, Hessen, Rheinland-Pfalz and Thüringen. In Nordrhein-Westfalen, Greylag Geese can only be hunted during August and in Sachsen only between 1 November and 15 January.

The annual bag for geese (all species) has increased considerably during recent decades, especially in the last five years since the unification of the two German republics, from c. 6000 in the 1960s, c. 7500 in the 1970s, c. 10,000 in the 1980s and 30,000-40,000 in the 1990s. The increase in the annual bag is most pronounced in Brandenburg, Mecklenburg-Vorpommern and Sachsen-Anhalt (Mooij 1995b).

Site safeguard: There are a number of important Greylag haunts in Germany which are protected at different levels. Some sites are hunting free zones (in most cases only the roosts), nature reserves, Ramsar sites or national parks, but in most protected areas hunting is not forbidden.

Agricultural conflict: A crop damage conflict caused by waterfowl occurs in Brandenburg, Mecklenburg-Vorpommern, Niedersachsen, Nordrhein-Westphalen and Schleswig-Holstein. There is no general overview relating to the extent of goose damage in Germany, since crop damage caused by waterfowl is the responsibility of the federal states and there is no central registration system. Crop damage by Greylags seems to occur mainly in Brandenburg, Mecklenburg-Vorpommern, Niedersachsen and Schleswig-Holstein and is mostly reported from cereals, rape and fodder grass, but exceptionally also from grassland. Most of this damage is caused by spring and summer grazing, especially by feeding on standing cereals shortly before the harvest.

4. STAGING AND WINTERING AREAS

4A. THE NETHERLANDS

4A.1 Distribution

Range: The Netherlands ranks among the most important countries for Greylag Geese on the Atlantic flyway, a large proportion of the entire population being present for most of the year (for a review see Koffijberg et al. 1997). The Oostvaardersplassen in Flevoland attracts large numbers of moulting Greylags and large numbers are widely dispersed throughout the country during autumn migration, the larger concentrations being confined to areas such as Dollard and Lauwersmeer in the northern part of the country, Flevoland in the centre, and the Haringvliet/Hollandsch Diep area and Verdronken Land van Saeftinge in the Delta, in the

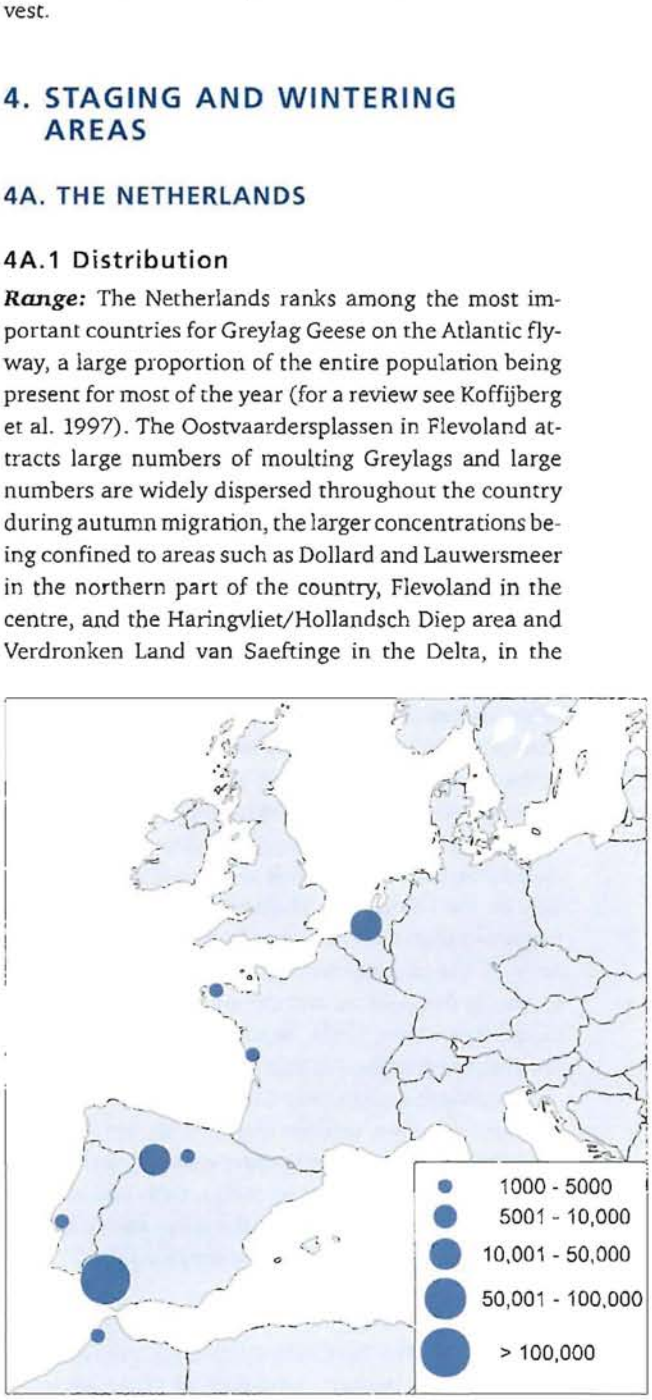

Fig. 11.3. The main wintering sites for Greylag Geese in western Europe.

south-west (Fig. 8.1 in Mitchell & Sigfusson this volume).

During cold winters, the geese are concentrated in the Delta area (Fig. 11.3). In mild winters this area holds about half of the wintering population, but additional large flocks may also winter around the Oostvaardersplassen, at Lake Zwarte Meer, in the Lauwersmeer area and in the Dollard. The Verdronken Land van Saeftinge, a saltmarsh area in the Scheldt estuary, has recently developed into a major wintering site with no less than 44,000 Greylags in 1993/94.

In spring, only Flevoland, southwestern Friesland, Lauwersmeer and Dollard support large numbers during migration. Staging flocks in these areas may not depart before the end of April.

Habitat and feeding ecology: After arrival in the Netherlands in August/September, Greylag Geese are mainly concentrated in large-scale agricultural areas such as Flevoland and Lauwersmeer, where they feed especially on stubble fields (Dubbeldam & Zijlstra 1996, Zijlstra et al. 1996). Greylag flocks occur throughout the country during peak migration in October/November and predominantly feed on stubble fields, remains of harvested sugar beet, grassland and pasture, as well as more natural habitats such as saltmarshes (Dubbeldam & Zijlstra 1996, Ouweneel 1981, Voslamber 1989). Large numbers were also reported feeding on rape fields, especially in Flevoland.

In winter, mainly rhizomes are taken. Most areas holding large numbers of Greylags in winter are characterised by the occurrence of rhizomes e.g. *Scirpus maritimus* and *Aster tripolium* (Verdronken Land van Saeftinge, Dollard), *Phragmites australis* and *Typha latifolia/angustifolia* (Oostvaardersplassen) (Voslamber 1989, Castelijns & Maebe 1996, Dubbeldam & Zijlstra 1996, Aerts et al. 1996). These rhizomes have a high nutrient content compared to other food items and are thus of special importance in winter. In addition, wintering Greylags also feed on grassland and autumn-sown cereals (Ouweneel 1981, Dubbeldam & Zijlstra 1996). The importance of *Scirpus* rhizomes is clearly indicated by the initial decline in the wintering population in the Haringvliet/Hollandsch Diep area: when this area lost its tidal influence in 1970 through the closure of the Haringvlietdam, the *Scirpus* vegetation gradually disappeared and the number of Greylags declined (Ouweneel 1981). Nowadays Greylags feed exclusively on grassland in this area.

In spring the majority of Greylags feed on grassland and autumn-sown cereals. During wing-moult at the Oostvaardersplassen, *Phragmites australis* is the main food resource (Loonen et al. 1991). Only just after arrival and before departure, do the geese also utilise the grassland areas surrounding the moulting site.

4A.2 Abundance

Phenology: The first migratory birds arrive in the Netherlands in August. According to observations of neck-banded individuals, these mainly originate from Norway (Nordic Greylag Goose Project unpubl., Nilsson 1992, Nilsson et al. 1993, Voslamber et al. 1993). By mid September, numbers counted total c. 27,000 (Fig. 11.2). The two most important areas during this part of the season are Lauwersmeer and Flevoland, and observations of marked individuals have shown that the geese frequently commute between these two areas. From the beginning of October, numbers increase sharply as birds from Germany, Sweden and Denmark arrive, joining the Norwegian birds already present. Peak numbers are usually recorded by end October/early November. Maximum numbers counted during mid monthly counts in October and November are c. 100,000 birds (1993), reaching 156,000 in November 1994.

During the first half of November a massive departure of Greylag Geese occurs. The majority migrate directly to the wintering sites in Spain (Guadalquivir Marismas, Villafáfila). In mild winters, Greylags remain at several sites in the Netherlands, whereas in cold winters they mainly concentrate in the southern part of the Delta area (Verdonken Land van Saeftinge), south-western Netherlands. During the mild winters in early 1990s, up to 70,000 Greylags were counted in January. According to sightings of neck-banded individuals, the wintering population mainly consists of birds breeding in southern Sweden and eastern Germany (Nordic Greylag Goose Working Group unpubl., Voslamber et al. 1993, Castelijns & Maebe 1996). The proportion of Swedish birds has increased in recent years (L. Nilsson unpubl.), a development which coincided with declining numbers in Spain. Several neck-banded birds which formerly wintered in Spain, nowadays tend to remain in the Netherlands.

A pronounced increase in numbers during the spring migration is limited to Flevoland, south-western Friesland, Lauwersmeer and Dollard. Numbers increase in February and counts in mid March record c. 20,000 individuals, peaking distinctly in April at major staging areas (Flevoland, Lauwersmeer and Dollard). In spring, the birds from southern Sweden and eastern Germany are the first to arrive from the wintering areas in Spain, and the first to leave on northbound migration (Nordic Greylag Goose Working Group unpubl., Voslamber et al. 1993). Norwegian Greylags arrive later from Spain, and stay in the Netherlands much longer, well into the second half of April. Swedish Greylags wintering in the Netherlands remain only for a short period and are already back in the breeding areas in January during mild winters.

Trends and numbers: Goose counts in the Netherlands started in the 1960s, when the maximum number of Greylags (in autumn) recorded was c. 10,000 birds. Annual peak numbers counted in autumn gradually increased through the 1970/80s, to c. 60,000 in the late 1980s. In the 1990s, this increase continued, reaching 156,000 in 1994. Counts in 1995 and 1996 have shown that this increase has now levelled off (SOVON Ganzen- en Zwanenwerkgroep unpubl. data). Comparable autumn peak count data are not available for such a long period from other countries.

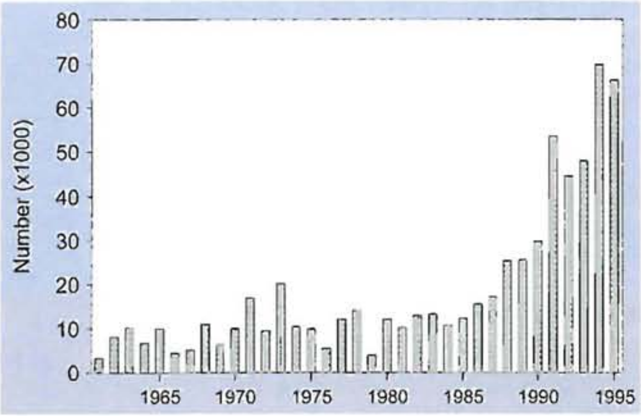

Fig. 11.4. January maximum numbers of Greylag Geese in the Netherlands 1961-1995.

Results from September counts are available since 1985. Contrary to the autumn peak, these counts do not show any increase at all, but tend to be stable at c. 20,000-35,000 birds (mean 27,000).

In the 1960s and 1970s, the annual mid winter counts revealed 10,000-20,000 birds. From the late 1980s onwards, a marked increase in the size of the wintering population has occurred, from about 15,000 birds in 1986 to 70,000 in 1994 (Fig. 11.4), of which a large proportion concentrates at the Verdronken Land van Saeftinge (44,000 birds in 1994). The increase in numbers in this area followed a hunting ban introduced in 1989/90 (Castelijns et al. 1991). In the 1990s, this area holds on average 50% of the wintering Greylags in the Netherlands. During cold winters the proportion may even be higher.

4A.3 Research

Census: Regular goose counts have been carried out since the 1960s (e.g. Rooth et al. 1981, Ebbinge et al. 1986, Ebbinge et al. 1987). Today, these counts are part of a large waterbird monitoring programme organised by SOVON Vogelonderzoek Nederland (e.g. SOVON Ganzen- en Zwanenwerkgroep 1995). Counts are carried out once every month between October and March. Moreover, there is a special Greylag Goose count in September, following the international census in September. The most important breeding areas are covered by annual surveys (e.g. van Dijk et al. 1994), although national coverage of the breeding population remains difficult as Greylags breed scattered throughout the country.

Ringing: Small numbers of breeding birds (329 birds, 1990-1997) have been marked with neck-bands at Oostvaardersplassen in Flevoland, De Deelen in Friesland and at the Scheelhoek in Zuid-Holland (see also Loonen & De Vries 1995). The main aim of this project is to study the movements of Dutch breeding birds and their role in damaging agricultural crops.

Other: At several staging and wintering areas, data on feeding ecology have been collected, e.g. Verdronken Land van Saeftinge (Castelijns & Maebe 1996), Dollard (Voslamber 1989, Aerts et al. 1996), Schiermonnikoog (van der Wal, Zoological Laboratory, University of Groningen unpubl.) and Flevoland (Dubbeldam & Zijlstra 1996). In the Dollard and on Schiermonnikoog, the impact of grazing Greylags on *Scirpus maritimus* has been studied in detail and at Oostvaardersplassen, the wing-moult of Greylag Geese has been studied in relation to *Phragmites* growth (Loonen et al. 1991).

4A.4 Protection and conservation

Hunting legislation: Hunting of Greylag Geese is allowed from 1 September to 31 January, but only during passage from the night-roost to feeding areas, until 1000 h. Outside this period, special permission may be given to local hunters when serious crop-damage by migratory birds occurs, in order to prevent further damage.

Site safeguard: Both in autumn and spring, the majority of Greylags feed in agricultural areas without special protection. Only the important wetland areas such as Verdonken Land van Saeftinge, Haringvliet, Biesbosch, Oostvaardersplassen, Zwarte Meer, Lauwersmeer and Dollard are protected (at least partly) by the national Nature Conservation Act. Oostvaardersplassen, Biesbosch and part of the Dollard are also Ramsar sites and SPAs. Many of the important feeding sites in agricultural areas are situated in close proximity to these wetland areas, which serve as night-roosts. Many of the strongholds for breeding Greylag Geese are situated in nature reserves.

Agricultural conflict: In the Netherlands, damage to agricultural crops by migratory Greylags is fully compensated. Damage is registered by a special committee, which also checks claims by farmers. For resident geese (feral and breeding birds), compensation for damage can only be claimed successfully if the farmer and local hunters have shown that other measures to prevent damage were not succesful.

4B. BELGIUM

4B.1 Distribution

Range: Passage of Greylag Geese is common in autumn and spring over the Flemish region and occurs in smaller numbers along rivers in the Walloon region. However, very few sites are regularly used by Greylags during migration and hardly any birds are seen on ground during autumn (Kuijken & Devos 1996). Small flocks may remain for short periods in spring, mainly in the coastal polders but also along the IJzer, Schelde and Meuse Rivers. The Zwin population was introduced at Knokke in 1956 but this limited stock of feral breeding birds only attracted a maximum of some hundreds of wintering geese over the following two decades. Higher numbers remain in Flanders, especially since the cold winters in the early 1980s. The Lower Schelde River area northwest of Antwerp (Polders Doel and Kallo) has become of increasing importance, with regular feeding of up to some thousands of geese which roost in the Land van Saeftinge area over the border in the Netherlands. The Zeebrugge harbour area (north of Brugge) is of increasing importance for wintering Greylags, as is the Creeck area of northeastern Flanders (the villages of Assenede and St. Laureins) along the Dutch border between Knokke and Antwerp, where Greylags traditionally expanded from resident breeding flocks, later attracting wild birds as well. More recently, regular occurrence of Greylags along the river IJzer (Blankaart Nature Reserve), Border Meuse (Limburg Province) and in the Antwerpse Kempen (Campine) region has been reported. The latter may be mainly the result of introductions.

Habitat and feeding ecology: The few flocks seen on the ground during migration favour permanent grasslands. The geese in the Schelde area feed in agricultural areas on grassland and crops as well as on tidal brackish marshes. Habitats in the Zeebrugge harbour and Antwerp areas are similar: artificially created land for industry and large new docks (brackish water), with remnants of former grasslands and fields. The tidal marshes along the Lower Schelde River offer suitable *Phragmites* and *Scirpus* vegetation for feeding. In the Creeck area, both brackish wet grasslands and arable land are used for feeding. The breeding groups here prefer mainly grasslands close to open water, marshes and reedbeds, but if disturbed by farmers shift to nocturnal feeding on fields. Staging Greylags along the Border-Meuse prefer river grassland (interwaarden).

4B.2 Abundance

Phenology: Autumn passage occurs from mid September to mid November, and the return migration is from late January to mid April. Following the increase in numbers of birds staging at Oostvaardersplassen in the Netherlands, there seems to have been a shift in timing of the autumn migration to the end of November.

Trends and numbers: Earlier data are summarised in Meire et al. (1989) and recent results in Kuijken et al. (1997) and Meire & Kuijken (1997). Numbers wintering in the Zwin area (partly resident feral birds, partly wild migrants) have been increasing to a reported 800 individuals (Kuijken & Devos 1996). Higher numbers (up to 5700 in 1995-96) have occurred on the Lower Schelde polders northwest of Antwerp, as a result of the increase in numbers in the Land van Saeftinge area (see section 4A.2 above). Some 1500 Greylag have wintered in the Zeebrugge harbour area in recent years (F. De Scheemaecker pers. comm.), and 500 Greylags regularly winter in the Creeck area, increasing up to 1500 in cold winters (De Smet 1996, 1997). Small numbers of Greylags now stage along the Border Meuse (maximum 1725 in January 1996; Meire & Kuijken 1997). Numbers in the IJzer valley remain low with most birds occurring during spring migration.

4B.3 Research

Apart from long-term monthly waterfowl censuses coordinated by the Institute of Nature Conservation (under the framework of Wetlands International), regional monitoring of Greylag numbers occurs in most relevant breeding and wintering areas. Records of neck-ringed birds of Nordic origin and information from the Belgian Ringing Scheme also exist. The increase in the number of small breeding flocks scattered throughout the northwestern part of the country is monitored and illustrates the origin of this phenomenon: expansion of the breeding range from the north and release of birds from captivity seem to be occurring at the same time.

4B.4 Protection and conservation

Hunting legislation: In Belgium, a total ban on hunting of geese has been in place since 1981. However, in order to prevent further expansion of the feral Greylag population in the vicinity of the Zwin Reserve, Greylag Geese may be shot in the municipality of Knokke from early September to end January, before 1000 h. This hunting practice seems to have had little effect, although no bag statistics are available.

Site safeguard: Most of the sites where Greylags occur during the breeding season and summer are located in SPAs and some have Ramsar status. The Greylags breeding and wintering in the harbour development areas of Zeebrugge and the lower Schelde polders northwest of Antwerp are only partially protected.

Agricultural conflict: Farmers have been used to the presence of geese over many decades, but the recent year-round presence of flocks with up to 250 Greylags has led to complaints of damage to fields (Kuijken & Devos 1996). When a significant decrease in yield is proven, tax relief on income from affected fields is allowed, although this is applied only exceptionally. A short, local/regional open season has been proposed, to reduce reproductive success in the core breeding areas; this proposal could restore the balance in relations between conservation and agriculture, necessary for maintaining the successful overall shooting ban on wintering geese in Belgium.

4C. FRANCE

4C.1 Distribution

Range: During migration, large numbers of Greylag Geese pass across France. However, stop-over is rare in autumn and the geese only stay for short periods, most birds flying directly to their Spanish winter quarters (Yésou 1987). In spring, Greylag Geese stage for longer periods in France (a few days to several weeks), mostly in the northwestern part (Fouquet 1991). The main staging areas are the Nature Reserve of Moeze (Charente-Maritime), Cebron Lake (Deux-Sèvres), the Bay of Aiguillon (Vendée) and the Somme Département. Other areas regularly visited during this period are in the Départements of Loire-Atlantique (Loire estuary), Maine et Loire (Verdon Lake), Indre et Loire (Rillé Lake), Indre (Brenne) and Gironde (Arcachon basin). Passage and staging is rarely observed in Brittany and east of a line from the Ardennes to the Hautes-Pyrénées.

Recent studies indicate that different groups use the

Somme Département (Triplet & Lecomte 1996) compared to the more western-central areas studied by Fouquet (1991). The geese probably come from different wintering areas in Spain.

France has long been known as a winter refuge for Greylag Geese during periods of severe weather (Roux 1963), whereas numbers are lower in more average years, when only few wintering sites are used. In the past, wintering Greylag Geese were mostly confined to the midwestern part of the country but, from the end of the 1970s, they have extended the winter distribution northeast to the centre of the country and also to the Camargue (Yésou et al. 1983, in Fouquet 1991). A large marsh in the southwest is also regularly frequented. Lac du Der in the northeast is, at present, the most important wintering site for the species (J.B. Mouronval unpubl.).

Habitat and feeding ecology: Staging during autumn and spring generally occurs in protected areas at least during the open season. The geese rest on lakes and ponds and feed on natural and artificial meadows, saltmarshes and cereal crops. Wintering sites are also mostly reserves, estuaries, inland lakes or fresh and brackish marshes. At Lac du Der the geese feed on Agrostis stolonifera, Phalaris arundinacea and Rorippa amphibia during the first part of their stay, but from November onwards they shift to feeding on winter cereals and rape (Mouronval et al. 1996).

4C.2 Abundance

Phenology: The autumn migration through France occurs from the end of September to mid December, with the major movement between early October and early December, the geese pass over France in successive waves both by day and night (Motel 1983, Fouquet 1991, Lang 1994). The spring migration occurs from early February to the end of March/early April (Yésou 1987, Fouquet 1991, Poire 1995, Triplet & Lecomte 1996), with a peak, varying in importance from year to year, between mid February and early March (northern part) or mid March (central/western part).

The marked birds of Nordic origin arrive at Lac du Der from early September and continue to do so until late December. In spring, the latest departures have been recorded around March 20.

Trends and numbers: Even though tens of thousands of Greylag Geese pass France on autumn migration, only small numbers stage; hence only some hundreds were counted at mid November counts (Saint-Gerand 1981). During spring migration they stay for longer periods and up to 10,000 birds have been counted in the central-western part in February 1984.

Independent of the changes in the European population as a whole the numbers in France have been strongly influenced by cold spells in northern Europe, which clearly shows the importance of France as a severe weather refuge. Thus, during the cold winter of 1962/63, 1100 Greylag Geese were counted in northwestern France (Roux 1963), whereas between 1967 and 1976 an average of only 66 geese stayed over the winter (Riols in Yeatman-Berthelot 1991). After that, the series of cold winters of 1979, 1982, 1985 and 1987 were the beginning of longer and more regular wintering periods for Greylag Geese in France. The average count for 1982-89 was 1500 birds present at the mid winter counts, compared to 2900 for mid January 1990-1995 (Fig. 11.3) (Riols 1981-1995).

4C.3 Research

Census: National censuses are undertaken in mid January each year. Monthly counts are made at Lac du Der.
Ringing: Resighting of marked Greylags (especially Nordic Greylags at Lac Du Der) are undertaken.
Other: Some local studies on the spatial distribution, feeding ecology and agricultural damages are carried out.

4C.4 Protection and conservation

Hunting legislation: The Greylag Goose is a quarry species with an open season from the end of July to 20 February.

Site safeguard: The main wintering sites are protected.

Agricultural conflict: No particular problem except at Lac du Der.

4D. SPAIN

4D.1 Distribution

Range: The Guadalquivir Marismas in southwestern Spain has long been known as the most important wintering area on the Atlantic flyway (Calderón et al. 1991). During the 1980s, Villáfafila in north-central Spain developed into an area of international importance for the Greylag Goose (Palacios & Rodriguez 1993). A third site, Laguna de la Nava, situated 70 km eastnortheast of Villafáfila has rapidly been growing in importance in recent years (Jubete 1991). In addition to these three sites, staging flocks of Greylag Geese have been seen at a large number of Spanish sites, although these are normally not used regularly, their use depending on the availability of water (and feeding opportunities). The flocks are normally small, a few hundred birds, but sometimes larger flocks have been reported.

Habitat and feeding ecology: Based on resightings of marked birds, Baltic and Norwegian Greylag Geese never feed in mixed flocks in Spain in undisturbed conditions (H. Persson in litt.). On arrival during autumn at the Marismas, the Baltic Greylag Geese feed on rice stubble. Depending on availability, this food source will be sufficient for the geese until the end of the year, but in some years supplies are exhausted by mid November. The Baltic Greylag Geese, being typical grubbers, then turn to the tubers of *Scirpus litoralis* and *S. maritimus*. The relationship between *Scirpus* and the Greylag Goose have been discussed by Amat (1986a, b, 1995). The Norwegian Greylag Geese, on the other hand, are grazers, feeding on very sparse steppe vegetation. In

Villafáfila, the staging Baltic Greylag also prefer to feed on *Scirpus* tubers, but the availability of tubers has decreased at one of the lakes and they are not always available when the water level is low. In such cases they shift to feeding on winter sown wheat. The Norwegian Greylag Geese mostly feed on winter wheat, often on more dry and sparsely vegetated areas than the Baltic Greylags.

4D.2 Abundance

Phenology: The arrival of Baltic Greylag Geese in Spain occurs from mid September to mid January with the major influx during the second half of October and the first three weeks of November (Persson 1993). The departure from Spain starts in the second half of January, with the majority leaving during the first half of February though some stay longer. On average, Norwegian Greylag Geese arrive and depart later than the Baltic birds (Persson 1993, unpubl.). The mean length of stay in Spain for both groups is approximately three months.

Even though up to 23,600 Greylag Geese can be seen simultaneously in Villafáfila in mid January, the number of true wintering birds is much smaller, probably not exceeding 500, all others being on their way to or from the Guadalquivir Marismas (H. Persson unpubl.). Although 20,000 Norwegian Greylag Geese have been counted there, there is no documented case of a marked Norwegian Greylag Goose spending the entire winter in Villafáfila. The normal pattern among Norwegian birds is to arrive there late in November and stay for a long period (up to three months in some cases) and then proceed to the Guadalquivir Marismas. Birds from the Baltic group also use Villafáfila as a stopover site on autumn and spring migration and as a refuge when they encounter severe conditions in their normal wintering area.

Trends and numbers: The total wintering number of Greylag Geese in Spain was estimated to be in excess of 150,000 in 1989/90 and somewhat lower during the following two winters (Persson 1995); 40,000-50,000 of these birds were thought to be from the Norwegian group and the remainder from the Baltic group. The estimates are higher than those obtained from summing available counts. There are three reasons for this discrepancy. First, only minimum counts are reported from the Guadalquivir Marismas. Secondly, a multitude of sites used by smaller flocks are not included in the national counts. Thirdly, the mid winter counts are made at the end of the hunting season after a varying proportion of the birds have been shot.

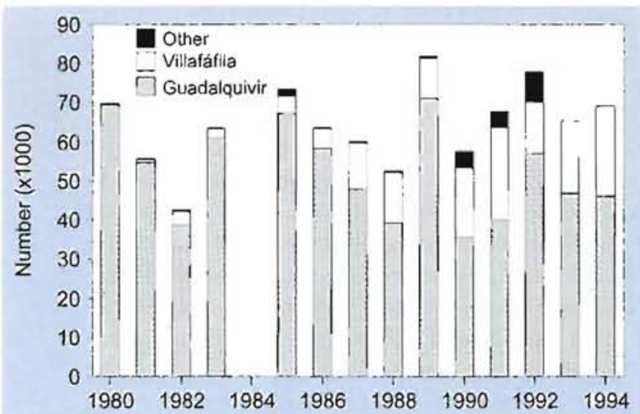

Fig. 11.5. Numbers of Greylag Geese counted at Spanish wintering sites 1980-1994.

Regular January counts in the Guadalquivir Marismas started in 1971/72, when 21,700 were counted (Sanchez et al. 1977, Amat 1986a), although 19,000 were reported in December 1967. Numbers then started to increase and, in the 1980s, up to 70,000 were counted (Fig. 11.5). There was some variation during the 1980s but in 1989, 70,000 were found in Guadalquivir, when c. 10,000 were counted at the other Spanish wintering sites, bringing the total wintering number to 81,000. During the 1990s, numbers in Guadalquivir during the January counts were lower (Fig. 11.5).

Villafáfila was established as an important site for Greylag Geese in 1979, following the creation of a hunting free area, after that showing a marked increase to a peak of 23,500 in 1991 (Fig. 11.5) (Palacios & Rodrigues 1993).

4D.3 Research

Census: Monthly censuses are carried out in the three main areas, aerial counts at the Guadalquivir Marismas and ground counts at the other two sites. Geese using other sites are covered to a much lower degree.

Ringing: Neck-banding has been carried out at the Doñana Biological Reserve, starting in 1985.

Other: Habitat selection by Greylag Geese was studied in the Guadalquivir Marismas in the early 1980s (Amat 1986a), but the results are somewhat confusing as Greylags of Norwegian and Baltic origin were not distinguished. Studies of individually marked birds from known parts of the breeding range started both in the Guadalquivir Marismas and at Villafáfila in 1989 (Persson 1996b).

4D.4 Protection and conservation

Hunting legislation: Hunting legislation differs markedly among the autonomous parts of Spain: in the length of the open season, the number of hunting days per week, the existence of daily bags and year to year consistency. In general, the season opens in October or November and closes in January. Hunting exploitation is low or moderate outside the southwestern part of the country. In the Guadalquivir Marismas, hunting pressure has varied considerably during the last ten years, being extremely high during the winters 1987/88, 1989/90, 1990/91 and 1994/95 with bags of 20,000 to 30,000 geese (Persson 1996a).

Site safeguard: Under optimal conditions, all Greylag Geese in the Guadalquivir Marismas can feed within the protected Doñana National Park, but when rainfall is too low or too high, the geese are forced to seek food on the surrounding farmland. In most areas outside the national park, the geese are exposed to extremely high shooting pressure (Persson 1996a). Feeding outside the national park means, besides exposure to shooting, that the geese experience a much higher disturbance level. Villafáfila and La Nava are protected with safe roosts and hunting restrictions on the feeding grounds.

Agricultural conflict: Traditional conflicts between agriculture and geese have been considerably relaxed at Villafáfila by compensating the farmers for loss of yield (Rodriguez & Palacios 1991). In the Guadalquivir Marismas, damage by geese has been reported on both ripening rice and newly sown fields. The extent of this damage is, however, difficult to evaluate as it almost exclusively occurs during extreme weather conditions.

4E. PORTUGAL

Greylag Geese winter in the Tejo estuary in Portugal. Normally they arrive from the middle of November and stay until early March, the exact phenology depending on the weather conditions.

As elsewhere, the number of Greylag Geese occurring in winter has increased in Portugal, from 450 in January 1986 to 3250 in January 1996.

4F. MOROCCO

The southernmost wintering area in the Atlantic flyway is found in the Merga Zerja marshes in Morocco. Numbers using this area have increased, from 67 in 1985 to 1091 in 1994 (Table 11.1).

5. DISCUSSION

Population status: Like many other goose populations in the Western Palearctic, the Greylag Geese in northwestern Europe have shown a marked increase during recent decades. This is apparent from both the data presented here and the summary of the earlier development of the population presented by Madsen (1987). According to his analysis, this population numbered c. 30,000 from the mid 1960s to the mid 1970s, after which there was a marked increase to 120,000-130,000 in the mid 1980s. The basis for estimating mid winter numbers is rather uncertain, especially as the results will be much influenced by hunting levels, however, as a winter estimate for the late 1980s this is too low. The estimate for southwestern Spain in the winter 1989/90 presented here (cf also Persson 1996a) was no less than c. 150,000 Greylags, to which should be added at least 30,000 for the Netherlands, 10,000 for Germany, 5000 for Belgium and about 2000 each for France and Portugal, in addition to smaller numbers at other locations. This brings the total number of wintering Greylags in the Northwest European population to c. 200,000 in 1989/90.

To overcome the problems with winter counts of the Greylag Geese, September counts have been organised in a number of countries since the 1980s. The highest total recorded to date in the September counts is 197,000 in September 1991. In 1989/90, when the winter population was estimated to number c. 200,000, the September total was 173,200 for the countries from which data were obtained. Adding about 5000 for Norway, from which data were lacking, brings the total close to 180,000. Moreover, it is known from neckbanding that some Polish Greylags use the Atlantic flyway (Dick et al. this volume) and will be included among the mid winter counts, but not in the September counts. In an expanding population like the Northwest European Greylag population, new sites will be taken into use and there may be a time-lag between the establishment of a new site and its detection and incorporation into the count network. Moreover, it has not been possible to cover all sites every year. Based on an evaluation of the Swedish September counts, it is estimated that 10-15% of the geese actually present in the country are not counted for one reason or another.

Table 11.1. Total numbers of Greylag Geese counted in various countries at mid winter (January counts).

	Norway	Sweden	Denmark	Germany	Netherlands	Belgium	France	Spain	Portugal	Morocco	Total
1980	54	50			12,120			69,560			81,784
1981		18	41		10,200			55,526			65,785
1982	47	0	30		13,000		1575	41,710			56,362
1983	84	30	499		13,200		1193	63,337			78,343
1984	454	46			10,580		700				11,780
1985	115	31			12,220		2207	71,675		67	86,315
1986	41	10			15,633		908	63,832	450	2	80,876
1987	5	14	5	7932	17,132	500	1730	57,023	840	281	85,462
1988	451	73	136	9582	25,370	1700	1645	50,856	700	270	90,783
1989	50	123	334	3404	25,410	860	1358	81,191	860	189	113,779
1990	3	69	252	10,130	29,669	5270	1749	51,415	947	977	100,481
1991	264	325	613	3757	53,567		1722	55,207	1720	367	117,542
1992	63	139	580	4775	44,417	2572	2048	69,230	983	229	125,036
1993	394	470	1745	6446	48,004	824	3826	65,414	1234	1039	129,396
1994	13	434	1808	12,480	69,907	4777	3483	69,069	1688	1091	164,750
1995	10	657	2946	14,342	66,375	2689	4645	109,986	1221	1014	192,885

The September counts record a peak in 1991, totals being lower in 1992-1994. A similar levelling off, or at least slower rate of increase, has also been noted in other data sets. At the present it is not possible to establish whether there has been a real levelling off of population numbers or whether the geese are simply less efficiently covered by the counts.

The pattern of change in Greylag Goose numbers has differed between countries. All countries have shown increases in September totals since the counts started in 1984, with rates of increase reflecting the development of breeding populations in different countries. Whereas September counts in Denmark increased from about 35,600 in 1984 to 47,200 in 1991 and counts in the Netherlands increased from about 20,000 in 1985 to 37,000 in 1994, the counts in Sweden increased from 19,000 to 54,000 (estimated total more than 60,000) between 1984 and 1993, i.e. a three-fold increase in ten years. This is similar to the trend in the breeding population in Sweden (Nilsson 1995, Persson 1990).

Parallel with the increase in the Northwest European Greylag population, has been a marked shift in the winter quarters. Formerly, the majority wintered in the Guadalquivir Marismas in southwestern Spain, and only smaller numbers were found at other sites. However, use of the Marismas peaked in 1989/90, after which wintering numbers have been lower. Within Spain, Villafáfila, a site in the northern part of the country, was established and has become an important site for the Greylag Goose. Furthermore, an increasing proportion of the population now winters in the Netherlands, especially in the Delta area. The increase in numbers wintering in the Netherlands was especially marked since hunting was prohibited in the important Land van Saeftinge reserve. Wintering has also been established on a smaller scale at some other sites (see above).

Greylag Geese using the Atlantic flyway and wintering in the Netherlands and Spain have in this chapter been treated as if they constitute one widely distributed population. Whilst this may be practical for management purposes, it is important to recognise that what we here treat as one Northwest European Greylag population is in fact comprised of two separate groups: a Norwegian breeding group from the Norwegian coast and a Baltic group with its centre in Denmark, Sweden and northern Germany. Even though the two groups occur in the same areas post breeding, their ecology is totally different, as has been revealed by intensive neckbanding in the two groups, especially by the Nordic Greylag Goose Project and similar projects in Germany. At the wintering quarters, the two groups never feed together in undisturbed conditions (H. Persson in litt). The Norwegian Greylags tend to be steppe grazing birds, whereas the Baltic Greylags are wetland grubbers preferring rhizomes of *Scirpus* and similar plants. It may be noted that *Scirpus* is very important in the Dutch Delta, where Baltic Greylags predominate among wintering Greylag Geese.

The phenology of the two groups arriving at the staging and wintering grounds is also entirely different. The early arriving Greylag Geese in the Netherlands (August/ September) are all Norwegian breeding birds, some of which stage in Denmark before reaching the Netherlands. The Baltic Greylags, on the other hand, do not arrive in the Netherlands until much later and leave after a short stay, i.e. before the Norwegian Greylags. In Spain, the Baltic Greylags arrive before the Norwegian birds and also depart earlier (Persson 1993). In spring, the Baltic Greylags pass through the Netherlands rapidly, whereas the Norwegian Greylags to a large extent use the Dutch sites for gaining reserves in preparation for the breeding season.

Conservation issues: The reasons for the marked increase in the Northwest European Greylag Goose population, as in other goose populations, has been much discussed (cf Madsen 1987) and most probably lie in the decrease in hunting pressure. Hunting pressure on the Greylag Goose was heavy for many years and, during the 1970s, it was estimated that more than 10,000 were shot annually out of a population that was much smaller at that time (Madsen 1987). In southern Spain, Amat (1986a) reported that hunting pressure had decreased in recent decades. Moreover, hunting has been prohibited in the Doñana National Park since 1983/84 (Persson 1996a). Similarly the establishment of the Oostvaardersplassen Reserve, where the geese are protected from hunters has certainly been of importance, as has the establishment of reserves such as Villafáfila and Land van Saeftinge.

Conditions in the Doñana National Park are of very great importance for the Greylags (Nilsson & Persson 1996, Persson 1996a), particularly the availability of water which determines the availability of the Scirpus tubers to the geese as a food source (Persson 1996a). Under drought conditions there are no tubers to feed on, and when there is too much water they are not accessible to the geese. In both situations, the geese are forced out of the park and heavily shot. Thus in 1989/90, more than 30,000 Greylags were shot in southwestern Spain out of an estimated 150,000 in the area (Persson 1996a). Similarly high hunting exploitation occurred in 1990/91. In dry conditions, the Greylags have great difficulty finding sufficient food from the surrounding fields and those that are not shot return in bad condition, e.g. in 1992/93 when many exhausted Greylags were found on spring migration in France (M. Fouquet in litt.).

The high mortality in Spain in some years is clearly reflected in the breeding populations in northern Europe (Nilsson 1995, Nilsson & Persson 1996). Amongst the neck-banded population in southwestern Scania, return and survival rates are clearly related to conditions at the winter quarters with a higher survival rate for those wintering in the Netherlands compared to birds wintering in Spain (Nilsson & Persson 1993, 1996). For those that survive, disturbance from heavy hunting is also a negative factor and a much higher proportion of Greylags wintering in the Netherlands managed to produce at least one fledgling compared to Greylags wintering in Spain (Nilsson & Persson 1996).

The importance of protected areas is clearly demonstrated by the fact that Greylags staging in the protected Villafáfila area on their northbound migration managed to build up sufficient reserves and reproduced as well as those wintering in the Netherlands.

It is clearly of great importance for the Greylag Goose populations on the Atlantic (Northeast European) flyway that hunting in southwestern Spain is controlled so that excessive shooting is avoided during periods when the geese cannot feed in the protected National Park. This is especially so during years with dry conditions when the Greylags also suffer from starvation and when extra disturbance (in addition to direct hunting mortality) will lead to a markedly reduced breeding performance among those surviving. Each year with excessive hunting in Spain has seen a marked levelling off of the increase in the breeding population in Sweden (Nilsson 1995, unpubl.). Moreover, it is important that a network of protected sites for Greylag Geese is established, especially in France where there is a long gap between Villafáfila in northern Spain and the reserves in the Netherlands.

Agricultural conflicts: Problems with Greylags causing damage to crops have been reported from different countries with large flocks in late summer and autumn. In most cases the reported damage has been to standing crops before the harvest, especially peas (trampling also causes damage), sugar beet and cereals. After the harvest of cereal grains and sugar beet, the Greylags generally seem to feed on spill with little conflict resulting, but they will in some situations feed on growing oil-seed rape or newly sown cereal fields causing damage.

Future research needs: With the overall increase and changes in wintering locations that have occurred in the Northwest European Greylag Goose population, it is urgent that proper monitoring (in form of the ongoing censuses) continues and is improved. High priority should be given to demonstrating through DNA analysis whether the Norwegian breeding group and the Baltic group are in fact separate populations and what status they should have. It is also important to continue the existing marking schemes in different countries so that survival regimes in different staging and wintering areas can be monitored. Moroever, the neck-banded populations with known breeding, staging and wintering areas offer excellent opportunities to use the Greylag Goose as a model species for the study of population processes, a sound understanding of which is required for the effective future management of the species.

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12 Greylag Goose *Anser anser*: Central Europe/North Africa

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1. POPULATION REVIEW

1.1 Range

Central European Greylag Geese belong to the subspecies *Anser anser rubrirostris*, although intermediate types between *A.a.rubrirostris* and *A.a.anser* are also found. The main breeding areas are the Great and Little Hungarian Plains and the north Viennese Basin in the Czech and Slovak Republics, Austria and Hungary (Niethammer 1968, Rutschke 1987). Additionally, this population includes birds from the Baltic region: Estonia, Latvia, Lithuania and Finland, hence the term "Central European population" is not a particularly good one (cf. Fig. 12.1). Non-breeders are known to migrate northwards as far as Sweden and Norway, and local groups undertake northerly summer movements before autumn migration. The main wintering areas are in Tunisia and Algeria, although resightings and recoveries have shown links to Slovenia, Croatia, Yugoslavia, Greece and even the Black Sea coast (Dick 1993, Vogrin 1996, Fig. 12.1, & Fig. 8.1 in Mitchell & Sigfusson this volume).

1.2 Delineation of flyways

Although it has long been recognised that Greylag Geese use two main flyways in continental Europe: (1) the Atlantic flyway through the Netherlands and France to Spain's Guadalquivir Delta (see Nilsson et al. this volume), and (2) the Central European flyway to the east Mediterranean/North African region, the borders between the two flyways remained unclear (Niethammer 1968). Through the Wetlands International neck-banding programme (Dick 1989), it has become clear that the border between these two flyways is quite distinct. Many of the Greylags from south Bohemia, south Moravia and Austria, and all those from the Neusiedler See (Lake Fertö) in western Hungary belong to this flyway. Some of the Greylags breeding in the Barycz Valley and Milicz in southern Poland join the Central European flyway, although recoveries from birds ringed in this area do exist from both the Atlantic and Central European flyways (Gromadzki & Majewski 1984). Similarly, Greylags from Finland have been resighted on both flyways (e.g. Persson 1993), suggesting that the border between the two flyways runs northwards from Poland to Finland. Greylags breeding in the Southwestern Archipelago and Bothnian Bay (which is the northern part of the Gulf of Bothnia, north of the town of Vaasa) in Finland, and Baltic birds from Estonia (Hudec 1984, unpubl. data) belong to the Central European flyway. Released birds complicate the picture.

Greylag Geese marked in south Moravia and Austria have never been observed in Spain but some birds from southern Bohemia, as well as c. 50% of southern Polish Greylags, winter in the Coto Doñana (Hudec 1984), and more recently at Villafáfila and in the Netherlands, thus indicating the location of the border between the two flyways. Individual Greylags from Barycz in Poland have even wintered in North Africa and Spain in alternate years. Greylags from south Bohemia also started to use the newly established wintering ground at Lac du Der, Marne, in France in the early 1980s, and some have been reported from Lake Ichkeul in Tunisia

one year and from the Camargue in France another year.

Greylags stopover in southern Moravia, on the Neusiedler See, and at northern Adriatic wetlands on the way to their winter quarters (Dick 1987). The extent and timing of these stays depends greatly on weather conditions, for example, in the winter 1982/83 there were still 4000 Greylags in the Neusiedler See area in early January, whilst early cold spells in 1984/85 hastened their departure from the area and all were gone by the end of November. Bad weather in Central Europe encourages the Greylags to proceed straight to their winter haunts. It was suggested that the creation of new reserves in Italy might tempt Greylag Geese to remain over the winter (Smart 1982) but no major wintering concentrations have developed so far, although small numbers may remain on the Tuscany coast, as well as at other sites during October to February (Perco 1991, Boldreghini & Montanari 1991).

1.3 Population trends

The available winter counts do not reflect the complete status of the flyway due to lack of data and it is impossible to analyse population trends. However, many details from the breeding sites and some censuses from the winter haunts reveal an increase in this population since the last analysis was made (Hudec 1984), when the number of breeding pairs in the Central European flyway was estimated at 2750. Hudec (1984) also noted that there had been a considerable increase in the period 1970-82. Apparent increases in numbers in recent years stem largely from improved count coverage, as well as a modest real increase to c. 4900 pairs at present (Hudec 1991, Hudec et al. 1992, Farágó 1995, G. Dick unpubl.).

Hudec (1984) calculated 16,000 wintering Greylags. Mid winter counts in recent years reveal 15,000-22,600 Greylags in North Africa, and Scott & Rose (1996) recognise that the population estimate of 20,000 given by Pirot et al. (1989) may be too low. Calculating the wintering population after the model used by Hudec (1984), and with reference to census data, the number of Greylags wintering in North Africa alone is now 23,000 birds, thus, if the Balkans are included, a total wintering population of approximately 25,000 can be assumed for the Central European flyway. According to the model used by Hudec (1984), a further 3000 Greylags originating from Central Europe would winter on the Atlantic flyway. Thus, the size of the entire winter population in the geographical breeding unit "Central Europe" is 28,000 Greylags, of which approximately 3000 in fact winter on the Atlantic flyway.

1.4 Breeding success

In the Barycz Valley, the majority of goose eggs hatch in mid April and mean clutch size is 5.5 eggs; 30% of the nests are destroyed, mainly due to predation by Wild Boar *Sus scrofa*, Hooded Crow *Corvus corone* or Raven *C. corax*, or deserted. In successful pairs, mean brood size at hatching is 5.0 and at fledging 3.6 (Witkowski 1983, unpubl.). By comparison, brood size after hatching at Neusiedler See was 4.2 (n=35) (G. Dick unpubl. data). No other studies have been carried out on breeding success.

1.5 Mortality

No specific studies of mortality have been carried out. However, observations of collared Greylags seen in the year after capture at Neusiedler See show that 58.5% of immature geese and 32.1% of adults (n=199) have apparently disappeared (G. Dick unpubl. data). This is relatively high compared to the 33% overall mortality of Paludan (1973) but accords well with preliminary results from Sweden (Nilsson & Persson 1993, L. Nilsson unpubl. data).

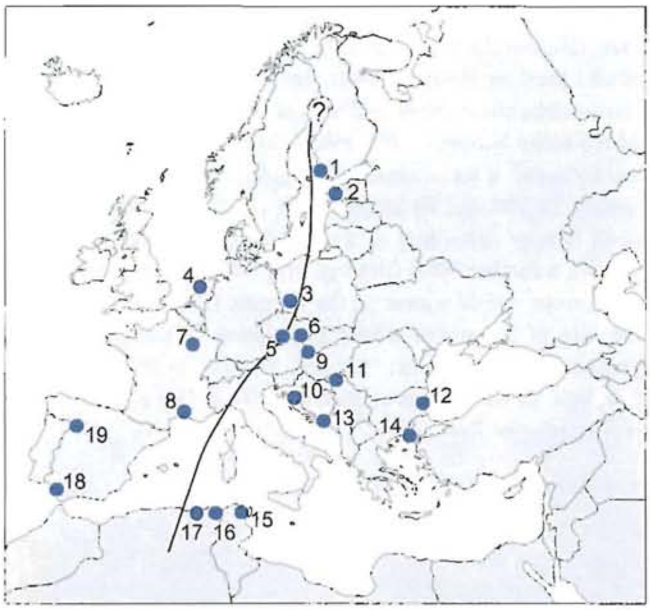

Fig. 12.1. Important breeding/ringing recovery, staging and wintering sites of central European Greylag Geese: 1. Finnish Archipelago; 2. Matsalu Bay; 3. Barycz Valley; 4. the Netherlands; 5. South Bohemia; 6. South Moravia; 7. Lac du Der; 8. Camargue; 9. Neusiedler See/Lake Fertö; 10. Karlovac; 11. Belgrade; 12. Jambol, Burgas; 13. Vrlika; 14. Lake Kerkini; 15. Lake Ichkeul; 16. El Kala; 17. Lake Fetzara; 18. Coto Doñana; 19. Villafáfila. The line indicates the border between the Atlantic and Central European flyway (for details see text).

2. BREEDING GROUNDS AND BREEDING ECOLOGY

2.1 Distribution

Range: Table 12.1 shows estimated numbers of breeding pairs in countries on the Central European flyway.

Austria: At Neusiedler See, the number of breeding pairs increased from 120-130 pairs in 1966/68 (Leisler 1969) to approximately 400 pairs in the 1990s (Dick et al. 1994). Additionally, up to 50 pairs breed on the Austrian side of the Morava/March River (T. Zuna-Kratky pers. comm.).

Czech and Slovak Republics: In southern Moravia, breeding numbers have increased since 1940, reaching a maximum of 297 pairs in 1982, and with 281 pairs in 1990. Due to water level regulation, the number of breeding sites decreased from 56 in 1968 to 37 in 1990 (Hudec et al. 1992). Table 12.2 shows the number of breeding pairs in regions of southern Bohemia (Pykal et al. 1992, Simek 1991), growth in numbers stopped in 1986. New breeding sites have been established at Pisek, Pardubice, Hodonin and Ostrava, and, in 1996, the first breeding record from Vinore in northwest Bohemia was proven. The Slovakian side of the Morava/March River supports approximately 15-20 pairs (Murin et al. 1994).

Poland: The situation in Poland is complicated by the difffering wintering provenence of Greylags breeding throughout the country. The breeding population has been censused and assessed overall at a national level

Table 12.1. Estimated number of Greylag Goose breeding pairs in countries on the Central European flyway.

Finland	1100 *
Estonia	1300
Latvia	100
Lithuania	100
Poland	1135 *
Czech and Slovak Republics	633 *
Hungary	100 (?)
Austria	450
former Yugoslavia	?
Total	4918

* Data include a small number of Greylags wintering on the Atlantic flyway: the Barycz valley in Poland, southern Bohemia in the Czech Republic and, of Finland's 1400 breeding pairs, 1100 are estimated to belong to the Central European flyway.

with little regard for differences in trends and distribution between the two elements. The total breeding population of Greylag Geese in Poland, which includes birds from both the Central European and Atlantic flyways, has increased considerably in the last 25 years, from 770 pairs in 1968, 1150 in 1977-79, 1500-1600 in 1983, to 2150-2400 pairs in 1993-95 (Dzieciolowski & Frankiewicz 1970, Gromadzki & Wieloch 1983, Gromadzki et al. 1994, Jermaczek et al. 1995, Tomialojc 1990, Witkowski et al. 1995, unpubl. data of Ornithological Centres in Poznan, Gdansk and Wroclaw). The Polish breeding population is now more or less stable or slightly increasing.

The range of the Greylag Goose in Poland is shown in Figure 12.2 and includes birds from both the Central European and Atlantic flyways. Important localities include the Slonsk Reservoir (Area 2), Barycz Valley (Area 5) and Lower Odra Valley (Area 1). Approximately 100 pairs breed outside the five areas shown in Figure 12.2, indicating that the expansion to the east and southeast which took place in the 1970s was not successful. Area 1 (in total 300-350 pairs) includes Lake Swidwie (110-150 pairs) and Lake Weltynskie (approximately 60 pairs; Gromadzki et al. 1994); Area 2 (in total 350-420 pairs) has 300-350 pairs at Slonsk Reservoir (Jermaczek et al. 1995); and Area 3 (in total 600-650 pairs) has 130-150 pairs at Lake Goplo (Dzieduszycki & Kupczyk 1993), 80 pairs in the central Warta Valley (Winiecki 1992) and 90 pairs at Woniesc Reservoir (Kuzniak & Lorek 1993). Area 4 (in total 210-250 pairs) includes Vistula Lagoon with 60-70 pairs and Lake Druzno with 50-60 pairs, and Area 5 (in total 580-640

Table 12.2. Number of Greylag Goose breeding pairs in southern Bohemia.

Year	Trebon basin	Ceske Budejovice basin	Pisek area	Total
1976	130	?	?	?
1981	145	?	?	?
1986	195	135	16	346
1990	131	160	25	316
1995	160	175	17	352

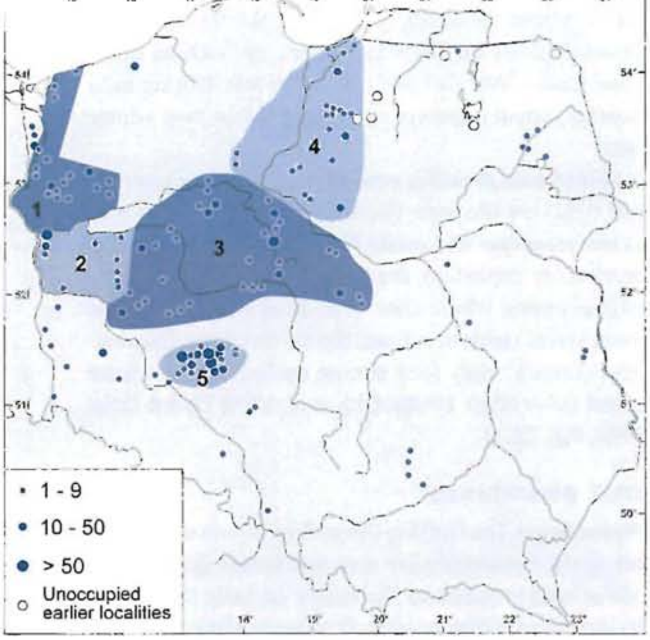

Fig. 12.2. Breeding localities of Greylag Geese in Poland. Regions shaded are: Area 1 (300-350 pairs): Lower Odra Valley and western Pomerania; Area 2 (350-420 pairs): Ziemia Lubuska Province; Area 3 (600-650 pairs): Wielkopolska (Great Poland) Province; Area 4 (210-250 pairs): Vistula Coastal Lagoon and Lake Districts; Area 5 (580-640 pairs): Fishponds in the Barycz Valley, these birds use both the Central European and Atlantic flyways. Legend indicates sizes of colonies as reported by Tomialojc (1990).

pairs) includes the entire Barycz Valley, of which the fishpond complex Stawno with 178-246 pairs is a part (Dolata 1993, Witkowski et al. 1995).

Some of the c. 600 pairs breeding at fishpond sites in the Barycz Valley and Milicz in Poland belong to the Central European flyway. In the Barycz Valley, the number of breeding pairs increased from 275-312 in 1972-1977 to 562-580 pairs in 1982-83, afterwards decreasing again to 440 pairs and then fluctuating between 498 and 582 pairs in 1992-95 and only 325 pairs in 1996 (Witkowski et al. 1995). At Slonsk Reservoir, the number of breeding pairs was only 13-20 pairs in 1968, 150 pairs in 1979, 310-340 pairs in 1983 and 350 pairs in 1992 (Jermaczek et al. 1993).

Estonia, Lithuania and Latvia: Greylags breeding in the Baltic countries predominantly belong to the Central European flyway and comprise 1200-1300 pairs in Estonia, 100 pairs in Lithuania and 50-100 pairs in Latvia (A. Leito & S. Svazas pers. obs.).

Finland: Greylag Geese breed along the northern coast of the Gulf of Finland and the eastern coast of the Gulf of Bothnia, and in the Southwestern Archipelago (Åland, the Turku Archipelago). The most important breeding concentrations are in the Southwestern Archipelago and around the Bothnian Bay - near the town of Oulu on the island of Hailuoto, around Liminganlahti Bay, and in the Haukipudas and Krunnit Archipelagos. At the end of last century and the beginning of this, Greylags seem to have been common but decreasing along the Finnish coast. Breeding numbers on Hailuoto Island, for example, were estimated at "hundreds of pairs" (Sandman 1892). The lowest numbers were recorded in the 1940s and 1950s, by which time there were only about 25 pairs on Hailuoto. After a total hunting ban in 1947, the trend was reversed, although the total Finnish breeding population was estimated at only 150 pairs in 1950 (Merikallio 1950). Today, the breeding population of Southwestern Archipelago is estimated at 700 pairs (Hildén & Hario 1993), that of the Bothnian Bay at 400 pairs (of which c. 125 were on Hailuoto), and the total Finnish breeding population at 1400 pairs (Hildén & Hario 1993) of which c. 1100 pairs are suggested to belong to the Central European flyway.

Habitat and feeding ecology: Greylags breed on natural lakes (Neusiedler See), river floodplains (March/Morava), reservoirs (Thaya/Dyje, Slonsk) and fishponds (Trebon basin, Barycz Valley) with a variety of wetland vegetation (e.g. *Triglochin maritimum, Phragmites australis, Potamogeton* spp.). Management of fishponds in southern Bohemia has created favourable habitat for the geese and the majority switched from nesting in reedbeds (75% in 1970) to new artificial islets (84% in 1990; Simek 1991).

Greylags in Finland mostly breed on small islets and skerries although, in the Bothnian Bay, and in increasing numbers elsewhere, they breed in reedbeds at the edge of bays (e.g. Liminganlahti Bay) and coastal lakes. Formerly, these reed beds were cut every year and Greylags nested inland on the larger islands of the Bothnian Bay in fens and pine forest heaths near lakes, as some still do, for example, on Hailuoto Island.

2.2 Moult migration and moulting areas

Some non-breeding Greylags from the Central European population moult near to the breeding grounds (e.g. Czech Republic, Poland) whilst others moult at more northerly moulting sites, especially in the Netherlands, Denmark, Sweden and Poland. These migratory birds return to the breeding grounds by the end of summer/early autumn. Preference for individual sites is changing and moulting Central European Greylags have been reported from northeastern Germany and even from Norway. Formerly, many Greylags from Slonsk and Barycz in Poland used to moult in Denmark and on Gotland (Gromadzki & Majewski 1984), although nowadays geese from Barycz moult nearer the breeding areas, or in the Netherlands, and only a few moult in Denmark and Sweden. In Finland, the largest flocks of non-breeders moult on Hailuoto (two sites with up to 1100 and 500 Greylags respectively), and in the Krunnit Archipelago (up to 800). There are many moulting concentrations in the Southwestern Archipelago where the total numbers of birds is probably much greater although individual sites hold fewer birds.

2.3 Research

No special research programmes are currently carried out in Austria, the Czech Republic, Slovakia or Hungary. Neck-banding of Greylags continues in southern

Bohemia and Poland, and in Finland as part of the Nordic Greylag Goose Project. International goose censuses under the International Waterfowl Count are carried out by all the countries involved.

2.4 Protection and conservation

Hunting legislation: The hunting status of Greylag Geese varies considerably throughout its range (see under each country, sections 3 and 4).

Site safeguard: All major Greylag breeding sites along the flyway are legally protected. For example in Austria, Neusiedler See, which includes the country's most important goose areas, was declared a National Park in 1992. In the Czech Republic, the Nové Mlyny Reservoir was declared a Nature Reserve in 1994 (Czech Institute for Nature Conservation 1993).

Public awareness: No special public awareness campaign concerning geese is carried out. A recent review of goose numbers, migration and hunting bags in Hungary has been published (Faragó 1995); a detailed analysis of Austria's Ramsar site Neusiedler See has been published (Dick et al. 1994); and the publication on Czech and Slovak Ramsar sites by Hudec et al. (1993) is up to date at the time of writing. In 1993, a wetland conservation campaign was carried out in Austria, organised by the Federal Ministry of Environment and the nine Austrian provinces.

3. STAGING AND WINTERING AREAS

The staging areas, identical to the breeding areas, attract bigger flocks of geese because of their adjacent arable land (cereal and maize fields, cf. Fig. 12.3).

3A. AUSTRIA

3A.1 Distribution

Range: The only important Greylag staging site is Neusiedler See and the adjacent small lakes of Seewinkel in eastern Austria (Dick 1987). Smaller flocks, mostly accompanying migrating Bean Geese *Anser fabalis* and White-fronted Geese *Anser albifrons* arriving from the north, occur along the Danube River or occasionally on lakes and reservoirs such as Drau, Enns, Traun, Wörther See and Zeller See. During mild weather, small numbers of Greylag Geese may winter over.

Habitat and feeding ecology: In spring, winter cereal fields are the most important food source, as well as wet meadows and maize fields. In autumn, maize is much more important, the geese gleaning spilt grain as well as eating whole cobs from field edges. They use sown cereal fields to a lesser extent. In winter (November-February) they feed almost exclusively on winter cereal fields (Dick 1988b, Dick et al. 1994, Dick & Grüll 1990, Fig. 12.3).

3A.2 Abundance

Phenology: The Greylag Goose first occurs in September in the Neusiedler See area and leaves during periods of cold weather in November or early December. Maximum numbers occur in October or November (e.g. November 1984: 9000 birds), after which time the Greylags tend to leave the area as temperatures fall below 0°C, lakes freeze and snow covers the fields. However, in mild weather up to 2000 may remain over the winter, as in January 1993. The overall phenology is shown in Fig. 12.4.

Trends and numbers: The maximum number of staging geese for the whole Neusiedler See (Austria and Hungary together) area varies between 5000 (October 1988) and 12,000 (November 1985). In most years, 1000-5000 were counted on passage, the spring migration being less spectacular both in numbers and duration of stay (Dick et al. 1994, Parz-Gollner & Faragó 1991).

3A.3 Research

In addition to behavioural ecological studies (Dick 1988a, b), investigations of regional movements (Dick 1990, 1991, Parz-Gollner & Faragó 1991, Parz-Gollner et al. 1993) and migration (Dick et al. 1984, 1991, Dick 1993) using neck-bands have been carried out. However, at the time of writing, only the internationally coordinated censuses are being conducted.

3A.4 Protection and conservation

Hunting legislation: Geese of any species may be hunted between 1 August and 31 January in Burgenland, the province in which Neusiedler See is located.

Site safeguard: All of Neusiedler See and the most important areas of the adjacent Seewinkel are included in a Ramsar site, although Hanság, an important feeding site, is not. In 1992, a National Park was established which includes the main roosts, such as the southern end of Neusiedler See and Lange Lacke. The latter is a management zone where hunting is still allowed along the edges.

Agricultural conflict: Depending on the daytime distribution of the geese (feeding either in Austria or Hungary) and weather conditions, agricultural damage

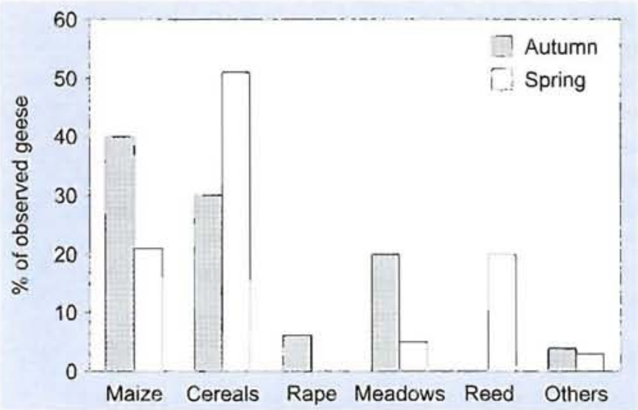

Fig. 12.3. Habitat use by Greylag Geese in the Neusiedler See area during spring (n=10,182) and autumn migration (n=11,962).

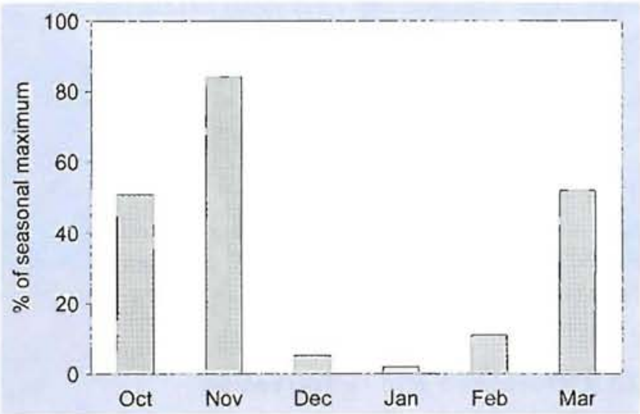

Fig. 12.4. Phenology of Greylag Geese in the Neusiedler See area: histograms indicate monthly percentage of the seasonal maximum for each month (n=72,858) for the period 1983/84 to 1988/89.

may occur. Up until the establishment of the National Park, compensation was paid to farmers whose fields were inside Lange Lacke Nature Reserve (Dick 1992).

3B. HUNGARY

3B.1 Distribution

Range: There are two important areas for Greylag Geese in Hungary: Transdanubia in western Hungary with 16 main sites, and the Great Hungarian Plain in eastern Hungary with seven main sites. Comparing the period 1972-1982 with the preceeding decade, numbers of staging Greylag Geese have increased by 28%. Since the early 1990s, Transdanubia has become more important for Greylags than eastern Hungary (Faragó 1995).

Habitat and feeding ecology: Greylags remain close to their night roost, tending to feed on pasture or meadows, including habitat reconstruction areas at Lake Fertö (Neusiedler See). They also feed on arable land several kilometers from the roost (Faragó 1994).

3B.2 Abundance

Phenology: During 1986-91, numbers were characterised by two seasonal peaks: one in spring and one in autumn. Maximum numbers occurred in March 1987 (11,124 birds) and November 1990 (13,034 birds), the latter being the highest number of Greylags counted in Hungary during the survey period. Peak Greylag numbers are recorded in October and November when the breeding stock is joined by migrants. With the onset of cold weather, the majority of lakes and ponds freeze over and the ground is covered with snow. As a result, numbers drop from an average of 6000 in autumn to some 1500 birds in December and 700-800 in January. In prolonged cold periods, similar numbers can also occur in February, whereas in average winters, numbers may exceed 2500 and in mild winters as many as 5000. In March, numbers average c. 5000 and peaks of 11,000 have been recorded (Faragó 1995).

Trends and numbers: Since the end of the 1988/89 season, numbers counted in Transdanubia have exceeded those on the Great Hungarian Plain (Faragó et al. 1991). In Transdanubia, Greylag migration mainly occurs during autumn. Large numbers were observed in autumn 1990, especially at Lake Fertö (Neusiedler See). Due to severe drought, the salt lakes of Seewinkel (Austria) had dried out and the geese that had previously wintered there were found on the restored shallow ponds of Mekszikópuszta. These ponds provided all the essential conditions which were lacking in the Seewinkel area (Parz-Gollner & Faragó 1991). The highest autumn migration counts were recorded in 1990, with peaks exceeding 10,000 in October and 12,000 in November. Averages for the autumn months ranged from 3000-3700. Monthly averages of migrating Greylag Geese (1972-1982) were: October 1564; November 1503; December 229; January 296; February 244; March 1368.

3B.3 Research

A comprehensive study of goose numbers and hunting bags has been published (Faragó 1995), and a detailed cross-border study on habitat use, daily activity patterns and goose numbers has been carried out at Lake Fertö (Neusiedler See) during 1989-92 (e.g. Faragó 1994). During winter, monthly goose counts are carried out throughout Hungary at 23 sites.

3B.4 Protection and conservation

Hunting legislation: The Greylag Goose is a protected species.

Site safeguard: Lake Fertö (Neusiedler See) is a National Park and Ramsar site. Twelve sites meet the Ramsar 1% criterion (200 individuals for Greylags), of these 11 are Nature Reserves and only the Saponya Fishponds remain unprotected.

Agricultural conflict: Formerly, there was no conflict regarding crop damage (Faragó 1992) although privatisation is changing this. So far no problems have arisen with Greylag Geese.

3C. CZECH AND SLOVAK REPUBLICS

3C.1 Distribution

Range: Greylags stage in the same areas as they breed, except for a new staging locality at Rezabinec Pond near Pisek, south Bohemia. Since 1974, Greylags have wintered irregularly in south Moravia (up to 200 individuals, maximum 350 in January 1989) and south Bohemia (maximum 61 birds, 14-16 January 1994). In Slovakia, staging Greylag numbers have declined, mainly due to increased disturbance after the opening of the border (A. Darolova pers. obs.). Geese also occur on the Slovak part of the Danube, although exact numbers are not available because the Greylags mix with other goose species totalling up to 40,000 birds. Greylags also use the Austria/Slovakia border region near Rusovce for feeding.

3C.2 Abundance

Phenology and numbers: From the beginning of July to the end of October, some 1000 Greylags occur at Rezabinec Pond, Pisek (maximum 1700 birds on 14 September 1991); some 2000 birds occur at Dehtar Pond, Ceske Budejovice, and some 4000 birds at Velky Tisy, Trebon, from early July to November; and some 6000 birds occur at Nove Mlyny Reservoir and Lednice Ponds from early July to December (maximum 8626 birds on 16 September 1990). In spring, Greylags use staging areas close to the breeding grounds in numbers not exceeding 1000 birds.

3C.3 Research

No research is undertaken in the Czech and Slovak Republics but international censuses are carried out.

3C.4. Protection and conservation

Hunting legislation: A new Czech hunting law (134/1996) permits shooting from 1 September to the end of February (formerly to the end of December) with no other restrictions. In Slovakia, geese are huntable until the end of February, the exact dates differ from year to year.

Site safeguard: Under the Czech National Council Act 114/92 (Czech Institute for Nature Conservation 1993) most of the breeding grounds (and hence also the staging areas) lie within nature protection areas.

Agricultural conflict: Damage occurs more or less the whole year round, although most concentrated during moult. Geese mainly damage cereal fields (Urbanek 1992).

3D. POLAND

3D.1 Distribution

Range: The staging areas holding the largest numbers of Greylags until late November/early December are Slonsk, the Lower Odra and Barycz Valleys, and Lake Goplo (Fig. 12.2).

Habitat and feeding ecology: Greylags in Poland feed mainly on grass, but also on winter cereals.

3D.2 Abundance

Phenology: Greylags first arrive on breeding sites in western Poland in early February with peak numbers in late February to early March. Up to 2000 have been counted at Slonsk Reservoir and the same number in the Barycz Valley, whilst some 3000 gather in the Lower Odra Valley (J. Witkowski unpubl. data). Some Greylags move northwards from the Barycz Valley by the end of July/August (as do Greylags from Neusiedler See in Austria) to Brandenburg, Mecklenburg and the Netherlands. The Greylags leave Poland at the end of November or in early December.

Trends and numbers: The biggest concentrations of Greylags occur in autumn, mostly in late September and early October when up to 6000 have been counted in Slonsk, c. 4000 in Lower Odra, 3800 in the Barycz Valley and c. 1000 (formerly up to 3500) on Lake Goplo.

Generally, Greylags do not winter in Poland but in mild winters small groups may remain at the western breeding grounds to a maximum of c. 500 birds.

3D.3 Research

In addition to the regular international goose counts, the Polish breeding population is well documented. Neck-banding is carried out in the Barycz Valley using green collars.

3D.4 Protection and conservation

Hunting legislation: The open season extends from 1 September until 21 December and there is no limit on the hunting bag. No bag statistics are available. In spring, all goose species are protected.

Agricultural conflict: There are problems with geese feeding on sown cereals (seeds and shoots of sown wheat and oats), but the damage is not great.

3E. ITALY

3E.1 Distribution

Range: Italy is situated on the migratory route between Central European breeding grounds and North African wintering haunts. Although Greylags can occur in small numbers at several sites throughout Italy, major concentrations are only observed in northern Italy (the Comacchio-Mezzano complex) and at the Om-

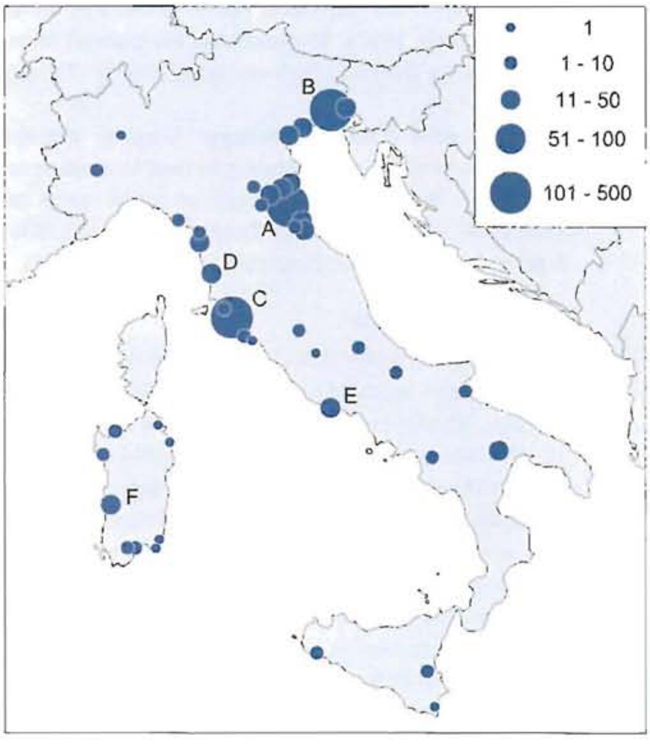

Fig. 12.5. Mean mid winter numbers of Greylag Geese in Italy, 1991-95. The sum of site means is 1022 individuals. Sites: A. Mezzano and Comacchio; B. Grado-Marano Lagoon; C. Ombrone mouth; D. Bolgheri Marshes; E. Pontini Lakes - Circeo National Park; F. Oristano Gulf.

brone River mouth (Fig. 12.5; Serra et al. 1997). Additionally, Greylags have been introduced not only at Laguna di Grado but throughout northern Italy.

3E.2 Abundance

Phenology and trends: Wintering Greylags are currently increasing at almost all key sites, numbering an estimated total of c. 1000 birds. According to Boldreghini & Montanari (1991), the Greylag was an irregular visitor throughout the winter, seen most frequently between mid February and the end of March, to a maximum of 740 birds. The Ombrone River mouth, a site which became important for geese since the mid 1980s, contained 422 birds in January 1995 and 358 in 1994. Generally, larger numbers are observed towards the end of winter when the geese return to the breeding grounds. All neck-banded geese observed at Ombrone have been of Polish origin.

3E.3 Research

Censuses are carried out but no other research.

3E.4 Protection and conservation

Hunting legislation: The Greylag Goose is a protected species. Hunting is illegal but nevertheless a problem, especially in the south, precluding the use of many suitable wetlands by Greylag Geese.

Site safeguard: The Mezzano area, covering over 17,500 ha and created during the last major reclamation in the 1960s, is uninhabited and hunting is prohibited in 80% of the total area of 35,000 ha. There has been a great reduction of hunting disturbance there, thus the area offers opportunities for staging and feeding which do not exist in other areas of the Po Delta (Boldreghini & Montanari 1991).

Agricultural conflict: Agricultural damage claims have been made locally, but at present this is not a problem.

3F. ESTONIA

3F.1 Distribution

Range: Greylags stage but rarely winter in Estonia. Ringing recoveries and censuses show that major concentrations exist in the west Estonian lowland and archipelago (Fig. 12.6). The most important autumn staging area for geese is Matsalu Bay. Most recoveries are from September and October when shooting is permitted. There is only one spring recovery of a Greylag in April 1978 (Kastepold & Kabal 1982, Kastepold & Kastepold 1992).

Habitat and feeding ecology: Greylag Geese traditionally feed on coastal meadows, although there are no studies available of dietary composition. They also feed on coastal pastures, arable fields and grasslands. In August and September, spilled cereal grain is an important food, especially barley. Sometimes geese also feed on ripe but unharvested barley, flooded or flattened by heavy rainfall.

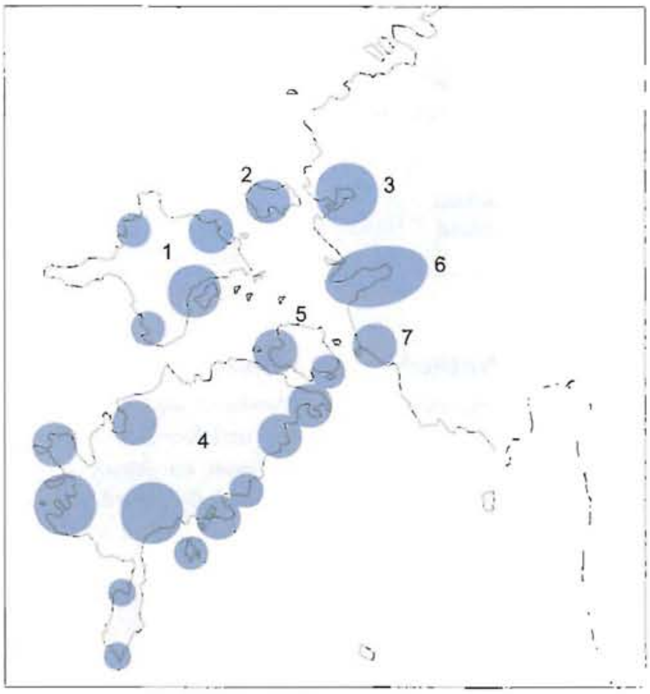

Fig. 12.6. Distribution of autumn staging areas for Greylag Geese in Estonia in the 1990s. Sites: 1. Hiiumaa; 2. Vormsi; 3. Haapsalu Bay; 4. Saaremaa; 5. Muhu; 6. Matsalu Bay; 7. Virtsu - Nehatu (A. Leito unpubl. data).

3F.2 Abundance

Phenology: On spring migration, Greylags usually arrive first in mid to late March and, in very mild winters, in late February. The average arrival date of the first birds is 14 March (1977-1986). Departure begins in August, the majority leaving by the end of September and early October. The last individuals are observed in late October to late November (average four November 1977-1986, Leibak et al. (1994)). Peak autumn staging occurs in early September, and single birds or small groups irregularly winter in the western archipelago in mild winters.

Trends and numbers: During spring, no substantial concentrations of Greylag Geese have been recorded, and accurate census data are not available. September counts have been carried out since 1990, revealing 10,000-16,000 Greylags without any clear trend (Table 12.3). Numbers at Matsalu Bay have been relatively stable (5000-10,000), whereas at Hiiumaa numbers declined from c. 3000 in the early 1990s to 700 in 1995. A new important gathering of Greylags in Haapsalu Bay started in 1993 (Fig. 12.6).

3F.3 Research

Regular censuses and studies of feeding ecology on arable land were started in 1990. Recently, some 50 members of the Estonian Ornithological Society and local bird clubs have participated in the work. Censuses of breeding, moulting and autumn staging Greylags are conducted by the Estonian National Monitoring Programme which started in 1994.

Table 12.3. Mid September counts of Greylag Geese in Estonia.

Region	1990	1991	1992	1993	1994	1995
Hiiumaa Island	2780	3350	2000	3600	1790	700
Saaremaa & Muhu Islands	770	1950	2640		5160	4590
Haapsalu Bay				200	400	1200
Matsalu Bay	6200	9550	4890	6490	5830	9200
Virtsu-Nehatu	400		300	160	100	
Vormsi Island	23				160	
Total	10,180	14,850	9830	10,450	13,440	15,690

3F.4 Protection and conservation

Hunting legislation: Acts concerning the protection of the wild flora and fauna and hunting regulation came into force in 1994. There are about 15,000 hunters at present, their numbers decreased dramatically some five years ago due to political and social changes. The Greylag Goose is a game species and shooting is allowed from 20 August to 1 December. The total goose hunting bag has been c. 1000 geese per season in recent years, 50% of which are Greylags. Bag statistics are, however, not very accurate.

Site safeguard: The Ramsar Convention was ratified in October 1993 and at present, the Matsalu wetland is the only Ramsar site. Matsalu is the most important staging area for geese, although Haapsalu and Kaina Bay are also important. Kaina Bay is protected as a Bird Protection Reserve but Haapsalu Bay is unprotected.

Agricultural conflicts: In some areas, Greylags can cause significant agricultural damage in autumn. Conflict is focussed around Matsalu Bay and on Hiiumaa Island. Geese feed on ripe unharvested fields of summer barley and on green crops of winter wheat and rye. No compensation has been paid to farmers for damage because the Greylag is a game bird and may be shot.

3G. FINLAND

3G.1 Distribution

Range: The most important staging areas during spring migration are in the Gulf of Bothnia in the vicinity of breeding sites. These include Liminganlahti Bay and the neighbouring fields (2-5 km away from the breeding sites on the shore), and the central part of the island of Hailuoto. The most important autumn staging areas are identical to the breeding sites: meadows along the shores of Hailuoto Island, Liminganlahti Bay and the Haukipudas and Krunnit Archipelagos in the Gulf of Bothnia region. Geese from northern parts also stage in the fields at Sulva (Söderfjärd), where no breeders occur, with peak numbers of 500-1000. However, staging areas on the southwest mainland and the archipelago are not the same as the breeding sites, being located in more shelter on larger islands and along mainland bays (Kemiö, Bay of Perniönlahti, Åland main island). Efforts have been made to restock the sparse populations on the southern coast of the Bothnian Bay and, more recently, on the northern coast (Merilä 1986, Merilä et al. 1986, Merilä & Pirkola 1988).

Habitat and feeding ecology: In spring, Greylags feed on stubble and hay fields until the ice has melted along the shores of the Bothnian Bay, when they switch to the rhizomes and new shoots of reeds *Phragmites australis* and other natural, coastal vegetation. Breeders and moulting birds feed on short meadow vegetation and reeds. In the Archipelago, Greylags graze on small meadows on these mostly rocky islets. In autumn, Greylags used to graze on natural grasslands, but, already in the late 1980s in southwestern Finland and since the beginning of the 1990s in the Bothnian Bay, they have begun to feed on cereal, stubble and hay fields which has also made them more vulnerable to hunting.

3G.2 Abundance

Phenology: Most Greylags arrive in southwestern Finland in March-April and in the northern parts of the Bothnian Bay in April, the peak being 17-18 April. Ten years ago the peak was 20-22 April. In autumn, most Greylags leave the Bothnian Bay in mid to late August, partly because of very high hunting pressure. Small numbers stage until October. Most flocks leave southwestern Finland in September.

Trend and numbers: In the Bothnian Bay, peak numbers of staging Greylags are 500-1000 around Liminganlahti Bay, and 500-600 on Hailuoto in April.

In late summer/early autumn, the largest flocks concentrate on bays and large islands of southwestern Finland. On Kemiö Island, at least 5000 Greylags have been counted, and at least 2000 around Perniönlahti Bay, similar numbers have been recorded on the main island of Åland.

3G.3 Research

In Finland, Greylags have only been studied on a small scale. A review was compiled by Hildén & Hario (1993). Studies from the main breeding area in southwest Finland are few (e.g. Blomqvist & Tenovuo 1980). More work has been carried out in the Gulf of Bothnia region and the most recent data available is contained in Siira & Pessa (1992), Markkola et al. (1993), Markkola et al. (1996) and Pessa (1996). In the 1980s, Pulliainen & Tynjälä (1984) studied the breeding biology of the Greylag in the Krunnit Archipelago, and Vikberg (1980) studied the status of the Greylag on Hailuoto Island.

An attempt to restock the sparse Greylag population on the southern coast of the Bothnian Bay was made in the 1980s by the Institute of Game Research in Finland

(RKTL), the Central Organisation of Finnish Hunters, local hunters' associations and independent researchers (Merilä 1986, Merilä et al. 1986, Merilä & Pirkola 1988). Follow-up has been incomplete as there are no longer any staff at RKTL studying geese.

3G.4 Protection and conservation

Hunting legislation: The Greylag is a game species under Finnish hunting law. The hunting season extends from 20 August to 30 November but there are local exceptions. For example, the hunting season begins on 1 September around Vaasa, 300 km south of Oulu, whilst on Åland, the Greylag is protected. In the Bothnian Bay, the new habit of feeding on stubble and cereal fields in August has led to very high hunting mortality in some years in the 1990s. However, it does not yet seem to have affected the breeding population.

Agricultural conflict: Exists only in southwestern Finland and Åland but is not a serious problem if the harvest is over before flocks arrive.

4. WINTERING AREAS

4A. TUNISIA AND ALGERIA

4A.1 Distribution

Range: In central North Africa, Greylags depend mainly on three wintering sites: Lake Ichkeul in Tunisia and Lake Fetzara and the El Kala wetlands in Algeria. Distribution between the sites varies according to the season and prevailing ecological conditions, such as water level.

Habitat and feeding ecology: The central North African wetlands are characterised by extensive beds mainly of *Scirpus maritimus* whose bulbils the geese feed on (for detailed site descriptions see Morgan 1982).

4A.2 Abundance

Phenology: Greylags tend to arrive in early November, depending on the weather conditions in Central Europe, and remain until early February. Some may arrive already in October and remain until March.

Trends and numbers: Census data available from the Tunisian and Algerian sites since the early 1980s suggest a wintering population of c. 20,000 Greylags (Dick et al. 1991). The interdependence of the sites has been clearly documented through observations of neck-banded geese. Although information is scarce, there seems to be a decreasing trend in the number of Greylags during the last three years at Lake Ichkeul. Recent January counts revealed 1655 in 1993, 6644 in 1994 and 2210 in 1996 (F. Maamouri, M. Smart pers. comm.), apparently due to dramatic ecological changes in the lake as a result of increasing salinity (see below). In 1994, a total of 14,667 birds were counted in Algeria, 13,400 of which were at Lake Fetzara. This indicates that displaced geese from Ichkeul stayed in Algeria, as previously shown for individually marked geese.

4A.3 Research

Censuses are carried out in Algeria. In Tunisia, ecological studies of the hydrology, vegetation and ornithology (e.g. Hollis 1986) were carried out over a period of several years. A private organisation, Les Amis des Oiseaux, is involved in census work.

4A.4 Protection and conservation

Hunting legislation: The Greylag is the only wintering goose species and has officially been protected in Algeria since 1983 by Presidential Decree. Poaching, and disturbance associated with poaching, especially at Ichkeul, is a big problem. Duck hunting is still legal in the El Kala wetlands outside the Park and at Fetzara on Fridays and Public Holidays, so here the birds are disturbed by both legal hunting as well as poaching.

Site safeguard: Lake Ichkeul is a Ramsar site, Biosphere Reserve, World Heritage site and a National Park. El Kala in Algeria is a National Park. Despite these official designations, poaching is a direct threat to the geese. Ecological changes at Lake Ichkeul, especially during the last three years, resulting from dam building on inflow rivers led to extremely saline conditions under which *Phragmites*, *Scirpus* and *Potamogeton* completely disappeared. The salinity of the lake became higher than that of sea water (c. 60g/l), resulting in the disappearance of many surface feeding ducks and Coot *Fulica atra*. In April 1996, the sluice controlling the inflow of seawater (or freshwater outflow) was closed for the first time as a counter measure.

Agricultural conflict: Greylags used to feed almost exclusively on the *Scirpus* marshes, especially in Tunisia, and only under dry conditions were some observed on winter cereal fields (e.g. December 1988, G. Dick pers. obs.). However, a problem is now arising because of the lack of *Scirpus* plants.

5. DISCUSSION

Population status: After about 20 years of more or less well documented population increase, the Central European flyway comprises approximately 4000 breeding pairs. Greylags in the former Yugoslavia are not included in this estimate but most of the Greylags breeding in Finland are. Whether all the Finnish birds belong to this flyway has yet to be proved, especially those in the Bothnian Bay. Although there may be a slight increase in some countries, censuses indicate a more or less stable population size. The wintering population in North Africa comprises at least 23,000 birds, and another 2000 Greylags may winter in the Balkans (former Yugoslavia, Greece, Albania and possibly further east), bringing the flyway total to approximately 25,000 wintering Greylags. A further 3000 Greylags of the Central European breeding population (calculated using Hudec's (1984) model) winter along the Atlantic flyway. September counts have not clarified the situation, mainly because of the mixing of geese from different flyways at staging areas.

Conservation issues: Except in Hungary, the Greylag Goose is hunted throughout the flyway. The new regulation in the Czech Republic, which now parallels the situation in Slovakia, allowing hunting until the end of February is a matter of international concern because the geese are shot as they arrive on the breeding grounds. Apart from this, no major threats could be identified at the breeding and staging areas, although some areas in different countries lack formal protection. A matter of grave concern is the situation in the central North African wetlands, especially the habitat degradation occurring at Lake Ichkeul. Ecological changes there may lead to a total change in the wintering distribution of Central European Greylags in years to come. None of the international designations of this site have stopped the processes of human induced ecological change.

Agricultural conflict: The problem exists, varying from country to country, but only exceptionally do serious problems occur.

Future research needs: Very little is known about the eastern border of the Central European flyway, where it adjoins the Black Sea Greylag population, or about the importance of the Balkans as a winter quarter. It is important to establish to what extent Greylags in northern Finland, southern Poland and southern Bohemia use the Atlantic as well as the Central European flyway, including new wintering sites in the Netherlands, Lac du Der, the Camargue and Villafáfila. The rest of the population moves south to North Africa and, to an unknown extent, to the Balkan/eastern Mediterranean region. Following ecological changes in North African wetlands and climatic changes, western European sites could become more important as winter haunts in the future. Better census coverage is needed, especially from the Balkans, to improve knowledge of the winter distribution. In many countries, data on the size of the breeding population are lacking (e.g. former Yugoslavia, Hungary, Austria). Censuses at post-breeding gathering sites would provide the best data on which to base flyway population estimates. Best results would be achieved by adjusting count dates according to latitude, instead of fixed dates throughout the whole flyway.

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13 Greylag Goose *Anser anser*: Black Sea

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1. POPULATION REVIEW

1.1 Range

Greylag Geese breed and winter in the Black Sea region in the countries of Romania, the Ukraine, the Russian Federation, Syria, Turkey, Greece and Bulgaria. Formerly considered only a summer visitor to Romania, the Greylag Goose has been regularly recorded wintering there since 1950 (Rudescu 1953).

1.2 Delineation of flyways

No Greylag Geese have been ringed in the Black Sea area and very little is known about the movements of this population. The borders between the Black Sea population and the Central European and Southwest Asian Greylag populations (Fig. 8.1.; see Dick et al. and Scott this volume) are not well known. Many Greylags may disperse locally, particularly to coastal areas (Scott & Rose 1996), but it is, for example, known that most wintering Greylags come to Romania from the north and northeast, and apparently flocks also pass right across Romanian territory flying west and southwest, occasionally north to south, indicating a larger scale of movement than previously recorded. Extended coverage during the mid winter census in recent years has also revealed large numbers of Greylags wintering in the Ukraine and a substantial number as far south as Syria (Table 13.1) although it is not known where these latter birds derive from.

1.3 Population trends

Longterm trends of this population are unknown. Pirot et al. (1989) estimated the Black Sea Greylag Goose population at 20,000 birds, although it is now evident that this estimate is too low. In 1989, over 52,000 Greylags were counted in Romania during the mid winter census and, in 1994, the second year of mid winter counts in the Ukraine revealed some 50,900 Greylags, at the same time as circa 33,900 Greylags were counted in

Romania (Table 13.1). The increase in total numbers which these counts give obviously results largely from improved coverage, although the major fluctuations in numbers counted between years are remarkable and need further study. Ukrainian ornithologists consider that the number of Greylags wintering in the country has increased in the last 10 years. However, the data available on the population as a whole at the present time are not good enough to establish any trends. It is notable that mid winter counts from the early 1970s in Greece show consistently larger numbers (range 1100-4350) than recent counts (Table 13.1), as do earlier counts from Bulgaria (maximum 3041 birds in 1978 cf. Table 13.1). Wetland drainage and severe hunting pressure are believed to have reduced the number of Greylags wintering in Turkey from an average of 6700 birds in the 1970s to only 600 by the late 1980s, and less than 2000 in the 1990s (Table 13.1).

1.4 Breeding success

The breeding success of this population has not been studied in detail. In Romania, an average brood size was 3.2 (range 2-5) amongst 17 Greylag families studied between 1985 and 1987 (D. Munteanu unpubl.). Almasan et al. (1971) studied 85 nests in the Romanian part of the Danube Delta, of which 31% were completely destroyed, 51% successfully hatched all eggs laid and the remaining 18% hatched at least one chick from a larger clutch.

1.5 Mortality

No information.

2. BREEDING GROUNDS AND BREEDING ECOLOGY

2.1 Distribution

Range: Greylags in the Black Sea region breed in the countries of Romania, the Republic of Moldavia, the Ukraine, the Russian Federation, Bulgaria, Turkey and Greece. The Danube Delta and the region east of the Sea of Azov are the most important breeding areas, while Turkey has an estimated 200-500 breeding pairs (G. Magnin pers. obs.), Bulgaria some 50 pairs (Rooth 1971) and Greece 10-20 pairs (Rooth 1971).

Little is known about the Greylags breeding in the area to the east of the Sea of Azov although some 3000 pairs are reported to breed there (Isakov 1972). The important wetlands of the area are described in Wilson & Moser (1994).

In Romania, the Danube Delta and the lagoon complex, Razelm-Sinoie, are the main breeding areas (Fig. 8.1 in Mitchell & Sigfusson this volume) with some 1500-2000 pairs. A further 50 pairs maximum breed in the rest of the country, namely, the lower Danube valley upstream from the delta, eastern Muntenia, central Moldavia and the western plain of Romania. Some 1000-2000 non-breeding Greylags are also present in the breeding season, giving some 12,000-14,000 birds present at the end of the breeding season (M. Marinov pers. comm.). During the post war period, there has been a severe reduction in Greylag breeding range and the number of breeding pairs as a result of wetland drainage or conversion to fishponds. During the 1980s, almost 18% of the Romanian part of the Danube Delta was reclaimed although it remains the largest and most important wetland in Romania. However, a recovery in the number of breeding pairs has been recorded since the protection of the Danube Delta as a Biosphere Reserve and Ramsar site in Romania.

Four main breeding areas are at present known in the Ukraine: the Danube Delta (600-1500 pairs), the flood plain of the rivers Orel' and Samara (1000-1500 pairs), the Dnestr Delta (150-250 pairs) and the Dnepr Delta (180-230 pairs)(Fig. 8.1 in Mitchell & Sigfusson this volume). Smaller groups of Greylags breed at many other lakes (e.g. Lakes Sukhoy, Tiligulskiy, Molochny and eastern Sivash) and single pairs or groups of two to five pairs nest widely on ponds, flood plains and along coastal bays. An additional 5000-7000 non-breeding Greylags are also present in the summer. The principal breeding grounds of Greylag Geese in the Ukrainian part of the Danube Delta are the coastal section of the Kilia channel, the Stentsov-Zhebriyanov wetlands and the Kugurluy-Kartal lake system (Zhmud 1996), although small numbers breed thoughout the region's larger wetlands where emergent vegetation cover has developed. Up to 3500 non-breeders are also present in summer.

Greylags are thought to breed in very small numbers at many Turkish wetlands (G. Magnin pers. obs.) and may be overlooked in counts.

Habitat and feeding ecology: In Romania, the Greylags prefer sites where dense aquatic vegetation alternates with open water; the existence of grass or

Table 13.1. Mid winter counts of Greylag Geese in the Black Sea region, 1988-95 (Wetlands International Goose Database).

Country	1988	1989	1990	1991	1992	1993	1994	1995
Bulgaria	19	171	n/a	n/a	43	897	8	621
Greece	264	128	68	n/a	n/a	164	449	190
Israel	n/a	n/a	n/a	n/a	5	n/a	19	13
Romania	1200	52,348	20,860	8569	25,252	10,851	33,892	16,550
Russian Federation	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Syria	n/a	n/a	n/a	n/a	n/a	880	1450	3100
Turkey	679	1339	1074	n/a	1249	1897	11	1294
Ukraine	n/a	n/a	n/a	n/a	n/a	7223	50,901	31,933

n/a not available.

arable land nearby is an added attraction. Greylags have adapted remarkably to new environmental conditions created by human activities, for example, repopulating fishponds which have been invaded by emergent aquatic vegetation and regained to some extent the characteristics of a natural basin, and breeding in reedbeds along canals despite shipping traffic (D. Munteanu pers. obs.). At the end of the breeding season, the geese gather in large groups in the vicinity of cultivated fields or on islets in the delta ("grinds") with abundant herbaceous vegetation cover. Birds breeding and roosting in southern Bessarabia in the Ukraine regularly feed in the Romanian part of the Danube Delta, mainly on farmlands in Pardina, Stipoc and Chilia Veche (M. Marinov unpubl. report). These birds are not included in Romanian counts of breeding geese (see above).

In the Ukraine, Greylag Geese respond rapidly to changing hydrological conditions, moving short distances to over 100 km to nest where conditions are favourable (T. Ardamatskaya pers. obs.). The Greylag's tolerance of human presence has enabled it to exploit small ponds close to villages. Hundreds of Greylags summer on Lake Kugurluy and pools of the coastal section of the Danube Delta in Ukraine and, in the 1990s, some 3000 Greylags concentrated in the upper part of the Sasyk Reservoir. Soon after fledging, the geese visit harvested cereal fields. Geese in the coastal parts of the delta feed on water chestnuts *Trapa natans*, primarily within the boundaries of the nature reserve (Zhmud 1996).

2.2 Moult migration and moulting areas

Greylags in Romania and the Ukraine generally moult in locations which are difficult to access and only occasionally are small groups of moulting birds seen in the second half of the summer. Generally moulting areas are not well known. The moulting, non-breeding birds from the lower reaches of the Duni and Dnestr rivers moult in the outer parts of the Duni Delta and Dnestrovski lagoon, while those from the Orel'-Samara rivers area moult in the breeding areas (Lysenko 1990).

2.3 Research

No special research has been done on Greylag Geese in Romania or the Ukraine.

2.4 Protection and conservation

Hunting legislation: According to the 1996 hunting law in Romania, the Greylag goose is listed as a game species and is legal quarry from 15 August to 28 February. There is no bag limit, nor are there any statistics available to assess the number of Greylags shot each year. The Danube Delta Biosphere Reserve Authority has the right to change the hunting season within the reserve and in some years the opening of the hunting season is delayed until October, as in 1996 when it was delayed until 10 October.

In the Ukraine, Greylag Geese may be hunted during the open season for aquatic species which is from the second Saturday in August to 15 November. No bag data exist; some 1000-1500 Greylags were shot annually in the years 1993-95 (T. Ardamatskaya pers. obs.).

Site safeguard: The Danube Delta, which contains over 95% of the Greylag Geese breeding in Romania, is a Biosphere Reserve and Ramsar site. There are 16 strictly protected areas within the reserve where all human intervention, including hunting, is forbidden. The Reserve Authority also has the right to adopt special local measures to limit hunting.

Public awareness: The Romanian Ornithological Society has produced leaflets and posters about the breeding birds of the Danube Delta, one of which shows a Greylag Goose with goslings.

3. STAGING & WINTERING AREAS

3A. ROMANIA

3A.1 Distribution

Range: During the autumn migration, most Greylag Geese are recorded in southeastern Romania, mainly in Dobrodja. Birds arrive from the north and northeast, and passage birds continue their journey south. According to Averin et al. (1971), some Romanian birds fly north in autumn, even as far as the Republic of Moldavia. Migrating Greylags also pass across inland Romania in autumn, particularly towards the west and southwest although occasionally from north to south. Greylags also cross Transylvania after crossing the Carpathians, presumably from the Ukraine. The spring migration takes place on restricted areas with a more evident concentration in southeastern Romania.

Greylag Geese are more widely spread in winter than during the breeding season. Dobrodja, particularly the Danube Delta and lagoon complex Razelm-Sinoie, is the most important wintering area. Small groups of Greylags also fly up the Danube to its confluence with the Olt, and small numbers winter on reservoirs on the lower Olt, on lakes and wetlands in southeastern Muntenia, possibly in eastern Moldavia, and rarely in Transylvania and Crisana. When the fresh water bodies freeze, many Greylags move to brackish lakes or to the sea, staying near the shore, especially where the Sf. Gheorghe arm flows into the sea; others may fly in the opposite direction, reaching the Danube River upstream of Braila. Greylag wintering areas have contracted following the decrease in wetland area during recent decades, although, in the Danube Delta, wetlands which have been converted to agricultural land have become a food resource.

Habitat and feeding ecology: Greylag geese usually stage in extensive agricultural fields where water for drinking is available nearby. The difference between roosting and feeding habitats is less obvious during staging. In winter, the Greylags roost on remote lakes and marshes and fly to agricultural fields in the morning to feed. In Dobrodja in particular, Greylag Geese mix with large flights of White-fronted Geese *Anser albifrons*.

3A.2 Abundance

Phenology: The spring passage takes place in March, the earliest arrival being 20 February and the last geese leaving by the beginning of April. The autumn migration takes place during October-November.

Trends and numbers: The largest number of staging Greylag Geese was recorded in the Danube Delta on 20 and 23 November 1969, when about 10,000 Greylags were seen during a flight across the Delta (Talpeanu 1971). There are no other data on numbers and trends during staging.

Mid winter counts from 1988-95 (Table 13.1) show an average of about 20,000 Greylag Geese in Romania, most of which occur in the Danube Delta/Razelm-Sinoie lagoon area. However, the counts show large fluctuations in numbers present between years. Ice conditions on fresh water bodies affect the distribution of Greylags within Dobrodja but there is no evidence that birds fly south beyond the Romanian border in response to harsh weather and icing.

3A.3 Research

Greylag Geese are counted as part of the International Waterfowl and Goose Counts, with a focus on the Dobrodja.

3A.4 Protection and conservation

Hunting legislation & site safeguard: See section 2.4 above.

Agricultural conflict: None recorded.

3B. RUSSIAN FEDERATION

No information is available at the present for the Russian Federation.

3C. SYRIA

Up to 3100 Greylags have been counted in Syria in recent years. Scott (1995) lists six sites where the species has been recorded: Buhayrat al-Khatuniyah (200 in January 1994); Tual al-'Abba (30 in October 1982); marshes and oxbows along the Euphrates River (up to 650 in the early 1990s); Buhayrat al-Asad (up to 150 in recent years); Baath Lake (800-1000 in November 1992); and Sabkhat al-Jabbul (maximum 600 in winter). As many as 2000 Greylags have been recorded in the marshes along the Euphrates in recent years (Scott & Rose 1996).

Hunting is prohibited at Baath Lake, but the important wintering sites for Greylags in the Euphrates Valley are unprotected.

3D. TURKEY

3D.1 Distribution and abundance

Range, trends and numbers: Little is known about the distribution of Greylag Geese in winter in Turkey. Kasparek (1992) reports over 12,000 Greylag Geese counted in the Sultans Marshes in October. Greylags have been counted in the Kizilirmak Delta on the Black Sea coast, on the deltas of the Göksu and Seyhan/Ceyhan rivers on the south coast and at other wetlands, mostly in western Turkey. They are rarely seen in central Turkey as the wetlands there are mostly frozen. Counts of Greylag Geese wintering in Turkey show large fluctuations and, as the species frequents wetlands with good cover and sits tight when disturbed, it is difficult to assess the reliability of the counts (Dijksen & Klemann 1994). However, the overall trend shows a sharp decline in total numbers wintering in Turkey from an average of 6691 in the early 1970s to 872 birds in the 1986-90+1992 period, and less than 2000 birds in the 1990s (Table 13.1). The 1996 count, which included more sites and had better coverage than any previous winter count, revealed only 164 Greylags (G. Magnin pers. obs.). The dramatic decline in the number of Greylags using the Kizilirmak Delta on the Black Sea coast is undoubtedly real and is presumed to be a result of hunting pressure. In the early 1970s, this site always held the largest number of Greylags counted in Turkey (1970-73 mean 4766 birds) but in the period 1986-90+1992, the average was only 93 birds.

Habitat and feeding ecology: Greylag Geese in Turkey are confined to wetlands more or less covered with reed, where they feed amongst the vegetation or at the water's edge. They are seldom seen feeding in fields with other goose species.

3D.2 Research

Census: Greylag Geese have been counted in Turkey in the years 1967-73 inclusive, and from 1986 to 1996 (excluding 1991) as part of the mid winter waterfowl counts organised in collaboration with Wetlands International. From 1967 to 1992, these counts were conducted by a small team from the Netherlands (Dijksen & Klemann 1994) whilst the 1993-96 counts were conducted by the Turkish Society for the Protection of Nature (DHKD). In all years up to and including 1990, geese were seldom counted whilst leaving the roost for the foraging grounds, the optimal time for counting, and counts give only a rough impression of distribution and numbers. In 1992, geese were the focus of the counts and three days were spent at Kizilirmak Delta establishing Greylag numbers.

3D.3 Protection and conservation

Hunting legislation: The Greylag has been closed to hunting in Turkey for the last couple of years. Turkey has comprehensive hunting legislation and there are many restrictions on hunting methods, however, many hunters are not aware of the regulations and, outside the national parks, hunting regulations are regularly violated (Magnin 1989).

3E. UKRAINE

3E.1 Distribution

Range: Post breeding, the majority of Greylags breeding in the Orel'-Samara rivers area migrate to the north Sea of Azov coast, Molochny and Utluski estuaries, Obitochny Bay and Eastern Sivash (Lysenko 1990). Greylag Geese aggregate on autumn migration wherever feeding and associated roosting conditions are favourable. Important staging areas occur in the Danube Delta and lakes, the Dnestr Delta and lagoons, the Dnepr Delta, Karkinitskiy Bay and many other areas in the western part of the northern Black Sea coast, as well as the northern shores of the Sea of Azov.

Greylag Geese winter in deltas, lagoons and bays along the coasts of the Black and Azov Seas. In the Danube Delta, Greylags primarily occur on islands, especially Yermakov Island, and some coastal parts of the Delta.

Habitat and feeding ecology: Greylag Geese feed mainly on winter cereals and, to a lesser extent, on meadows used for cattle grazing (Zhmud 1996). A series of mild winters without snow and the availability of feed on stubble and winter cereal fields have encouraged the geese to remain in coastal areas through winter (Kosholov 1995).

In spring, the Greylags feed on extensive saltmarshes on the coast and winter cereals in close proximity to reservoirs where they roost.

3E.2 Abundance

Phenology: The autumn migration begins in the second half of August in many parts of the Ukraine, although it can occur as late as the end of October/first half of November, and peaks from the third week of September and first half of October.

Trends and numbers: The total winter number of Greylags reported for the entire Black Sea/Sea of Azov region by Grinchenko et al. (1995) was 15,000-25,000 individuals, but counts since then indicate that some 30,000-50,000 may winter. Numbers are thought to have increased in the last 10 years (T. Ardamatskaya pers. obs.), a result of changes in wintering areas, creation of reservoirs which provide roosts, a series of mild winters and improvements in bird protection through changes to hunting seasons and provision of refuges. In the Ukrainian part of the Danube Delta, some 1000 Greylags usually winter and, since 1983, have only been absent once, during the unusually severe winter 1984-85.

In spring, concentrations may reach 10,000-30,000 birds which stage for anything between a few days to two or three weeks.

3E.3 Research

The Ukraine has delivered counts to the Wetlands International Goose Database since 1993.

3E.4 Protection and conservation

Hunting legislation: See section 2.4 above.

Site safeguard: The coastal areas of the Ukraine have been greatly modified by human activities, support high densities of human populations and attract a great deal of recreational activity. The present network of protected areas is probably not sufficient to provide adequate staging and wintering grounds for geese in terms of safe feeding and roosting areas (Grinchenko et al. 1995).

Agricultural conflict: There is some conflict in areas with high concentrations of geese.

3F. OTHER COUNTRIES

Mid winter counts in Greece and Bulgaria are presented in Table 13.1. No other information is available for these countries. The Greylag Goose has been recorded as a casual passage migrant and winter visitor at one site, Azraq Oasis, in Jordan; small parties have been recorded on several occasions, and as many as 100 were present in February 1974 (Scott 1995). The origin of these birds is unkown and it is possible that they derive from the Southwest Asian population.

4. DISCUSSION

Population status: Increased coverage during the mid winter counts has revealed that this population is far larger than previous estimates allowed. However, until count coverage is increased and ringing studies establish migratory movements of both this and the Caspian Greylag population, reliable estimates of numbers and trends cannot be produced.

Conservation issues: Most of the important sites for this population are unprotected, although breeding and roosting sites in the Danube Delta Biosphere Reserve in Romania are protected. Changes in the hydrology of the Danube River catchment have led to an abnormal rise in water levels in spring and the first half of summer in some years, mainly in the western half of the Delta, which destroyed many Greylag nests by flooding and resulted in birds laying a second clutch as late as May (M. Marinov unpubl. report). Moderately high water levels are beneficial to breeding Greylags but catastrophic floods, such as those in 1970 and 1975 in particular, contributed to the decline in the number of Greylags breeding in Romania.

Wetland loss in Turkey, which is likely to be amongst the factors causing the decline in Greylag numbers since the 1970s (see section 1.3 above), has been documented in detail for the first time (Magnin & Yarrar 1997). Some 1.3 million ha of wetland has been irreversibly lost in the last four decades and many additional wetlands have been degraded.

Agricultural conflict: The Ukraine is the only country where agricultural conflict has been noted, in areas with large concentrations of geese. If the number of geese is increasing in the Ukraine, as has been suggested, this problem could develop.

Future research needs: There is clearly much to be learned about this population. Mid winter censuses should be continued and extended to cover all potential sites for wintering Greylag Geese in the area. Thorough monitoring will establish a series of data on which to base a better estimate of numbers and indicate trends in the population. Ringing of individual birds in both the Black Sea and Caspian populations would give valuable information about migratory movements and enhance our understanding of the biological delineation of these populations and their flyways. Studies of breeding success, recruitment and moulting sites are also important for proper management and conservation.

International conservation: A preliminary action plan for the conservation of wetlands in the Odessa region in the Ukraine was drafted in October 1993 during a workshop held by Wetlands International and identifies the establishment of inventories and monitoring of wetland resources in the Black Sea area as being a key priority.

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14 Greylag Goose *Anser anser*: Southwest Asia

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1. POPULATION REVIEW

1.1 Range

The Greylag Geese breeding in western Siberia south to the Caspian region winter mainly in the north and south Caspian, Iran and Iraq and belong to the subspecies *rubrirostris*. Knowledge about this population is sketchy and mostly dated. The small number of Greylags breeding in the extreme eastern part of Turkey and northwestern Iran vacate their breeding grounds in winter, presumably joining up with the large flocks of migrants arriving from the north.

1.2 Delineation of flyways

No birds have been ringed in this population and details of the Caspian flyway, including the extent of the breeding range of birds using this flyway, are not known. Kistchinski (1979) describes the migration route of Greylags breeding in the Volga delta as following a narrow passage southwards along the western shore of the Caspian Sea to wintering areas in Azerbaijan, Iran and Iraq. There is no suggestion of an overlap between the Caspian and Black Sea wintering areas but only ringing or satellite transmitter studies can clarify this. The eastern and southeastern borders of the flyway, distinguishing Greylags migrating south and west to the Caspian region from the two Eastern Palearctic populations migrating to winter in the Indus valley/northern India and eastern Asia, are not known (Fig. 8.1 in Mitchell & Sigfusson this volume).

1.3 Population trends

Perennou et al. (1994) estimate this population at 100,000 birds, based on data from the period 1987-91. However, there are several indications that the population has been rapidly increasing since the early 1970s and may now be considerably larger than this. Late breeding season estimates give figures of 224,000 for the whole of the central part of the former USSR (Krivenko 1993), or about 230,000 for the Turgay Basin and North Caspian regions alone (Finlayson et al. 1993, Vinogradov & Auezov 1990), although both these estimates include some birds which probably winter in other flyways. Perennou et al. (1994) estimate the total wintering population in the Indian subcontinent at only 15,000 Greylags, thus, if Krivenko's figures are reliable, Perennou et al.'s estimate for the Caspian flyway is too low. Table 14.1 shows totals for countries and regions on the flyway.

1.4 Breeding success

No information.

1.5 Mortality

No information.

Table 14.1. Midwinter counts of Greylag Geese on the Caspian flyway.

Afghanistan	3000-4000
Iraq	3000-5000
Iran	80,000-100,000
Syria	1000-3000
Kazakhstan	8000-10,000
North Caspian	0-36,000
Azerbaijan	8000-15,000
Turkmenistan	2000-8000
Uzbekistan	1000-2000

2. BREEDING GROUNDS AND BREEDING ECOLOGY

2.1 Distribution

Range: Greylag Geese breed in a broad belt extending from the Caspian Sea region and Ural Mountains east across the Russian Federation (Fig. 8.1 in Mitchell & Sigfusson this volume). The range was probably continuous until the early 20th century but has since been broken into numerous small areas due to hunting and habitat destruction (Isakov 1972). According to Finlayson et al. (1993), Greylag numbers in the Volga Delta nesting area during the 1970s and 1980s were estimated at 12,000-16,000 pairs. After the breeding season, the number of young birds reached 80,000. In the second half of the 1980s, increased water depths in the fore-delta degraded the breeding habitat and the Greylag population began to decline. In the late 1980s, the breeding population in the lower delta did not exceed 10,000 pairs. According to Krivenko (1996), during the last ten years the number of breeding pairs of Greylags has decreased from 13,000 to 9000 as a result of the recent rise in sea level. However, the number of Greylags breeding in the Western Ilmen Area, a vast region of freshwater, brackish and saline lakes to the west of the Volga Delta, has been increasing in recent years, mainly because of the high water levels in the region (Krivenko 1996). Over 1000 pairs of Greylags now breed in this area (Krivenko 1996). According to Krivenko (1993), numbers on the breeding grounds in the central region of the former USSR are increasing (based on information from 1972-1989); he estimates that there are 224,000 Greylag Geese in the forest-steppe, steppe and deserts of Kazakhstan and the Caspian Sea area at the end of the breeding and moulting seasons. Most of these birds presumably belong to the Caspian population, although some may migrate south-east to winter in the Indus valley and northern India.

Small numbers of Greylag Geese are reported to breed at wetlands in extreme eastern Turkey (Hue & Etchecopar 1970, Cramp & Simmons 1977). Known breeding sites include the delta marshes of the Bendimahi River where it enters Lake Van, Caldiran Marshes near Lake Van, and the valley of the upper Murat Vadigi near Yoncali (Grimmett & Jones 1989). These birds are widely separated from the main Turkish Greylag breeding areas in western Anatolia, and are more likely to belong to the Southwest Asian population than to the Black Sea population. There is no recent information on numbers, but the total breeding population of Greylags in Turkey has recently been estimated at only 200-1000 pairs (Hagemeijer & Blair 1997), so the population in eastern Turkey, if it still survives, is likely to be very small.

Only about five to ten pairs of Greylag Geese breed in Iran, confined to marshes around Lake Uromiyeh in Azerbayjan Province and Lake Zaribar in Kurdistan Province. At Lake Uromiyeh, which is extremely saline and devoid of vegetation other than *Enteromorpha*, the geese breed in *Phragmites* reedbeds at the mouths of rivers entering the lake. Only one survey has been made of Lake Zaribar, an isolated freshwater lake in the mountains with extensive *Juncus* and *Phragmites* marshes, so it is not known if breeding is regular at the site. Two pairs were found in the 1974 survey. There has been no evidence of breeding at wetlands in the Iranian portion of the Seistan Basin, although Greylag Geese apparently bred in the vast reedbeds around Hamoun-i Puzak on the Afghanistan side of the border at the turn of the century (Savage 1968a). In recent decades, the wetlands of the Seistan Basin have dried out almost completely on several occasions and no Greylags were observed during an extensive breeding season survey of the Iranian portion of the wetlands in 1973.

Greylag Geese are known to have bred in Iraq in the earlier part of this century (Ticehurst et al. 1921-22, Hale 1932). Small numbers of Greylags formerly bred in the marshes and swamps of lower Mesopotamia: Hale (1932) found nests and Thesiger (1954) noted that a few still bred in the vast expanses of *Typha* in the East and Central Marshes and that the Ma'dan often searched for the nests and took the eggs to hatch out under chickens. Thesiger (1964) noted that "occasional Greylag remained to breed" in the Feraigat Marshes (31°30'N 47°10'E), in the northernmost section of the Central Marshes. There have been no breeding records since then.

2.2 Moult migration and moulting areas

The Volga Delta is a major moulting area for Greylags in the Southwest Asian population, with up to 25,000 birds assembling to moult (Krivonosov 1970). In late August and early September, many birds which have completed their moult move a short distance to the west, to the Western Ilmen Area, where up to 9000 Greylags have been recorded in early autumn (Krivenko 1996). Greylags are also reported to moult in their thousands in the Turgay Basin in Kazakhstan (Krinitski et al. 1982). Vinogradov and Auezov (1990) observed very large numbers of Greylags in the Turgay Basin in August in the late 1980s, during a period of increased humidity when the lakes had reached their highest levels for 40-50 years. Thirty-one thousand Greylags were recorded in 1986, 44,400 in 1987 and 153,000 in 1988.

2.3 Research

No known projects.

2.4 Protection and conservation

The major breeding areas in the Volga Delta in the Russian Federation are protected in a number of reserves. The Astrakhan Biosphere Nature Reserve comprises three separate sites which together provide strict protection to a total of 66,816 ha. Two of these sites have buffer zones totalling 47,600 ha. Protected areas of other types include the Krestovy Nature Reserve, temporary wildlife refuges and nature monuments (Krivenko 1996). The entire delta (650,000 ha) was designated as a Ramsar site in December 1975. A small part (7300 ha) of the neighbouring Western Ilmen Area, which supports over 1000 breeding pairs of Greylags, was designated as a temporary reserve (Zakaznik) in 1995 (Krivenko 1996). The important breeding and moulting areas in the Turgay Basin in Kazakhstan are protected in the Turgay State Reserve (348,000 ha), which was designated as a Ramsar site in October 1976. There is a ban on hunting throughout this reserve (Krinitski et al. 1982). None of the known breeding areas in eastern Turkey is protected. The small breeding population at Lake Uromiyeh in Iran is protected within the Uromiyeh National Park (463,000 ha), first established as a Protected Region in 1967 and given National Park status in the early 1970s.

3. STAGING AND WINTERING AREAS

3A. AFGHANISTAN

3A.1 Distribution and abundance

Greylags have been recorded in winter at two sites in Afghanistan, Ab-i Istada (32 30' N 67°55' E) and Hamoun-i Puzak (31°30' N 61°42' E). Ab-i Istada is probably of primary importance for Greylags as a staging area in spring and autumn. Up to 1457 Greylags have been recorded in mild winters (Evans 1994), but in most winters, most of the lake freezes over. Nothing is known of the origin or destination of Greylags passing through Ab-i Istada, but it seems likely that they belong to the Central/South Asian flyway, as other waterfowl passing through this region of Afghanistan are known to winter in the Indian subcontinent (e.g. Siberian Crane *Grus leucogeranus*). The extensive wetlands of the Hamoun-i Puzak in southwestern Afghanistan remain poorly known. These are the most permanent of the vast wetlands of the Seistan Basin, and probably support the bulk of the Seistan wintering population of Greylags in dry years. A ground survey of the Hamoun-i Puzak in February 1971 found 1457 Greylags, but only a small part of the 35,000 ha of wetlands was covered. A total of 3150 Greylags was recorded during a comprehensive aerial survey of the Hamoun-i Puzak in January 1976. This was a relatively dry year with low water levels, especially at the wetlands in the Iranian portion of the Seistan Basin, where there were only 284 Greylags. Up to 2570 Greylags were recorded on the Iranian side of the border in wet years in the 1970s, and almost 4000 were recorded at the Hamoun-i Sabari (31°20' N 61°20' E) and Hamoun-i Hirmand (31°10' N 61°10' E) in January 1993.

3A.2 Research

No special research has been carried out on Greylags in Afghanistan. Mid winter censuses of geese were carried out at Hamoun-i Puzak in Afghanistan in February 1971 and January 1976.

3A.3 Protection and conservation

Hunting legislation: Some information on hunting legislation relevant to waterfowl has been given for Afghanistan in Scott (1995). In Afghanistan, the Government introduced legislation to curb unregulated hunting in the 1970s. However, conservation activities were brought to an abrupt halt in 1979 due to political unrest, and since then little if any protection has been afforded to the passage and wintering Greylags in Afghanistan.

Site safeguard: Hamoun-i Puzak remains unprotected, although it was proposed for National Park status in the 1970s. This wetland is under threat from flood control projects and irrigation schemes on the Hirmand River, both in Afghanistan and in Iran. Ab-i Istada, which has held almost 1500 Greylags in mild winters, was declared a National Flamingo and Waterfowl Sanctuary (27,000 ha) in 1974, and was also proposed for National Park status in the late 1970s.

3B. AZERBAIJAN

3B.1 Distribution and abundance

In most years, 8000-15,000 Greylag Geese winter in Azerbaijan, the largest numbers occurring in wet years. Tkachenko & Litvinova (1990) give the following totals for the principal sites: Lake Adzhi-Kabul (39°58' N 49°00' E) up to 700; Kirov Bays (39°05' N 48°57' E) 7000-15,000 in wet years; Lake Akh-Chala, Lake Plavni and the Novogolovskie Marshes (39°30' N 48°40' E) up to 1800; and Lake Aggel (40°05' N 47°40' E) 300-700. Scott & Rose (1996) list four key wintering sites for the species: Kirov Bays, 6040 in 1991, but 38,000 in 1982; Lake Akh-Chala, Lake Plavni and the Novogolovskie Marshes, maximum 1800, the Mahmud-Chala area (39°30' N 48°40' E) 1600 in 1986 and Lake Sarysu (40°02' N 48°07' E) no census data available. Up to 400 Greylags occur in the Kura Delta (30°20' N 49°25' E) during the migration seasons (Tkachenko & Litvinova 1990).

3B.2 Research

Waterfowl censuses are undertaken annually in Azerbaijan, but the results have seldom been communicated to Wetlands International.

3B.3 Protection and conservation

Site safeguard: The Kirov Bays (132,000 ha) were designated as a Ramsar site in October 1976. Within the boundaries of the Ramsar site, the Kyzyl-Agach State Reserve (88,400 ha) gives strict protection to Kyzyl-Agach Bay, while the Maly Kyzyl-Agach zakaznik (10,700 ha) provides a year-round ban on hunting in part of the neighbouring Maly Kyzyl-Agach Bay (Krinitski et al. 1982). The Mahmud-Chala area is also partially protected, as is Lake Sarysu.

3C. IRAN

3C.1 Distribution

Range: Scott & Rose (1996) list 35 key sites for Greylag Geese in Iran, i.e. sites which are known to have held at least 1% of the population (over 1000 birds) at any time since 1970. However, two of these sites, Caspian Coast Bandar Turkman-Gomishan-USSR Border and Gomishan Marsh, are almost certainly the same site under different names. Eleven of the key sites have held over 5000 Greylags in winter: Lake Uromiyeh (37°50' N 45°30' E) maximum 5672, Dasht-e Shoeybi (36°00' N 46°00' E) maximum 10,076, and Goorous Marsh (37°02' N 45°46' E) maximum 11,450 in Azerbayjan Province; Miankaleh Wildlife Refuge (36°50' N 53°45' E) maximum 10,020, and Fereidoonkenar Marshes (36°35' N 52°31' E) maximum 15,060 in the southeast Caspian lowlands; Lakes Bakhtegan and Tashk (29°40' N 53°30' E) maximum 8245, Dasht-i Arjan and Lake Parishan (30°34' N 51°53' E) maximum 5760, and Zarghan Marshes maximum 7500 in Fars Province; the Karun River marshes (31°45' N 48°54' E) maximum 10,050, and Hamidieh Plains (31°20' N 48°20' E) maximum 10,050 in Khuzestan Province; and the Helleh Delta (29°10' N 50°50' E) maximum 10,056 on the Gulf coast.

Habitat and feeding ecology: As early as the late 1960s, Greylag Geese were reported feeding on winter cereals in Iran, and this habit has increased markedly in recent years. Much of the increased utilisation of arable land by Greylags may be linked to the conversion of large areas of steppe and semi-desert around the main wetlands to irrigated agriculture. This great expansion in the amount of potential feeding habitat without significant reduction in the size of the main waterbodies (used for roosting and loafing) has undoubtedly led to an improvement in conditions for wintering Greylags in many parts of Iran, especially where the main wetlands are in protected areas. Thus, for example, at Lake Parishan in Fars Province, the development of agriculture immediately to the south of the lake and adjacent to the protected area has greatly increased the extent of feeding habitat for Greylags, and numbers have increased from an average of only 130 (maximum 215) in the mid 1970s to an average of 2490 (maximum 5760) in the late 1980s/early 1990s. Similar increases in numbers of wintering Greylags have been recorded in Khuzestan Province in southwest Iran, where large areas of formerly unsuitable semi-desertic plains in the vicinity of protected wetlands have been converted to arable land.

In the south Caspian region, major changes have occurred to Greylag wintering habitat as a result of a two metre rise in the level of the Caspian Sea between the late 1970s and early 1990s. Important natural feeding habitat at the west end of Gorgan Bay in the Miankaleh Wildlife Refuge became deeply flooded by the rising sea level, and the large flocks of Greylags (5000-10,000) and Lesser White-fronted Geese *Anser erythropus* (up to 4900) which wintered in the reserve during the 1970s disappeared. However, during the early 1980s, large areas of former low-lying *Salicornia* flats and grassy steppe to the east of the Caspian Sea about 50 km northeast of Gorgan Bay were inundated by the rising sea level, creating about 20,000 ha of shallow brackish lagoons and seasonally flooded marshes. In recent years, this new wetland has supported an average of 2000 Greylags (maximum 3000), as compared with only a few hundreds in the 1970s.

3C.2 Abundance

Phenology: Data from the 1970s show that the first Greylags arrive in the south Caspian region in the third week of October, with an influx in the last week of October/early November. Peak numbers at Miankaleh Peninsula/Gorgan Bay in Iran occur in late November/early December (9000 Greylags on 3 December 1972 but only 1118 on 29 January 1973), suggesting a substantial through passage, possibly to Fars in south-central Iran and/or to the Seistan Basin in southeastern Iran. Little information is available on the arrival and departure of Greylags at wetlands further south in Iran. Counts at wetlands near Shushtar in Khuzestan on 11 November 1973 recorded 1500 Greylags and in Fars on 17-20 November 1973, 285 Greylags were recorded, so it appears that arrival dates may not differ markedly from those further north.

The main departure from the south Caspian region occurs at the end of February or in the first week of March, with a few birds lingering until the end of March.

Trends and numbers: The total number of Greylags wintering in Iran in the 1970s was estimated at 15,000-32,000. Mid winter counts have been carried out from 1966/67 to 1974/75 inclusive, in 1977/78, and again from 1987/88 to 1993/94 (Table 14.2). The apparent rapid increase in numbers from the 1966/67 count to the 1971/72 count is a reflection of the great improvement in coverage during the period. Coverage was relatively complete in the years 1971/72 to 1974/75, including extensive aerial surveys of wetlands in central and southern Iran. The number of Greylags counted has been much higher in recent years, especially in western, central and southwestern Iran. Counts from 1988-94 are those submitted by the Department of the Environment and include some counts carried out by untrained game guards in the Department's reserves; considerable over-estimation of numbers may have occurred in some areas. However, there can be little doubt that there has been a big increase in the numbers of Greylag Geese wintering in Iran since the late 1970s. Possible reasons for this increase include a reported increase in

Table 14.2. Midwinter counts in Iran, Turkmenistan and Uzbekistan (as given by Perennou et al. 1994 or subsequently reported to the International Waterfowl Census).

	Iran	Turkmenistan	Uzbekistan
1966/67	916	-	-
1967/68	1125	175	-
1968/69	8578	-	-
1969/70	4784	154	-
1970/71	8685	-	-
1971/72	15,079	826	-
1972/73	12,630	1086	-
1973/74	21,235	386	-
1974/75	12,602	430	-
1975/76	-	720	-
1976/77	-	64	-
1977/78	10,965	241	-
1978/79	-	3988	-
1979/80	-	2550	-
1980/81	-	270	-
1981/82	-	3142	-
1982/83	-	2067	-
1983/84	-	540	-
1984/85	-	1999	-
1985/86	-	7745	306
1986/87	-	1866	1425
1987/88	28,795	1084	382
1988/89	34,659	4407	-
1989/90	51,807	182	-
1990/91	48,355	4244	30
1991/92	40,365	-	-
1992/93	85,074	8276*	
1993/94	100,204	12,265*	

* counts for Turkmenistan and Uzbekistan combined.

numbers on the breeding grounds in the central part of the former USSR (Krivenko 1993), and a shift in wintering grounds with birds favouring the relatively well-protected wetlands in Iran and no longer travelling on to Mesopotamia in Iraq, where there has been massive degradation of wetlands in recent years. The much larger numbers of birds wintering in northwestern Iran (Azerbayjan Province) and southwestern Iran (Khuzestan lowlands) may include many birds which formerly continued on to winter in the lowlands of Iraq. Recent large numbers of Greylags in Azerbayjan may also be linked to a series of mild winters in the late 1980s and early 1990s, contrasting with the severe winters there during the 1970s when temperatures dropped to -25°C and most waterbodies were frozen solid.

3C.3 Research

No special research has been carried out on Greylags in Iran. Mid winter censuses of waterfowl, including geese, have been carried out in Iran in most years since 1966/67 (Table 14.2).

3C.4 Protection and conservation

Hunting legislation: Some information on hunting legislation relevant to waterfowl has been given for Iran in Scott (1995). The Game and Fish Law and Regulations were enacted in 1967 and amended in March 1975. The Regulations prohibit all hunting of geese and other waterfowl between 21 March and 22 September, and from one hour after sunset to one hour before sunrise. Hunters may at no time during a hunting trip shoot or be in possession of the carcasses of more than five geese. The Regulations also prohibit the destruction or removal of eggs, the use of automatic or semi-automatic weapons, the use of poisons, narcotics or explosives, the use of aerial nets, and the use of motorised vehicles, including motor boats, for the pursuit of waterfowl and other game species. Waterfowl hunting occurs commonly at unprotected wetlands throughout Iran, but in general, enforcement of the hunting regulations is good, and hunting pressure on geese does not appear to be excessive. Commercial waterfowl hunting occurs on a large scale at wetlands in the south Caspian lowlands and locally elsewhere in Iran, but the preferred techniques (clap-netting, 'net, gong and flare' and decoy netting) catch mainly ducks and coots, and relatively few geese are harvested by the market hunters.

Site safeguard: In Iran, 12 of the 34 key sites listed by Scott & Rose (1996) are partly or wholly protected within national parks, wildlife refuges or protected areas, and seven of these 12 sites have also been designated as Ramsar sites. A further four key sites have been designated as Ramsar sites, but otherwise receive no legal protection. A further two sites (Gomishan Marshes and Ghara Gheshlaq Marshes) have recently been designated as No-Hunting Areas with a view to future upgrading to Protected Areas. Both of these have been proposed as Ramsar sites. The most important protected wetlands for Greylags are as follows: Miankaleh Wildlife Refuge (68,800 ha); Uromiyeh National Park (463,600 ha); Bakhtegan Wildlife Refuge (327,820 ha); Arjan Protected Area (52,800); Hamoun Protected Area (193,500 ha); Shadegan Wildlife Refuge (296,000 ha); and Helleh Protected Area (42,600 ha) (Scott & Rose 1996). All of these sites except Helleh Protected Area have been designated as Ramsar sites. Outside the protected areas network, there have been relatively few major losses of wetland habitat compared to the situation elsewhere in the region, and in most regions in Iran, the wetlands remain in good condition. Large tracts of natural wetland habitat have been lost to agriculture in the wetlands of Khuzestan in the southwest and around some of the wetlands in central Fars Provice, but the continuing expansion of irrigated agriculture in the semi-desert regions around these and other wetlands has probably resulted in an overall improvement in conditions for wintering Greylags.

Agricultural conflict: Large numbers of Greylag Geese feed on agricultural land during the winter months in Iran, especially in the southeast Caspian region, Khuzestan and central Fars. Some concern was expressed by local farmers in areas adjacent to the Miankaleh Wildlife Refuge in the southeast Caspian region in the mid 1970s, but no action was taken to control the numbers of geese on agricultural land at the time, and the numbers of Greylags and other geese wintering in this area have decreased markedly since then.

More recently, there has been a substantial increase in the numbers of geese feeding on winter cereals in central Fars, especially near Lake Parishan in Arjan Protected Area, and this has led to some complaints from local farmers.

3D. IRAQ

3D.1 Distribution and abundance

The Greylag was formerly a common winter visitor to Iraq. Ticehurst et al. (1921-22) describe the species as "extraordinarily abundant in the great marshes and swamps of lower Mesopotamia". Large flocks were still present in the 1970s but the total number of wintering birds was probably only a few thousand. Winter counts in Mesopotamia in the 1960s and 1970s recorded the following numbers of Greylags: 1712 (December 1967-January 1968); 991 (December 1972); 18 (January/February 1975); and 1553 (January/February 1979). The nine most important sites for Greylags located during these surveys were: Samarra Lake (34 15' N 43°50' E) maximum 105; Baquba wetlands (33°55' N 44°50' E) maximum 50; Attariya plains (33°25' N 44°55' E) maximum 50; Lake Al Habbaniya and Ramadi Marshes (33°16' N 43°30' E) maximum 300; Al Musayyib Wetlands (32°50' N 44°18' E) maximum 230; Haur Al Shuwaija (32°42' N 45°55' E) maximum 460; Haur Al Sa'adiyah (32°13' N 46°33' E) maximum 1030; Haur Chubaisah complex (31°53' N 47°18' E) maximum 280 and Haur Al Hammar (30°45' N 47°05' E) maximum 785 (Scott 1995). According to Savage (1968b), Haur Al Hawizeh (31° 22' N 47° 37' E) provides wintering habitat for large numbers of Greylag Geese. No counts are available from the Iraqi portion of this wetland but a maximum of 1995 Greylags has been recorded in recent years in the Susangerd marshes (31°45' N 47°55' E) on the Iranian side of the border.

3D.2 Research

No special research has been carried out on Greylags in Iraq. Mid winter censuses of geese were carried out at some wetlands in Iraq in the winters of 1967/68, 1972/73, 1974/75 and 1978/79.

3D.3 Protection and conservation

Hunting legislation: Some information on hunting legislation relevant to waterfowl has been given for Iraq in Scott (1995). In the 1970s, the Government of Iraq introduced laws banning all hunting in Iraq in order to conserve wildlife, particularly terrestrial game which had been heavily persecuted in the past. However, these laws and later hunting restrictions have never been implemented or enforced. Waterfowl hunting remained widespread in the marshes in 1979 (Carp & Scott 1979), and in recent years sport hunting has been organised by the Government through a hunting club. Hunting pressure has increased markedly since 1991 because of the UN trade embargo and the unusually high prices of meat that have resulted. A study of waterfowl hunting in central and lower Iraq in the 1992/93 and 1993/94 seasons found a total of 13 species of Anatidae on sale at 11 main markets, and estimated that about 30,000 ducks and geese were being sold each season in the Basrah market alone (K. Al-Robaae, in Scott 1995).

Site safeguard: The Government of Iraq gives low priority to nature conservation. No special measures have been taken by the Government to conserve wetlands, and no legal protection has been given to any part of the wetlands. Many wetlands are under serious threat from drainage and the diversion of water supplies for agricultural purposes. Dam-building on the Euphrates in Turkey and Syria and the increasing utilisation of the waters of the Tigris and Euphrates for irrigation in upper and middle Iraq, have greatly reduced the extent of seasonal flooding in the wetlands of lower Iraq, and facilitated drainage of large areas for cultivation and the exploitation of oil resources. Within the last few years, major hydrological engineering activities in and around the wetlands of Lower Mesopotamia have resulted in the drying out of vast areas of wetland in the Central Marshes and Haur Al Hammar, and could eventually lead to the disappearance of these systems.

3E. KAZAKHSTAN

Kazakhstan participated in the International Waterfowl Census in 1990/91 and 1991/92, and conducted counts at four sites. Significant numbers of Greylag Geese were reported at only one site, Chardara Reservoir (41°10' N 68°15' E), where there were 2500 in January 1991 and 8000 in January 1992. There is also a count of 6000 Greylags at Chardara Reservoir in 1970 (Scott & Rose 1996). This is the only site in Kazakhstan listed by Perennou et al. (1994) and Scott & Rose (1996) as being of international importance for Greylags in winter. However, Vinogradov & Auezov (1990) found very large numbers of Greylags in the Turgay Basin during aerial surveys in August in the late 1980s. They report counts of 31,000 Greylags in 1985, 44,400 in 1987 and 153,100 in 1988. In October 1996, it was estimated that 78,000 Greylags occurred in the Kustanay area in the Turgay Basin (Tolvanen & Pynnönen 1998).

No information is available about the protection status of key wintering sites for Greylags in Kazakhstan.

3F. RUSSIAN FEDERATION

The number of Greylag Geese remaining throughout the winter in the north Caspian region varies widely according to the severity of the winter. According to Krivonosov & Rusanov (1990), 36,200 individuals were present in the mild winter of 1980/81, whereas none was recorded in the severe winter of 1984/85. The principal wintering area in the north Caspian is Kizlyar Bay (44°30' N 47°00' E), where there were 31,400 Greylags during the mild winter of 1980/81.

The wintering areas in the Volga Delta are protected (see section 2.4 above), but the major staging and wintering areas at Kizlyar Bay are unprotected.

The Greylag is one of the first migrants to arrive in the Volga Delta and Western Ilmen Area in spring, with the first flocks arriving in early March. Most of these early arrivals are thought to be birds breeding locally (Krivenko 1996).

Waterfowl censuses are undertaken annually in the Russian Federation, but the results have seldom been communicated to Wetlands International.

3G. TURKMENISTAN AND UZBEKISTAN

Perennou et al. (1994) reported mid winter totals of Greylag Geese in Turkmenistan from 1968 to 1989, and in Uzbekistan from 1986 to 1988. Totals for 1990 (Turkmenistan only) and 1991 (both countries) are given in the reports of the Asian Waterfowl Census (Perennou et al. 1990, Perennou & Mundkur 1991). Recent combined totals for Turkmenistan and Uzbekistan are 8276 Greylags in 1992/93 (Rose & Taylor 1993) and 12,265 in 1993/94 (Rose 1995) (see Table 14.2). The apparent large increase in numbers wintering in Turkmenistan from an average of 454 (maximum 1086) in nine censuses between 1968 and 1978 to an average of 2730 (maximum 7745) during the ten-year period 1982-1991 echoes the situation in Iran, and the very high counts in 1993 and 1994 suggest that this increase is continuing. Scott & Rose (1996) identify seven key sites for wintering Greylags in Turkmenistan. Three of these are sections of the Amudarya Valley: the stretch from Chardzhou to Karabekaul (38°55' N 63°52' E) maximum 1350 in 1994; the stretch from Karabekaul to Kerky (38°15' N 64°37' E) maximum 3760 in 1994; and the stretch from Kerky to Mukry (37°40' N 65°30' E) maximum 1254 in 1986. The other sites are: the Kelifskiye Lakes (37°50' N 64°20' E) maximum 3785 in 1986; Lake Sultandag (38°45' N 64°18' E) maximum 1635 in 1993; the lower Atrek floodplain (37°28' N 54°30' E) maximum 3799 in 1979; and Zeidovskoye Reservoir (37°40' N 65°00' E) maximum 1200 in 1994. Only one key site has been identified in Uzbekistan, namely, Zamanbobo Lake (40°00' N 64°00' E), which held 1246 Greylags in 1987.

No information is available about the protection status of key wintering sites for Greylags in Turkmenistan and Uzbekistan.

Mid winter censuses of waterfowl, including geese, have been carried out in Turkmenistan in most years since 1967/68, and Uzbekistan in most years since 1985/86.

3H. OTHER COUNTRIES

In the United Arab Emirates (UAE), the Greylag was formerly a rare winter visitor (Jennings 1981), but in recent years it has become more frequent, perhaps because suitable habitat has become more widely available in the Gulf (Richardson 1990). Eighteen Greylags were recorded in the UAE during the mid winter waterfowl census in 1993/94 (Rose 1995). In Oman, the Greylag is a vagrant or scarce and irregular winter visitor (Gallagher & Woodcock 1980); recent records have included four birds in the winter of 1988/89 (Scott & Rose 1989), a single bird in the winter of 1990/91 (Perennou & Mundkur 1991), and five birds in the winter of 1993/94 (Rose 1995). In Saudi Arabia, the Greylag is a rare winter visitor (Jennings 1981); twelve were recorded in the northwestern part of the country during the 1993/94 mid winter waterfowl counts (Rose 1995). The Greylag is also listed as a rare winter visitor to Bahrain and Kuwait (Jennings 1981), but there have been no records from either of these countries in recent mid winter waterfowl counts. There do not appear to be any records of Greylags in Qatar or Yemen.

4. DISCUSSION

Population status: This population is thought to be increasing but the cause of this increase is completely unknown. Mid winter counts suggest a population in the range of 106,000-183,000. However, there is clearly much variation between years in response to the severity and wetness of winters. Moreover, the reliability of the very high counts from Iran in recent years is questionable. More detailed and reliable data are needed before a useful, new estimate can be made.

Conservation issues: Not enough is known about this population to identify the issues.

Agricultural conflict: No studies have been carried out on the feeding ecology of the Greylag Geese wintering in southwest Asia. At their main wintering grounds in Iran, Iraq and Afghanistan, Greylags favour shallow freshwater to brackish lakes and lagoons with extensive emergent stands of *Phragmites* and *Typha*. The geese often forage in small groups or family parties, upending in shallow water and presumably feeding on submerged aquatic vegetation. Larger flocks occasionally move short distances to forage in seasonally flooded grassy marshes or *Salicornia* marshes on the landward side of the reedbeds. Such natural habitats remain widespread throughout the region, and continue to support large numbers of geese, particularly in the Seistan Basin on the Afghanistan/Iran border, in parts of Fars and Khuzestan Provinces in southern Iran, and in lower Mesopotamia in Iraq. Therefore, on the whole, there is very little agricultural conflict in these areas.

There have been some complaints of goose damage to crops in the south Caspian region and Fars Province in Iran, but no special action has been taken, and the problem does not as yet appear to be serious. No information is available on possible agricultural conflicts elsewhere in the flyway.

Future research needs: There is obviously a great deal to be learned about this population and basic monitoring needs to be continued and extended to cover all important potential wintering sites. Monitoring must be conducted by qualified counters and training of these may be necessary in some countries. Only a series of reliable data can be used in estimating population size and trends. Ringing and/or satellite transmitter studies are needed to establish the limits of the flyway in relation to neighbouring Greylag Goose flyways. Data on mortality and recruitment are necessary to understand trends and identify management needs. Bag statistics, problems such as illegal hunting, agricultural conflict and loss of wetlands are also important areas which should be documented.

International conservation: Many of the most important breeding, staging and wintering sites for the Southwest Asian population of Greylag Geese are wholly or partially protected (see above). The two most important breeding and moulting areas (Volga Delta and Turgay Basin) have been designated as Ramsar sites, as have eleven of the 34 key wintering sites in Iran and the single most important wintering area in Azerbaijan (Kirov Bays). Most of the countries in the flyway now participate in the International Waterfowl Census, and provide goose counts to the Goose Specialist Group. However, to date there have been no international research or conservation projects specifically related to Greylag Geese within the region. The prolonged periods of political unrest in Afghanistan and Iraq continue to hamper national and international efforts to study and conserve geese in these countries, and would inevitably limit the effectiveness of any 'flyway-wide initiative'.

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15 Canada Goose
Branta canadensis
Introduced: United Kingdom

Author:
J.S. Kirby

Photo:
A. Bylin

1. POPULATION REVIEW

1.1 Range

The Canada Goose is native to North America where 8-12 races are recognised (Delacour 1959, Palmer 1976, Madge & Burn 1988). They were first introduced to the United Kingdom (UK) as an ornamental addition to the waterfowl collection of King Charles II in St. James's Park, London in 1665. Introductions to other waterfowl collections followed and birds were introduced in Sweden, Norway and Finland in the 1930s. The morphology and coloration of the UK population suggests that the original introductions were from the larger south-eastern races: the nominate (*B.c.canadensis*) and the Giant Canada Goose (*B.c.maxima*; included in *B.c.moffitti* by some e.g. Palmer 1976). Rapid temporal and spatial population growth resulted from the creation of much suitable habitat in the form of reservoirs and gravel-extraction pits (Owen et al. 1986), and subsequent translocations by Man to relieve local agricultural problems and provide shooting opportunities for wildfowling clubs (Kirby et al. 1996). Canada Geese are now abundant across much of the UK.

1.2 Delineation of flyways

Few Canada Geese ringed in Britain and Ireland have been recorded overseas (Kirby et al. 1996). Of 8815 recoveries, seven birds have been recorded on the coast of northwestern France and none elsewhere, four in the severe winter of 1962/63. Ringing recoveries and sightings of neck-banded geese show that vagrants from North America and Scandinavia occur in the UK from time to time. However the true scale of such movement is unknown and masked by the presence of the large introduced population. Overall, the UK population is believed to be relatively self-contained.

1.3 Population trends

Total population size has been regularly assessed during the late summer moult; censuses between 1953 and 1991 have shown an increase from 2200-4000 to 64,000 (Blurton-Jones 1956, Ogilvie 1969, 1977, Delany 1992, 1993). Population trends are available from monthly counts at UK wetlands collated via the Wet-

land Bird Survey (WeBS; organised by the British Trust for Ornithology (BTO), the Wildfowl & Wetlands Trust (WWT), the Royal Society for the Protection of Birds (RSPB) and the Joint Nature Conservation Committee (JNCC), e.g. Cranswick et al. (1995). These data show a population increase at an average rate of 9.8% per annum during 1960/61 to 1984/85, but population growth has subsequently slowed to a level of c. 2.4% per year since then (Kirby et al. 1996). Increases on different habitats have occurred at average rates of 7-18% per annum, but there is evidence of population stabilisation on all habitat types (Kirby et al. 1996). Regionally, growth rates varied from 7-8% to 17-19% per annum, but numbers in five of 13 regions examined are stabilising, these regions supporting c. 44% of the population counted by WeBS (Kirby et al. 1996). Thus, the UK population, as portrayed by the WeBS counts, is perhaps beginning to stabilise (Fig. 15.1), but further work is required to ensure that WeBS is fully representative of the population as a whole.

1.4 Breeding success

Typical clutch size is 4-7 eggs (mean 5.9; Cramp & Simmons 1977, White-Robinson 1984, Owen et al. 1986, Wright & Giles 1988). Hatching success is highly variable, but usually 40-60% (Johnson & Sibley 1993, Baker et al. 1993), depending upon factors such as nest site location, weather, predation pressure and the experience and social status of the parent birds (Wright & Giles 1988, Warren 1994). Gosling survival to fledging is often high (Walker 1970), but varies between 45% (Warren 1994) and 77% (Johnson & Sibley 1993). Gosling survival may be enhanced by creching at some sites, the groups being tended by older, dominant adults which contribute their greater experience to the safety in numbers provided by the creche itself (Warren 1994).

1.5 Mortality

Shooting provides 67% of ringing recoveries (Thomas 1977). In a recent study, 72% of dead birds had been deliberately killed by Man: 93% were reported as shot with the remainder culled, with regional variations (Kirby et al. 1996). Although most mortality occurs during the hunting season, a smaller peak in reported deaths during April and May suggests mortality associated with breeding may also occur (Thomas 1977).

Annual adult mortality based on ringing recoveries was estimated at 10-20% (Thomas 1977) and was quoted as 22% by Cramp & Simmons (1977). Survival estimates from national and regional ringing-recovery data sets, and from a number of local mark-recapture studies, produced estimates ranging from 33-95% for juveniles and 25-95% for adults (Kirby et al. 1996). There were no consistent differences in survival between geographical regions or study locations, and survival rates appeared not to show marked temporal trends. This suggested that density-dependent regulation of survival was not occurring, but the survival estimates often showed poor precision, with the data sets containing much unexplained heterogeneity and suffering from bias. Improved data sets are required from which to generate more precise survival estimates.

2. BREEDING GROUNDS AND BREEDING ECOLOGY

2.1 Distribution

Range: On account of a marked sedentary behaviour, Canada Geese were initially slow to spread from the points of first introduction. However, by the early 1900s groups existed in many parts of the UK, most resulting from deliberate redistributions by

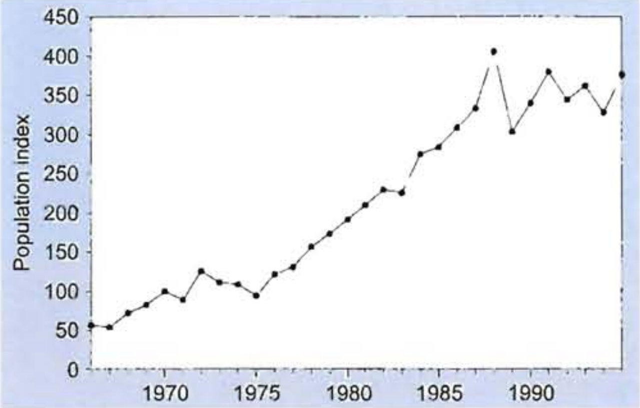

Fig. 15.1. National population index for the Canada Goose in Britain between 1966 and 1995. Based on counts made in September for the annual Wetland Bird Survey (WWT unpubl.).

Man (Atkinson-Willes 1963, Ogilvie 1969). Translocations in the 1960s involved at least 2000 birds, the geese spread far and wide throughout the UK (Kirby et al. 1996). The first comprehensive census of Canada Geese, carried out in 1953, found discrete sub-populations and there was thought to be little or no natural movement between them (Blurton-Jones 1956). By 1976, some of these sub-populations were still evident but the steady spread of birds had blurred the boundaries and some had disappeared altogether (Ogilvie 1977). By 1991, division into discrete sub-populations was no longer possible (Delany 1992, 1993). Breeding Canada Geese are now widespread in all English counties, although becoming more sparse, in terms of numbers and distribution, towards the north and in south-west England (Carter 1993). Wales, Scotland and Ireland are thinly populated, with large tracts of currently vacant and suitable breeding habitat perhaps waiting to be occupied. Most sites support few breeding pairs and, even in the autumn, concentrations are usually rather small: in the UK in 1991, 57% of the 1104 sites with Canada Geese held fewer than 25 birds (Delany 1992).

Habitat and feeding ecology: Prospecting for breeding sites begins in late February. A wide variety of habitats are utilised from park lakes, reservoirs and gravel pits to rural and suburban canal and river banks. Nesting is normally on the ground close to a body of water, with a clear preference for low flat islands far from the shore where there is protection from terrestrial predators (Giles & Wright 1986, Wright & Giles 1988, Warren 1994). Foods include underwater and emergent vegetation and pastures, with broods reared on the spring growth of grass in May and June (Owen et al. 1986).

2.2 Moult migration and moulting areas

For successful breeders, choice of moult site is limited to the distance that they can walk with their goslings, and so is usually confined to the breeding water. Birds which breed on one moorland site may walk their broods considerable distances to find a safe moulting site, whilst others remain on the moorland to moult (Garnett 1980). Moult migrations over greater distances are performed by some birds in the UK, reflecting the moult migrations of their North American ancestors (Salomonsen 1968, Zicus 1981, Davis et al. 1985). In the early 1960s, ringing of a moulting flock on the Beauly Firth in northern Scotland showed that these birds originated 450 km further south in Yorkshire (Dennis 1964, Walker 1970); it is now known that English Midlands birds also moult there (a movement of 600 km). This northward moult migration involves mainly immatures, non-breeders and failed breeders which depart in May and June (Walker 1970). Yorkshire birds which undertake the moult migration to Scotland have a c. 16% lower survival than those remaining (Thomas 1977).

2.3 Research

Aspects of Canada Goose breeding ecology have been the subject of several PhD studies in the UK (e.g. Lessells 1982, White-Robinson 1984, Johnson 1986, Warren 1994), and detailed studies of local populations (e.g. Hughes & Hughes 1981, Giles & Wright 1986, Wright & Giles 1988). Voluntary ringing groups have largely been responsible for the marking of more than 50,000 Canada Geese since 1959, with the ringing heavily concentrated during the moult period (June-July) and into relatively few areas. Nationwide surveys have been conducted during the moult period in 1953 (Blurton-Jones 1956), 1967-1969 (Ogilvie 1969), 1976 (Ogilvie 1977) and 1991 (Delany 1992, 1993), whilst the development of the breeding population throughout Greater London has been monitored by Baker (1985, 1992).

2.4 Protection and conservation

Hunting legislation: Breeding Canada Geese are protected by Section 1 of the Wildlife and Countryside Act 1981. However they may be killed or their nests or eggs destroyed under licences issued by the Department of the Environment, Transport and the Regions (DETR) or the Ministry of Agriculture, Fisheries and Food (MAFF), under Section 16 of the Wildlife and Countryside Act, in order to: conserve wild birds; protect any collection of wild birds; preserve public health or public or air safety; or prevent serious damage to livestock, foodstuffs for livestock, crops, vegetables, fruit, growing timber or fisheries. Control statistics for the 1991-1995 period show that less than 2000 adults and 4000-10,000 eggs were destroyed each year, mainly in certain parts of England (Kirby et al. 1996). Recent population modelling provided a good agreement between predicted and actual UK population behaviour when known levels of population control were included (Kirby et al. 1996). Thus control measures seem to have been important in slowing down the growth of the UK population. The extent of illegal, non-licensed destruction of Canada Geese is not known but is perhaps extensive.

Public awareness: The Canada Goose appears to be extremely popular with the general public, allowing close approach and being one of the few 'wild' species that the public may encounter. The value of the species in this respect has not been determined. In 1994, the DoE's Canada Goose Working Group issued a public information leaflet aimed at informing site managers of the legal ways of solving Canada Goose problems (DoE 1994).

3. WINTERING AREAS

3.1 Distribution

Range: The winter distribution of Canada Geese in the UK has changed in relation to the development of population (Fig. 15.2). However, the geographic limits to the population were established relatively early, and the population has developed by infilling within the existing range and thus increasing local densities (see Allan et al. 1995). Most birds winter close to their breeding areas, the overall winter distribution corresponding

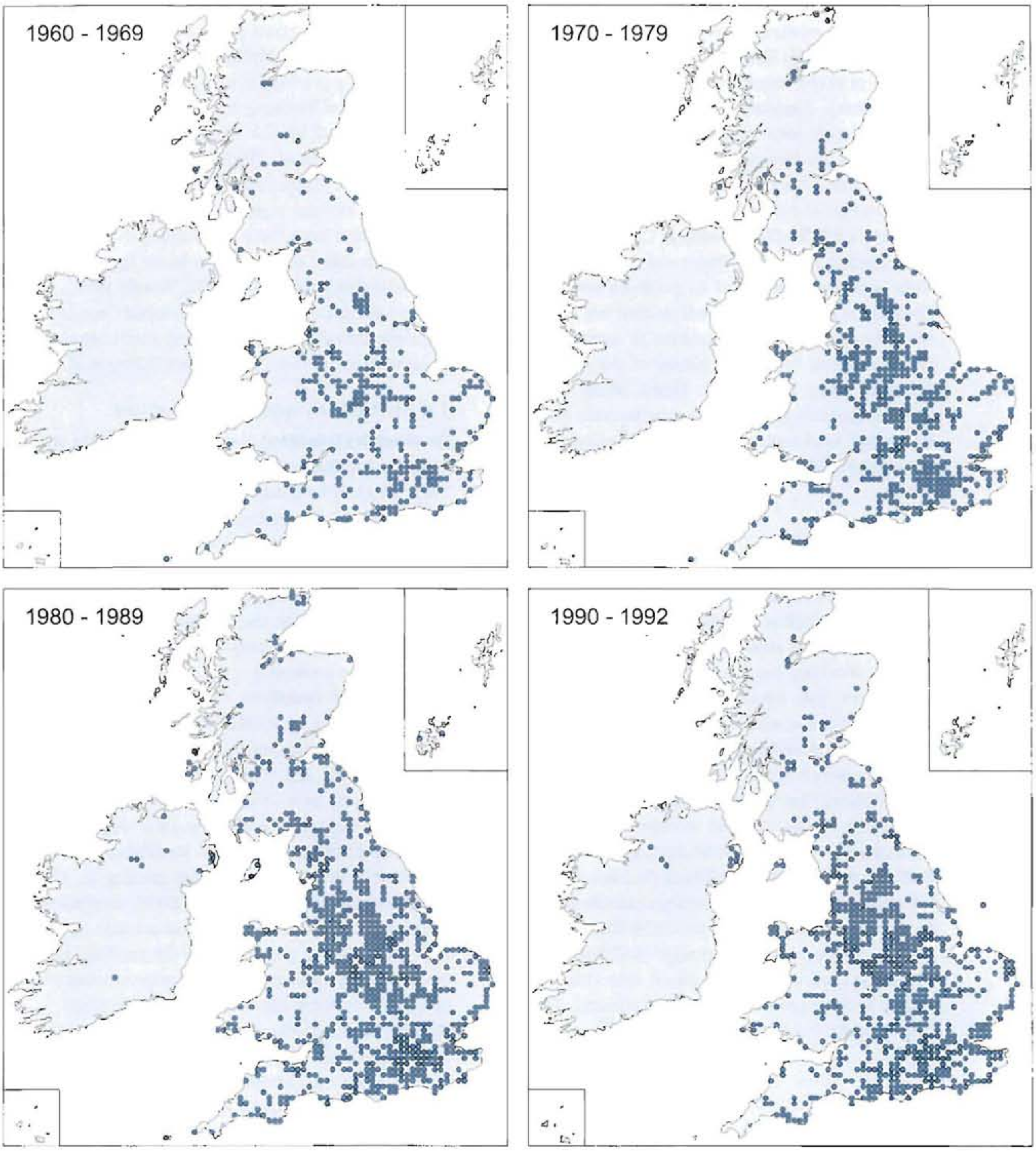

Fig. 15.2. Winter distribution of Canada Geese recorded during the annual Wetland Bird Survey, conducted September-March during 1960-1992. Filled circles represent 10-km squares containing sites where Canada Geese were recorded during each 10-year period. Reproduced with kind permission from Allan et al. (1995).

closely with that of the summer (Lack 1986, Owen et al. 1986). Some populations undertake short migrations, for example from upland to lowland areas (Garnet 1980, Watola 1993), and ringing recoveries provide evidence of some longer distance movements e.g. from northern Scotland and the English Midlands to London (Baker 1985). In adverse weather, some birds have been recorded in continental Europe (Cramp & Simmons 1977, Lack 1986, Kirby et al. 1996) and some move between regions within Britain (Watola 1993). Overall though the evidence is that Canada Geese do not normally range very far. Most reports of dead geese were from the region of ringing or adjacent regions (c. 92%) and the median recovery distance was only 11 km (Kirby et al. 1996). Geese ranged just 4-29 km on average except in the very severe winter of 1962/63 (median 432 km). Similarly, sightings of live birds also showed mainly local movements (Kirby et al. 1996). Most adults are thought to return to the same wintering areas year after year, but some, especially juveniles, may move greater distances (Cramp & Simmons 1977).

Habitat and feeding ecology: Canada Geese make short feeding flights in winter and in many cases the birds walk from the water to graze on nearby fields. Their foods have not been well studied but in most areas they concentrate on stubbles in autumn and on grass or cereals for the remainder of the year (White-Robinson 1984, Owen et al. 1986). Many flocks use public recreation areas where they become very tame and accept food from the hand, also feeding on aquatic vegetation and roots when available (Owen et al. 1986).

3.2 Abundance

Phenology: The maximum monthly WeBS count is almost always in September (e.g. Cranswick et al. 1995), with a steady decline through to March thereafter. The decline occurs on account of winter mortality, mainly through shooting, but may result from dispersal from moult sites onto smaller (unsurveyed) waters, and movements in late winter into breeding localities.

Trends and numbers: A slowing in the rate of population growth is evident from the WeBS data (see section 1.3 above) but this needs further study. In an analysis of site-by-site changes, numbers at 74% of 350 WeBS sites remained stable during the 1985/86 to 1993/94 period, with significant declines at a further 9% of sites (Kirby et al. 1996). Sites colonised by Canada Geese relatively early (pre-1974/75) showed the lowest mean annual rate of change (1.67% per annum), whilst the most recently colonised sites (1984/85 onwards) had the greatest (18.1% per annum). This suggests that the sites first colonised had now reached capacity.

3.3 Research

Census: Winter numbers and distribution are monitored through monthly counts at UK wetlands made for WeBS (e.g. Cranswick et al. 1995). Comparisons with total population censuses in late summer (e.g. Delany 1992, 1993) suggest that WeBS encompasses approximately 60-70% of the total population and should therefore provide good measures of population change (see also Kirby et al. 1996).

Ringing: The bulk of the Canada Goose ringing effort coincides with the moult period (see section 2.3 above), with small numbers ringed at other times of the year. A number of intensive, locally-based studies are continuing under the auspices of various ringing groups, often involving mark-release-resighting programmes. Few of these studies have yet been published.

Other: Recent research has often focussed on the management of Canada Goose populations. For example, studies at Great Linford in Buckinghamshire (Giles & Street 1990, Wright & Phillips 1991) have addressed the efficacy of egg-pricking as a means to control local populations, whilst hatching has been shown to be effectively prevented by the coating of eggs with liquid paraffin (Baker et al. 1993). MAFF's Central Science Laboratory (CSL) is currently researching the effectiveness of various regional population management strategies and how these techniques should be combined with other methods to achieve specific population reduction goals (Allan 1992, Watola 1993). Under contract to the DoE, WWT has developed Canada Goose population models which are being used to explore the general effects of control measures (Kirby et al. 1996).

3.4 Protection and conservation

Hunting legislation: Though Canada Geese are protected by Section 1 of the Wildlife and Countryside Act 1981, they may be hunted during an open season which extends from 1 September to 31 January (20 February on the coast). At least 6000 wildfowlers shoot Canada Geese annually in the UK (J. Harradine pers. comm.) but they are not highly regarded as quarry (Harradine 1991). Unfortunately, the precise number taken is not known but is perhaps only 3000-5000 (M. Owen & J. Harradine pers. comm.).

Agricultural conflict: Canada Geese have been recorded feeding in stubble fields, on root crops and grazing newly sprouted winter cereals (e.g. White-Robinson 1984), and are now considered by some to be an agricultural pest (Allan et al. 1995). Despite this, there have been few studies on their effects on crop yields: Kear (1970) reported no significant grain losses attributable to winter or spring grazing by Canada Geese, though White-Robinson (1984) concluded that significant agricultural damage can occur in certain situations. The geese probably have the potential to cause severe localised damage, but our understanding of their overall agricultural impact remains inadequate.

Other: As the population has grown, conflicts with human interests have become more frequent, with amenity land and crop damage being of particular concern. Other potential problems include public health risks, eutrophication of waterbodies, damage to natural habitats and possible adverse competition with native species. Evidence to support most of these is at best circumstantial (see review of Allan et al. 1995). The potential for Canada Geese to transmit diseases to humans, via contact with faeces, has been recently investigated by CSL, under contract to DoE. Whilst the presence of potentially harmful bacteria has been confirmed (CSL unpubl.), there is, as yet, no conclusive evidence for transmission to humans.

4. DISCUSSION

Population status: The WWT (unpubl.) predicted that the UK population would exceed 135,000 by the millennium. More recent analysis suggests the population may be beginning to plateau, but the population has not ceased to grow and may conceivably come close to the predicted level by the year 2000 (Kirby et al. 1996). Many will find such an increase unacceptable and thus there are likely to be further calls for a drastic reduction in the size of the UK population.

Conservation issues: There are no key conservation issues surrounding the growth of the UK Canada Goose population. The strongest arguments for control are now based largely on public health risk and economic damage to amenity grasslands. It is of concern that current population management is undertaken in an *ad hoc* way, often without proper experimental design, adequate monitoring or with little or no follow-up or publication of the results. Integrated Management Strategies (IMS), which combine techniques such as scaring, habitat modification and population control, are now being promoted to prevent damage at sensitive sites (e.g. Allan et al. 1995), but have yet to be evaluated in UK field situations.

Agricultural conflict: Agricultural damage by Canada Geese has rarely been quantified, nor financially evaluated in the UK, and no national assessment has ever been attempted. There is, however, no doubt that localised damage can be severe and responsible for significant costs to the individual farmer or landowner (Simpson 1991). Licences may be issued by MAFF to address such local difficulties.

Future research needs: There remain a number of research priorities for UK Canada Geese, especially if the population is to be managed. A further moult survey is required to provide a new population estimate, and the representativeness of WeBS coverage for Canada Geese should be assessed. Consideration should be given to monitoring productivity in the field by recording the numbers of adults and juveniles in autumn flocks. Ringing effort needs to be restructured to reduce bias and carried out at sites distributed adequately and maintained over time.

Research into the factors important in the selection of breeding, moulting and wintering sites, and into what influences the carrying capacity of these sites, is needed. The latter is most important if the upper limit to population growth is to be estimated. Knowledge of the factors governing the carrying capacity of a site will also help in developing habitat management techniques to limit the number of Canada Geese at a particular location. Field studies are required to investigate the stabilisation of Canada Goose numbers.

More accurate estimates of all region-specific demographic parameters (survival, productivity, migration pattern and control rates) are required before fully reliable population models can be constructed. Accurate quantitative records should be kept at all sites where population control occurs, and detailed hunting statistics are required. Carefully designed studies which investigate the role of hunting and population control on local Canada Goose populations would be useful, especially if these are to be promoted as components of IMS. Management strategies should be carefully designed and consider local populations rather than addressing the geese at just one site only. The best way to carry out IMS should be investigated with the aim of preventing damage at sensitive sites.

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16 Canada Goose *Branta canadensis*: Fennoscandia/continental Europe

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1. POPULATION REVIEW

1.1 Range

The North American Canada Goose was introduced to Sweden in 1929 by private persons with the purpose of enriching the native fauna, and deliberately introduced for hunting purposes in Norway in 1936 and in Finland in the early 1960s. Repeated translocations and natural dispersal have extended the breeding range, and in many areas the Canada Goose now outnumbers native goose species. At present the breeding range covers most of Sweden, parts of southern and central Norway and the southwestern part of Finland, where several groups also occur further north. In Denmark, Germany, the Netherlands, France, Belgium, the Ukraine and Russia, free-flying populations have been established through introduction or from birds escaping from ornamental parks. Several of these populations are now growing rapidly.

The Canada Geese breeding in Fennoscandia are migratory except for a substantial proportion of Norwegian geese. The wintering area for Swedish/Finnish geese is limited to southernmost Sweden, Denmark and northern Germany. The Norwegian Canada Geese are residents, short-distance migrants moving to open water along the coast or migrating to Denmark and Sweden. The Canada Geese breeding on the European continent are largely resident.

The Canada Geese introduced and now breeding in northern Europe are usually assumed to belong to the subspecies *Branta canadensis canadensis* (Cramp & Simmons 1977) although there are a few records of *Branta c. minima* from the Netherlands, Belgium, Germany, Denmark, Sweden and Finland. These are presumably escapees from collections in southern Sweden, the Netherlands or northern Germany. In West-Friesland in the Netherlands a few semi-wild pairs of the latter subspecies breed (Lensink 1996).

1.2 Delineation of flyways

After an initial period when many Swedish/Finnish Canada Geese wintered further north than they do today, the geese developed a pronounced migration to winter quarters at the limit of or south of the climate zone with mid winter snow cover. Almost all Swedish and Finnish geese move southwest to winter in a fairly limited area around the southern Baltic Sea, concentrating in coastal areas (Fig. 16.1). Norwegian Canada

Geese exhibit stationary, short-distance as well as long-distance migratory habits. In harsh winters many geese move to areas with a milder climate.

Winter recoveries of leg-ringed (Fabricius 1983) and neck-collared geese (Fabricius unpubl.) are predominantly from southern Scandinavia and northern Germany. A small number of Finnish Canada Geese move along the east side of the Baltic passing Estonia, Latvia and Lithuania before reaching winter haunts in Poland and eastern Germany (A. Leito pers. comm., Strazds et al. 1994, Zalakevicius et al. 1995). There are scattered recoveries outside this area, most from years with very cold winters (e.g. 1986/87), or of geese which have been translocated or imprinted on other species. At least one ringed Canada Goose from Sweden (Fabricius 1983) and three from Norway (Reitan 1995a, pers. obs.) have reached England, and one bird ringed in Norway was recovered in Shetland (Heggberget 1987) whereas none from the United Kingdom have been seen in Scandinavia or on the continent except France (see Kirby this volume). Thus it is clear that the two European populations are almost completely separate. No confirmed records of North American Canada Geese are known from Fennoscandia.

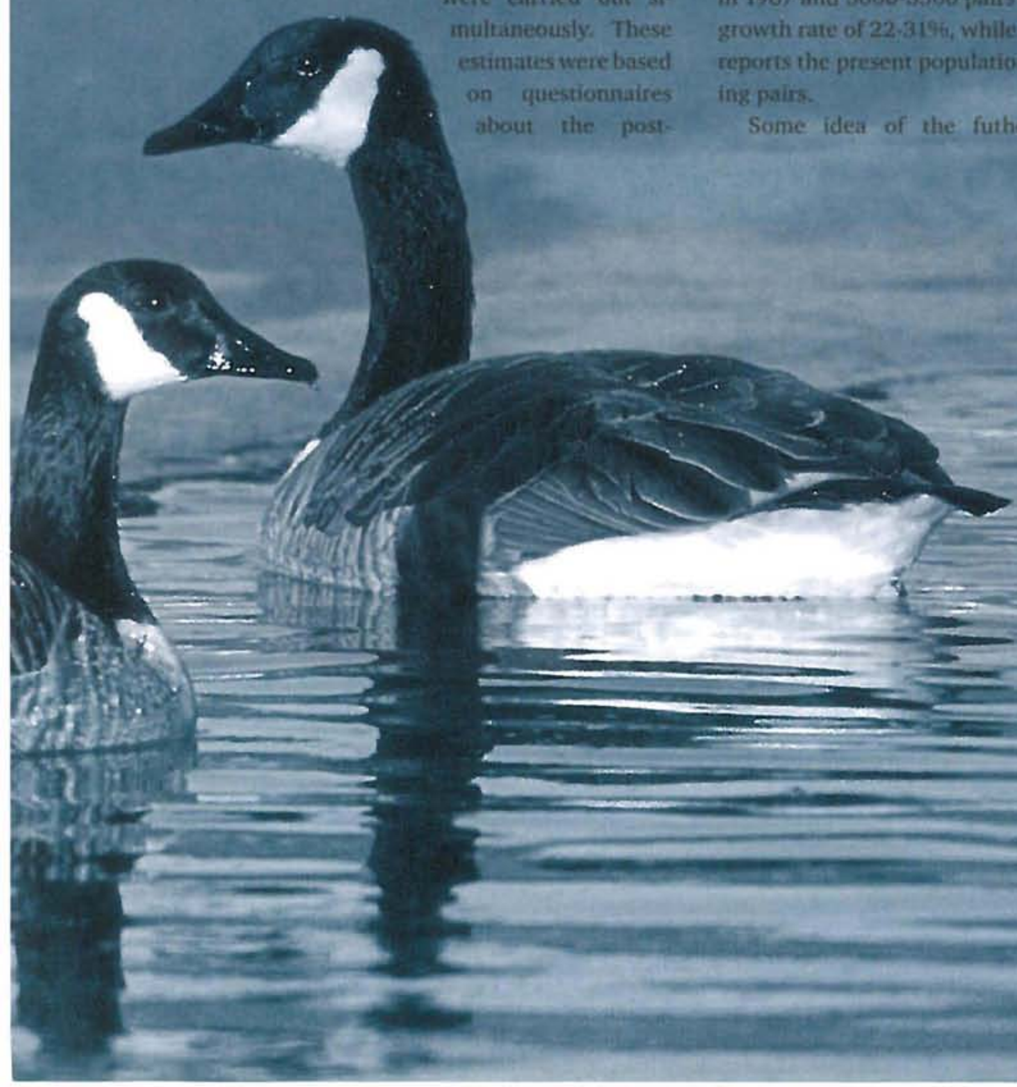
1.3 Population trends

The growth of the Canada Goose population in Fennoscandia has not been subject to detailed long-term counts. Of the estimates available, the early ones from Sweden seem to be the most reliable, since they were carried out simultaneously. These estimates were based on questionnaires about the post-breeding population during the early autumn. From 1966 to 1971, the number of birds increased from 3700 to 9000 (19% annual increase) and to 17,000 in 1976 (14% annual increase)(Fabricius 1983). In 1981 the stock was roughly estimated at 30,000 individuals (12% annual increase)(Fabricius 1983).

A rough calculation of the size of the Swedish population in 1981 is possible using winter counts: in Sweden 5678 (L. Nilsson pers. comm.); in Denmark c. 2000 (Madsen 1986); in Mecklenburg, Germany, 3068 (H.W. Nehls pers. comm.); and an estimated 2000-3000 in western Germany (Schramm 1985, Prokosch & Rösner 1991, J. Mooij pers. obs.), which gives a total of c. 13,000. Compensating for sites not surveyed at that time, but included in later censuses, it is estimated that the Swedish population totalled 14,000-16,000 Canada Geese in 1981, of which relatively few were from Finland. In the January counts in 1988 and 1989, the total number of Canada Geese recorded in Sweden, Denmark and Germany was 23,000 and 29,000 respectively. Of these, however, at least 3000 can be expected to be from Finland according to figures given in Vikberg & Tiainen (1996). This indicates that the growth rate of the Swedish population during the period 1981-1988/89 had slowed down, presumably being rather closer to 5% than 10%.

In Finland, a rapid increase in numbers started during the 1980s and has continued (Vikberg & Moilanen 1992, P. Vikberg pers. comm.). Estimates reported by Vikberg & Tiainen (1996) are 300-350 breeding pairs in 1987 and 3000-3500 pairs in 1996 giving an annual growth rate of 22-31%, while P. Vikberg (pers. comm.) reports the present population to be 1500-3000 breeding pairs.

Some idea of the futher development of the



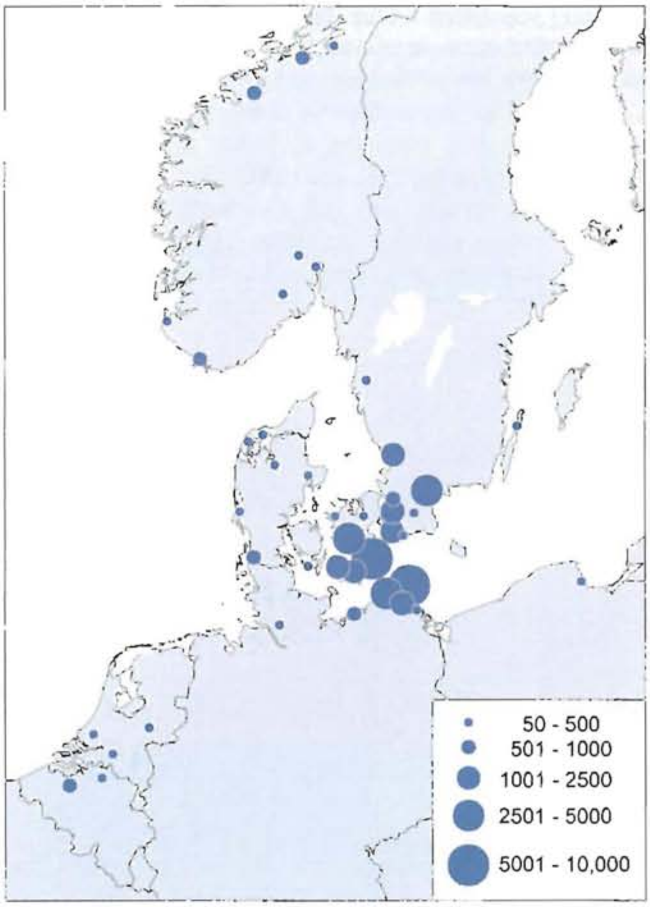


Fig. 16.1. Distribution of Canada Geese in Scandinavia and continental Europe in January 1994 (Norway in January 1993). Only sites with >50 geese are shown. Data sources: Belgium, Anselin et al. (1996); Denmark and Sweden, Wetlands International Goose Database; Germany, Biologische Station im Kreis Wesel (unpubl. data); the Netherlands, SOVON Ganzen en Zwanenwerkgroep (1995); Norway, Ole Reitan (unpubl. data).

Swedish/Finish populations can be gained from the winter counts. Coverage in Germany has improved since reunification (J. Mooij pers. obs.), accounting for the abrupt increase in winter numbers counted between 1989 and 1990 (Fig. 16.2). For the period 1990-1994, the total number of Canada Geese counted in the internationally coordinated goose counts in Sweden, Denmark and Germany increased from 36,294 to 45,599 (Fig. 16.2) corresponding to an annual increase of about 6%, where it seems reasonable to assume that Finnish birds contributed more to the growth than Swedish.

The totals for the winter counts of the Fennoscandian/continental Europe Canada Goose population in 1993 and 1994 were almost identical, while 1995 showed a marked decrease to 42,216 Canada Geese (Fig. 16.2). In January 1996, Sweden and Denmark recorded even lower numbers, while in Germany, information was only available from the coastal area of Mecklenburg-Vorpommern (and not completely synchronised with the January counts, H.W. Nehls pers. comm.). This gives a total of only 32,556 geese in 1996. In January 1997, Denmark recorded 23,275, Sweden 10,960 and coastal Mecklenburg-Vorpommern 12,019 making an all-time high of 46,254 Canada Geese. To these figures from 1996 and 1997, an unknown number in the rest of Germany should be added. Although the yearly variation is relatively large, the trend from 1992 onwards indicates a stabilisation or even decrease in recent years (Fig. 16.2). It should be noted that compared to other goose species, the Western Palearctic mid winter counts for the Canada Goose still have so many gaps that they must be used with caution in analyses of trends and estimation of total numbers.

In Norway the first successful introductions took place around 1960. From 1972-1984 there was an increase from 185-230 to 5000-7000 individuals (Hegg-berget 1991, Reitan 1995b) giving an annual increase of 29-35%. The total Norwegian population is now estimated to comprise more than 15,000 geese, but there exists no estimation of autumn population size after 1990 in any part of Norway (Reitan 1995a). Numbers seem to be increasing all over the country (O. Reitan pers. obs.).

The pattern of population increase described for Fennoscandia is similar to that recorded for the introduced population in the British Isles from 1953 to 1991 (see Kirby this volume). The initial increase seems however to have been faster in the Finnish, Norwegian and Swedish populations.

The breeding populations in Germany, the Netherlands and Belgium have increased markedly in recent years. For Germany, Rheinwald (1993) estimated the feral population at about 500 breeding pairs which would give 3000-5000 birds in total. In the Netherlands, the wintering population of Dutch-born geese increased from 18 breeding pairs in 1987 to 108 in 1994 (Lensink 1996) giving an annual increase of 29%. Around 1995, the winter population had risen to about 2000 birds (B. Voslamber pers. comm.). In Belgium, the first breeding record was in 1972 (E. Kuijken pers. comm.) the population has increased markedly since the mid 1980s to about 280-300 breeding pairs and a total of 2500-3000 individuals in 1996 (Devos et al. 1989, Anselin et al. 1997, A. Anselin pers. comm.).

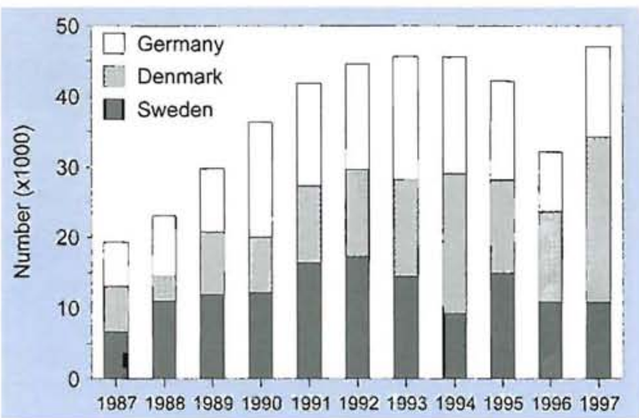


Fig. 16.2. January totals of Canada Geese counted in Sweden, Denmark and Germany 1987-1997. Totals for Germany in 1996 and 1997 are not fully complete.

1.4 Breeding success

Clutch size varies between 2-10 eggs (Fabricius 1987). A non-significant clutch size variation of 4.84-5.30 eggs between areas was recorded in four breeding groups in different parts of Sweden, while the same groups showed a significant year effect ranging from 4.48-5.63 (Sjöberg & Sjöberg 1992). In two Swedish areas hatching success differed markedly, 51% and 72% respectively (Fabricius 1983). Gosling mortality is often low. The proportion of yearlings in the hunting bag in Sweden varied between 24% and 37% in 1986-1991 (Å. Andersson unpubl.). This is lower than for the Greylag Goose *Anser anser* but higher than for the Taiga Bean Goose *Anser fabalis fabalis* for the same period. It seems that the annual variation in fledgling success is relatively low compared to goose species breeding further north.

1.5 Mortality

Fabricius (1983) analysed Swedish ringing data from established populations as well as translocated families and found that about 70% of recoveries of leg-ringed birds were reported shot; another 23% were reported as found dead and apparently include a high proportion of birds hit during hunting. The survival rate of geese ringed as goslings was calculated to be 72% for the first year compared to 58% during the second year and 67-74% for the following three years of age (Fabricius 1983 using the Haldane method). The resighting frequency from banding to the age of one year of neck-collared Canada Geese in central and northern Sweden was at a minimum of 82% and 76% respectively (Å. Andersson unpubl., G. Sjöberg & K. Sjöberg unpubl.). After their second year of life, at least 84% and 73% of the females were observed in central and northern Sweden respectively. For males the rate is lower (64% and 59%) presumably due to emigration. For geese ringed at an age of at least one year, resighting frequency varied between 61% and 97% for different areas, years and sexes.

2. BREEDING GROUNDS AND BREEDING ECOLOGY

2.1 Distribution

Range: In Sweden, translocations were common during the 1950s-1970s creating a patchy distribution, followed by spontaneous colonisation of the areas in between during the 1980s and 1990s widening the range. Today the species breeds throughout southern and central Sweden as well as in coastal and parts of inland northern Sweden. There are few Canada Geese on the lakes in southernmost Sweden (Nilsson 1994). While some areas along the coast have dense populations, large coastal areas are still not colonised.

In Norway, the distribution of the Canada Goose is discontinuous and only half a dozen areas have substantial populations (Heggberget & Reitan 1994). The largest breeding groups occur in the Trøndelag counties, the Agdar counties in the south, the lowland areas around Oslo fjord and in some districts in western Norway. A few breeding records are reported north of the Arctic Circle. Along the Norwegian-Swedish border in Nord-Trøndelag/Jämtland breeding occurs up to the sub-alpine zone at an altitude of 650 meters above sea level.

In Finland, the main breeding area covers the southwestern and western coastal areas with a more scattered distribution in the central and eastern part of the country (Väisänen et al. 1998). A few have crossed the Swedish border just north of the Bothnian Bay (P. Vikberg pers. comm., R. Väisänen pers. comm.).

In Denmark, a small breeding population (<50 pairs) exists in the western part of the island of Sjælland (J. Madsen pers. obs.). In Germany, where the Canada Geese started to breed in the 1960s, the core areas are in the northwest in Niedersachsen, Nordrhein-Westfalen and Schleswig-Holstein (Mooij 1995), although local groups breed elsewhere, e.g. in Bayern (Rheinwald 1993, J. Mooij pers. obs.). In the Netherlands, concentrations are along the Rhine and close to the Belgian border, but small groups breed in the west and north (Lensink 1996). The Belgian breeding population is limited to the provinces of East Flanders, West Flanders and Antwerp (A. Anselin & E. Kuijken pers. comm.). In France there are groups scattered over the country (Hagemeijer & Blair 1997).

After translocation of a group of Russian-reared feral Canada Geese in 1987 to an area southeast of the Sea of Azov, about 300 birds were recorded there in the autumn 1991 (O.S. Gabuzov pers. comm.). One breeding record is reported from Lake Ladoga (Medvedev 1992). In the Ukraine there is a population at Askania Nova north of Krim (T. Ardamatskya pers. comm.), the size of which is not known.

There are a few nesting records from Latvia (Strazds et al. 1994, Adamsons & Roze 1995) and Switzerland (Hagemeijer & Blair 1997). On the Faroe Islands, one pair ringed in Britain arrived in 1984 and established a small breeding group which still survives there (Anon. 1987, J. Kjeld Jensen pers. comm., Hagemeijer & Blair 1997).

Habitat and feeding ecology: Breeds almost exclusively on islands in lakes or rivers, along the coast or in marshes. The availability of nesting islands greatly influences the breeding distribution. In forested areas, the Canada Goose shows a clear preference for small islands or islets and usually nests solitarily, while in areas with extensive shore meadows and pastures medium-sized and larger islands attract a number of pairs, sometimes forming loose colonies with 50 or more pairs. When coexisting with Greylags on lakes, the Canada Geese usually nest on islands while the Greylag Goose nests in reed beds or marshes in the vicinity. Along the coast, the two species often breed on the same islands though Greylags usually prefer more sheltered nest sites than Canada Geese (Å. Andersson unpubl.).

During the breeding period, Canada Geese feed mainly on terrestrial plants including cereals, other grasses and herbs. Broods often share good feeding habitats on pastures with Greylag Goose families. Moulting geese rely more on reeds and emergent vegetation.

2.2 Moult migration and moulting areas

Pairs with goslings moult on the breeding sites. Subadults and adults without goslings assemble in groups during the moult. In Finland, Norway and Sweden flocks of moulting Canada Geese usually do not exceed 100 birds. Results from neck-collar programmes indicate that these flocks are more or less locally recruited. Most flocks moult on lakes similar to those used for breeding. The only record of a larger concentration of moulting birds is from Lake Tåkern where 800 geese spent the summer in 1988 (L. Gezelius pers. comm.). Cramp & Simmons (1977) referring to Bauer & Glutz von Blotzheim (1968) state that moulting birds appear at Hiddensee in Mecklenburg-Vorpommern in July. This must be a mistake because the source only says that the geese appear in mid July, which is after the moult. However, Klafs & Stübs (1977) report a few observations from that area in June and July which indicate moulting. Thus, it seems that no large-scale moult migration has developed in breeding areas in northern Europe (cf. the British population; see Kirby this volume). During the period of intense translocation, some records of Canada Geese moving about 300 km for the moult were reported.

2.3 Research

Release programmes, establishment and population development are summarised by Heggberget (1991) and Heggberget & Reitan (1994) for Norway, by Fabricius (1983) for Sweden, by Viberg & Moilanen (1992) for Finland and by Teixeira (1995) and Lensink (1996) in the Netherlands. A more general up-date was given by Madsen & Andersson (1990). Studies of breeding ecology of the Canada Goose have been carried out mainly in Norway and Sweden. Behavioural studies concern courtship, pair formation and signal systems (Radesäter 1974, Fabricius et al. 1974, Fabricius 1991). Aspects of dispersal (Sjöberg & Sjöberg 1998), reproduction (Gautvik 1992, Fosse 1992, Opdal 1996, Sjöberg & Sjöberg 1992, Sjöberg 1994a, b) and foraging ecology (Åström 1993) have been the subject of recent studies. Neck-collar programmes have been in operation in Sweden 1987-1992 and are still continuing in Norway. In the Netherlands and Belgium, anual censuses of breeding pairs are made (Lensink 1996, A. Anselin pers. comm.).

2.4 Protection and conservation

Hunting legislation: During the breeding period Canada Geese are protected in the Nordic countries. The open season starts on 11-25 August in Sweden, 20 August in Finland, and 10-21 August in Norway (the further north the later the start). Sweden, with the largest breeding population, has the most liberal legislation outside the open season. In order to prevent damage to crops Canada Geese may be shot on arable fields throughout the country from 20 July and in the southernmost part of Sweden also from 1 January-31 March. Canada Geese causing problems by fouling in parks and on beaches may be shot under licence issued by the County Administration.

Public awareness: The rapid increase of the Canada Goose and the problems they cause have changed the earlier positive attitude and, in areas with dense populations, the species is now considered a nuisance at least in Sweden. Small-scale culling is usually accepted by the public.

3. STAGING AREAS

3A. SWEDEN

Shortly after fledging, Canada Geese breeding in forested areas leave the breeding lakes and usually form post-breeding flocks in the nearest arable area where they remain until autumn migration. Flocks exceeding 500 birds occur on relatively few sites at that time of the year.

Despite extensive neck-collar programmes, detailed knowledge of the migration pattern is limited. In late autumn a concentration takes place and flocks numbering 1000-2000 geese have been reported. It is still unknown whether the flocks move directly to the wintering grounds or if they use staging areas en route. In some areas there seems to be a time lapse of some weeks between departure from autumn sites to arrival at the winter quarters. Neck-banded birds have produced no resightings until the birds arrive on their wintering areas (G. Sjöberg, Å. Andersson & K. Sjöberg unpubl. report) and extremely few ringed geese are reported shot between autumn and wintering areas. Though a few coastal sites in the province of Halland on the Swedish west coast may function as staging areas for birds from northern Sweden during the autumn migration, direct flights to winter quarters are likely for most flocks.

In spring, geese breeding in central Sweden usually migrate directly to areas close to their breeding sites without being seen along the migration route. In contrast, geese from more northern areas were observed staging along a broad corridor extending from Scania, north-northeast through central Sweden. The geese used to stop for a week or more (G. Sjöberg, Å. Andersson & K. Sjöberg unpubl. report).

3.B NORWAY

The pattern is similar to that found in Sweden. Concentrations of 1000-2000 Canada Geese have been recorded from a few places which may function as staging areas (Heggberget 1991, O. Reitan pers. obs.).

4. WINTERING AREAS

4A. NORWAY

4A.1 Distribution

Range: Wintering sites are located mainly near the coast and in fjords, at least north to Nord-Trøndelag county (Reitan 1995b). In addition, several wintering sites occur along open rivers and lakes inland.

Habitat and feeding ecology: Canada Geese in Norway seem to prefer winter habitats near the sea, along open rivers or on large lakes with ice-free sites. A common factor amongst winter habitats is open water in combination with foraging opportunities close to lakes or rivers.

4A.2 Abundance

Phenology: The Canada Geese generally arrive on the wintering grounds in November. During winter, some birds move on to other wintering grounds (Fig. 16.1, O. Reitan pers. obs.). Departure is during March or in early April.

Trends and numbers: Some wintering groups seem to have increased, while others have decreased recently. According to neck-banded birds, an increasing number of Norwegian Canada Geese, mainly from the southern breeding groups, have wintered in Denmark and along the southwest coast of Sweden in recent years. Norwegian birds may occasionally winter in the Netherlands, Germany and France. The total number of Canada Geese wintering in Norway is unknown. In January 1993, a total of 2720 Canada Geese were counted in Norway (Table 16.1), and in 1995, 2220. However, coverage in both years is known to be poor in respect of Canada Geese. It is estimated that at least 4500 Canada Geese were present in Norway in January 1995 (O. Reitan pers. obs.).

4A.3 Research

Census: Censuses were carried out all over Norway in January 1993-1995. After the 1995 census, geese will be censused as part of the international swan surveys (i.e. next in 2000). In some areas geese are counted together with other waterbirds as part of the international mid winter counts.

Ringing: All neck-banding and most leg-ringing of Canada Geese has been carried out during the moult in summer.

4A.4 Protection and conservation

Hunting legislation: Hunting of Canada Geese was allowed for the first time in Norway in autumn 1986 in eight municipalities in the Trøndelag counties. In the following years, hunting was allowed in an increasing number of districts, and in 1992 in all parts of Norway (Reitan 1995a). Prior to 1997, the hunting season was from 21 August to 31 October, and since 1997 has been extended to 10 August to 23 December (see also section 2.4 above).

The hunting bag in Norway was estimated to c. 3500 Canada Geese in autumn 1993 (Direktoratet for naturforvaltning 1996).

Agricultural conflict: In some districts there have been conflicts between agriculture and Canada Geese but the problems seem to be local.

Table 16.1. Total numbers of Canada Geese counted in Fennoscandia/continental Europe in mid January.

	Numbers	Year	Source
Belgium	1200-1500	1994	2
Denmark	19,687	1994	1
Finland	9	1993	1
France	98	1994	1
Germany	16,556	1994	1
Latvia	1	1993	1
Lithuania	5	1993	1
The Netherlands	475	1994	1
Norway	2720	1993	1
Poland	162	1994	1
Sweden	9356	1994	1
Total	48,935		

Source: 1. Wetlands International Goose Database; 2. Anselin et al. (1996).

4B. SWEDEN

4B.1 Distribution

Range: The winter distribution is restricted to southwestern Sweden (Fig. 16.1). Depending on the severity of the winter, about 75-95% of the wintering Canada Geese occur in southwestern Scania, the remaining occurring in Halland, Västergötland, Blekinge and Öland. Almost all the regular wintering sites are located south of the -2°C January and February isotherms where average snow depth during these months does not exceed 10 cm. In cold winters the Canada Geese move south, abandoning all sites except those in southwestern and western Scania and southernmost Halland. During the introduction phase, many Canada Geese spent the winter further north along rivers where they were artificially fed. This habit came to an end in the early 1960s, although a remnant flock of 400-600 geese still winters at Lake Storsjön in Jämtland (latitude 63° N) at a hole in the ice kept open by local people.

Habitat and feeding ecology: Coastal bays close to arable land comprise the dominant wintering habitat. The agricultural landscape is characterised by large fields, intensively used for growing cereals, rape and root crops. In early autumn the Canada Geese primarily exploit newly harvested fields, changing to winter cereals as soon as these sprout - the preferred food throughout late autumn and winter. Remains from the harvest of sugar beet and potatoes are frequently used when available. During periods with snow cover, rape is the most preferred food source (Nilsson & Persson 1991).

4B.2 Abundance

Phenology: The Canada Geese arrive in southwestern Scania in late November and during December, as they do in Denmark and Germany, supporting the hypothesis that the geese go directly to their winter quarters without visiting staging areas.

Trends and numbers: From 1978-1983, numbers varied between 6000-7000 geese with the exception of 1982 when only 1042 occurred due to cold weather (Nilsson 1984). Later, during the 1980s, there was a peak in 1986 with over 15,000 followed by a new low during the cold winter 1986/87 (Nilsson 1988). Since then, numbers counted have varied between 9000-17,000 birds. Because of cold weather movements, there is no point in analysing numbers and trends in individual countries; a comprehensive outline for the whole Fennoscandian/continental European population is given in section 1.3 (above).

4B.3 Research

Census: Canada Geese have been censused since counts began in January 1978. A number of well known goose sites are visited and additional information is received from the mid winter duck counts (IWC). Count effort is similar from year to year, although many sites with Canada Geese are not visited. This, however, mainly affects the reliability of the estimate of total numbers not so much the trend figures.

Ringing: No leg-ringing or neck-banding has been carried out during winter.

4B.4 Protection and conservation

Hunting legislation: An open season was first established in 1970 (two counties) with a duration of one month. Since then the season has successively been extended concurrent with the population increase. The species may now be hunted from 11 August (25 August in the north) to 31 December over the whole country. In the four southernmost counties, shooting is allowed only until 1100 h for all geese from 1 October-31 December with the intention of giving the birds the opportunity to feed undisturbed and to prevent shooting on flocks returning to roost. In southern and central Sweden, shooting of Canada Geese is allowed on arable fields 1 January-31 March in order to prevent crop damage. The hunting bag in 1990 was c. 17,000 (Bergström et al. 1992) and 20,000-25,000 in 1992-1996 (official bag statistics, Swedish Hunters' Association).

4C. DENMARK

4C.1. Distribution

Range: The most important wintering grounds are situated in eastern Denmark (Fig. 16.1) where more than 90% of the geese occur (Jørgensen et al. 1994). In southern Sjælland-Møn-Falster-Lolland, more than 1000 geese have been recorded at at least five sites. During cold winters the geese concentrate in the southern part of this area. In northern Jutland approximately 500 geese winter, neckbands suggesting that these are primarily of Norwegian origin.

Habitat and feeding ecology: Canada Geese occur at both inland waters and coasts. The most important sites are shallow coast and fjord areas where, in addition to crop plants, the geese feed on coastal meadows and submerged vegetation (Jørgensen et al. 1994). In recent years there has been a tendency of increasing numbers of geese at coastal sites.

4C.2 Abundance

Phenology: On the island of Møn, the first birds appear in late October followed by a gradual inflow during November and early December (Jørgensen et al. 1994). Numbers are relatively stable from mid December to mid February but movements between different areas in southeastern Denmark seem to be common. Departure starts in mid February and virtually all the geese have gone by March.

Trends and numbers: A maximum of 400-600 Canada Geese from Sweden wintered in Denmark in the late 1960s and early 1970s (Fog 1977). From a total of c. 2000 geese in the early 1980s (Madsen 1986) a pronounced increase took place in the mid 1980s (Jørgensen et al. 1994). In January counts during the period 1987-1994, the number increased to a peak of 19,700 in 1994 (Table 16.1). In 1995 and 1996, c. 13,000 were recorded. An all time high of 23,275 was recorded in 1997.

4C.3 Research

Census: The January counts cover most areas where Canada Geese winter. During aerial censuses of the coast, Canada Geese have been observed on shallow waters far from the coast. It is estimated that these birds, together with Canada Geese at sites which are not surveyed, number c. 1000-1500 birds (Jørgensen et al. 1994). Local studies involving repeated counts follow numerical changes during the winter season (Jørgensen et al. 1994).

Ringing: No leg-ringing or neck-banding has been carried out during winter.

Other: The effect of a recent change (1994) in shooting regulations by which geese generally are only allowed to be shot until 1000 h is being studied by the National Environmental Research Institute, including behaviour of Canada Geese.

4C.4 Protection and conservation

Hunting legislation: The Canada Goose has an open season from 1 September to 31 January (in January only in marine areas). Since 1994, geese can only be shot between 1.5 h before sunrise and 1000 h (since 1997 until 1100 h). From the mid-1960s to the early 1990s, the annual hunting bag of Canada Geese has increased from c. 100 to 1000 (Madsen et al. 1996).

Agricultural conflict: Because Canada Geese rely heavily on winter rape and winter cereals, damage to crops does occur locally, although the extent has not been quantified. Conflicts have been exacerbated by the population increase. In the severe winter of 1995/96, when shallow fjords and bays froze, Canada Geese fed solely on winter cereals and rape right through into spring. Licences were for the first time granted by the National Forestry and Nature Agency to shoot a restricted number of geese after the closure of the hunting season and after 1000 h.

4D. GERMANY

4D.1 Distribution

Range: Canada Geese breeding in Sweden and Finland winter in large numbers in northern Germany, some 90-95% usually occurring in Mecklenburg-Vorpommern (J. Mooij pers. obs.) and, of these, the majority are concentrated to the Rügen-Stralsund-Zingst area (Fig. 16.1). Other important areas are the Wismar Bay in Mecklenburg-Vorpommern, the Fehmarn area in Schleswig-Holstein and Lower Elbe, border between Schleswig-Holstein and Niedersachsen. In cold, snowy winters, Fennoscandian geese reach Niedersachsen (Schramm 1985). Geese seen further south in Germany mainly come from introduced stocks, which are generally sedentary. As none of these sites exceeded 50 birds they do not appear in Figure 16.1.

Habitat and feeding ecology: Similar to Sweden and Denmark.

4D.2 Abundance

Phenology: In northern Mecklenburg, first birds arrive in late July and during August. The main influx starts in November and includes birds from the neck-banded populations in central and northern Sweden. Peak numbers are usually recorded in January/February. Departure starts already in mid February and the last birds leave in April (Dierschke et al. 1995, Mooij 1995, M. Bräse pers. comm.).

Trends and numbers: In northern Mecklenburg, 250 Canada Geese were reported in 1957 (Bauer & Glutz von Blotzheim 1968) and almost 1500 in 1975 (Klafs & Stübs 1977). In Schleswig-Holstein, substantial numbers of wintering Canada Geese appeared for the first time during the winter 1978/79. There was an increase during the following decade (Prokosch & Rösner 1991), but recent trends are not known. The total number in Germany in January 1988 and 1989 was c. 9000 geese. Count coverage has improved considerably since the winter 1989/90 and some 12,000-17,500 birds have been counted annually since then (Mooij 1995, Fig. 16.2), except in 1996, when less than 10,000 were reported.

A number of sites seem not to be included in the national counts: 18,900 were counted in coastal Mecklenburg in January 1992 (W. Nehls unpubl. report) which is 4500 geese more than reported from the whole state (Bundesland) of Mecklenburg-Vorpommern in the national survey of the same month. There is reason to believe that up to 5000 Canada Geese escape record in the national counts. If this is true, numbers wintering in Germany may be in the order of 19,000-22,500 birds.

4D.3 Research

Census: Regular goose counts were carried out from the mid 1960s until 1989 in each of the former Federal Republic of Germany and German Democratic Republic, and from 1990 onwards counts have been coordinated. Results from the national January counts are at present available from 1987 onwards, and some regional counts carried out since the 1950s have been published (see e.g. Prokosch & Rösner 1991).

Other: A few local studies of breeding and feeding ecology of Canada Geese and competition with other species, especially the Greylag Goose, have been carried out.

4D.4 Protection and conservation

Hunting legislation: In Germany, the Canada Goose is a game species and has a maximum open season between 1 November and 15 January. The federal states can shorten or cancel this hunting season or extend it in specific regions under specific conditions. At present, there is no hunting season for the Canada Goose in the federal states Baden-Württemberg, Hessen, Niedersachsen, Nordrhein-Westfalen, Rheinland-Pfalz and Thüringen. Although the annual goose bag has increased considerably in recent decades, the proportion of Canada Geese in the annual German goose bag is low, estimated to be less than 100 birds (J. Mooij pers. obs., H. Kalchreuter pers. comm).

Site safeguard: Most haunts of Canada Geese in Germany are protected at different levels. Some haunts are hunting free zones (usually only the roosts) but in most protected areas hunting is allowed.

Agricultural conflicts: The proportion of goose damage caused by Canada Geese is negligible compared to other goose species.

4E. THE NETHERLANDS AND BELGIUM

4E.1 Distribution

Range: In the Netherlands, local birds winter along the river Rhine and concentrate along large rivers in hard winters. Geese migrating from Sweden and Finland reach the Netherlands during hard winters, concentrating in the northeast and along the river IJssel (Lensink 1996, B. Voslamber pers. comm.). In 1994, no migratory geese seem to have been recorded during the January counts (Fig. 16.1). In Belgium, the largest concentrations are around the city of Gent and in the province of Antwerp, and there are increasing numbers near Brugge (A. Anselin & E. Kuijken pers. comm.). All these geese are local and mainly sedentary. There is little overlap between Canada Goose distribution and the coastal polder wintering grounds of White-fronted Geese *Anser albifrons* and Pink-footed Geese *Anser brachyrhynchus* (E. Kuijken pers. comm.).

4E.2 Abundance

Trends and numbers: In both countries there has been a rapid increase, bringing numbers to c. 2000 geese in the Netherlands in 1995 (B. Voslamber pers. comm.) and 2700 in Belgium in 1997 (A. Anselin pers. comm).

4E.3 Research

Census: As a part of the Wetlands International goose census programme, synchronous nationwide counts have been carried out in January in the Netherlands, and specific Canada Goose counts in Belgium since 1996.
Other: Ringing started in Belgium in 1994 and since 1995 neck-collars have been used (A. Anselin pers. comm.).

4E.4 Protection and conservation

Hunting legislation: There is no open season for the Canada Goose in either country.

5. DISCUSSION

Population status and conservation issues: After a phase of rapid expansion with an annual increase of 15-30% in Sweden in the 1960s and 1970s, in Finland in the 1980s and early 1990s and in Norway in the late 1970s and 1980s, the growth rate for the migratory part of the population slowed during the early 1990s. January counts from recent years indicate a tendency towards stabilisation. A similar pattern of population increase has been recorded for the introduced population in the British Isles between 1953 and 1991 (see Kirby this volume), although the rate of increase seems to have been faster in the Fennoscandian population. In Fennoscandia, the Canada Geese had access to an almost unlimited resource of suitable freshwater and coastal wetlands while the British population largely developed in parallel with the creation of reservoirs and gravel pits.

The Canada Goose has not yet colonised all suitable areas and habitats in Fennoscandia. Assuming that neither the resources in the breeding areas nor the staging and wintering areas are limiting further growth, which seems unlikely at present, there is reason to focus on breeding frequency and mortality rate in explanation of the recent population development. Research and monitoring efforts for this species are limited and do not allow any conclusions about breeding performance so far. The available bag statistics indicate a surprisingly high harvest in recent years, totalling 22,000-27,000 geese, of which 20,000-25,000 are shot in Sweden (official bag statistics, Swedish Hunters' Association), 800-1000 in Finland (P. Vikberg pers. comm.), 1100 in Denmark (Madsen et al. 1996) and less than 100 in Germany (J. Mooij pers. obs.). While the Danish and Finnish harvest numbers are thought to be relatively reliable, the sampling methods used in Sweden and Germany give highly unreliable estimates. Furthermore, an unknown proportion of the 3500 Canada Geese shot in Norway should also be included (Direktoratet for naturforvaltning 1996). These data give a post-fledging population of at least 70,000 geese (c. 25,000 geese reported shot plus 45,000 counted during the January counts). The harvest, which is mainly taken before the January counts, thus comprises about 35% of the post-fledging population. Thus, population numbers are stabilising, the harvest rate appears to be high but nevertheless sustainable at current levels.

The breeding populations of Canada Geese in western European countries (especially Germany, the Netherlands and Belgium) are still local and relatively small but are currently growing rapidly, suggesting that they may have entered the phase of rapid increase earlier exhibited by both the Fennoscandian and the British populations.

Possible competition between Canada Geese and the native bird fauna has been a justified concern during the population increase (see Madsen & Andersson 1990). Interspecific aggression and territorialism has frequently been observed between Canada Geese and other goose species and swans. Studies of the relationship between Canada and Greylag Geese when both species were increasing in numbers did not reveal any negative consequences during the breeding period (Fabricius et al. 1974). Furthermore, food competition between goose species may occur in staging and wintering areas influencing, for example, distances flown by different species from roost to feeding area (e.g. Nilsson & Persson 1991).

Problems do occur in parklands and lakes used for human recreation as well as by geese. Fouling of grounds and beaches is locally a nuisance for people walking, sunbathing, swimming and golfing. In Sweden, this problem was first solved by translocation, but now usually by shooting.
Agricultural conflict: Crop damage is a problem on the wintering grounds in the southern Baltic. Canada Geese make extensive use of winter cereal fields and, during periods of thaw, uproot plants and damage the fields by trampling. In late summer the geese can devastate unharvested crops (J. Madsen & Å. Andersson pers. obs.). When problems are local, personal licences to kill geese in the closed season are used as a management tool for individual farmers. In areas where serious damage is widespread, as in southern Sweden, shooting on fields where damage occurs is permitted during special extensions before and after the regular open season. With a stable or decreasing population the need for large-scale solutions is decreasing. Effective scaring methods usable by the individual farmer or landowner seem to be in increasing demand.
Future research needs: There is an urgent need to confirm the trend in the migratory population and understand the underlying population processes. Besides the internationally coordinated mid winter counts, local or regional counts in breeding areas are recommended. While the Netherlands and Belgium seem to have an adequate census programme of their breeding populations, improvements in coverage would be worthwhile in Denmark and especially Germany. Monitoring productivity by recording the proportion of juveniles in autumn flocks as well as more reliable bag statistics are essential steps towards better knowledge.

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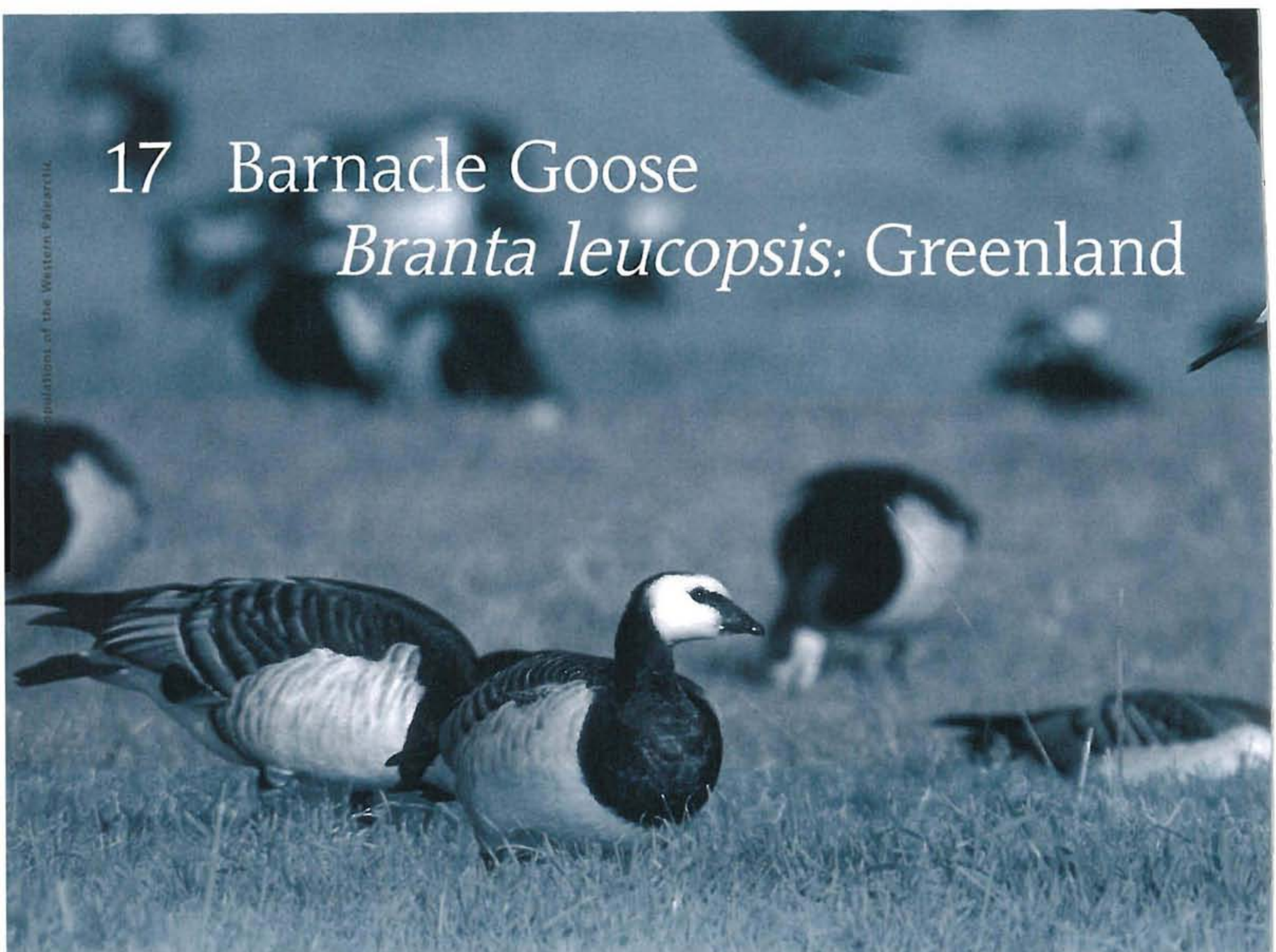

17 Barnacle Goose *Branta leucopsis*: Greenland

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1. POPULATION REVIEW

1.1 Range

The Greenland population of the Barnacle Goose breeds in high arctic northeast Greenland between Kangertittivaq/Scoresby Sund (c. 70° N) and Hertugen af Orléans Land (c. 79° N). It migrates in autumn via Iceland to winter in western Scotland and Ireland. Its wintering range is maritime. All but a handful of wintering sites are on offshore islands which, with one exception off the east coast of Ireland, are confined to the northern and western coasts of Scotland and Ireland (Fig. 17.1). Most are relatively small, from one or two to a few hundred hectares, but by far the largest haunt, Islay, has actual or potential feeding habitat extending to c. 90 km². The traditional feeding requirement of short-cropped swards was formerly met exclusively by grazed saltmarsh and islands where the vegetation was restricted by exposure to wind and salt spray. Such habitat is still used throughout the range, but most large flocks now use intensively managed grasslands. The highly dispersed nature of their wintering range makes annual censusing impractical, due to inaccessibility and the relatively high cost of aerial censusing. The entire range has been censused by aerial survey just nine times since 1959, the last time in 1994.

1.2 Delineation of flyways

The separation of this population from the Svalbard-breeding population which winters on the Solway was suspected for many years and confirmed by Boyd (1964, 1968) following the marking of several hundred birds in northeast Greenland, Svalbard and on the Solway beginning in the mid 1950s. Marking in northeast Greenland has been confined to relatively few areas and there is only limited evidence thus far for links between particular parts of the breeding and wintering ranges. Percival (1991) found that there was differential wintering on Islay by birds caught in three different parts of the breeding range.

1.3 Population trends

The nine aerial surveys mentioned above are the only complete census data available (Fig. 17.2). Nearly all were carried out in late March or early April (see e.g. Fox et al. 1990, Delany & Ogilvie 1994, Merne & Walsh 1994). Aerial survey of the Scottish range was carried out in March 1965 and of the Irish range in March 1993. Annual counts of the main haunt, Islay, commenced in the early 1960s, and have varied between two and seven full counts per winter, with the most regular being in November, January and March. Annual counts of the main Irish haunt, Inishkeas, County Mayo, commenced in 1962 and have continued to the present. There are less regular counts from a small number of other haunts.

The total number of sites which have been used since censuses began is just over 100, but these can be con-

veniently grouped into 32 major haunts in Scotland and about 20 in Ireland (Fig. 17.1).

The total population has increased more than four fold since the first attempted full census, in December 1959, when 8277 were counted, to the latest census, in April 1994, when the total reached 38,355. The count on Islay in December 1959 was unusually low, while the 1994 census suffered from poor conditions, especially in Scotland, and may well have been an underestimate.

Islay holds such a high proportion of the total population that changes there have a major effect on the total. The numbers wintering on Islay, in the rest of Scotland, and in Ireland, are shown in Figure 17.2. During the December 1959 census, the population was split roughly equally between the three areas. Since then, however, both the numbers and the percentage on Islay have risen steadily, to 66.8% in April 1994. Numbers in the other two areas increased initially but have since fluctuated, though with a slight recovery in Ireland in 1988, 1993 and 1994 and something of a decline in the rest of Scotland, especially between 1988 and 1994. After Islay, the next largest flock is that on Inishkeas, Ireland, where 2500-3000 winter, with an early winter peak of up to 5000. Flocks of 1000-2000 occur on islands in the Sound of Harris, Scotland, and at Lissadell, Ireland. Very recent counts of over 1000 have been made on Tiree and Orkney, Scotland. There are several flocks of less than 100, some of which are not found on every census. The infrequency of the censuses makes it difficult to be certain that any one haunt has been deserted or, equally, that a new haunt has come into existence at a particular time.

Current population estimates are 40,000-45,000, as the number on Islay has increased from the 25,600 of April 1994 to an average 31,000 in winter 1995/96 and again in early winter 1996/97. However, this assumes that the continued increase on Islay has not been at the expense of other Scottish or Irish haunts. The population on Islay grew at an average 10.2% between 1982 and 1992, but then fell back to c. 8% up to 1994/95 (Choudhury & Owen 1993, Percival 1996).

1.4 Breeding success

Age ratio counts have been undertaken on Islay every autumn since 1958 (Ogilvie 1978, unpubl. data). Sample sizes were often very small in the earlier years and so the data before about the mid 1970s should be treated with caution (Fig. 17.3). In recent years, the sample aged has been between 25% and 40% of the Islay wintering population.

The only other age-ratio data come from the Inishkeas, Ireland (Cabot & West 1973, 1983, D. Cabot pers. obs.), where breeding success (mean 5.3%) is consistently lower than on Islay (mean 15.0%), and a small series from Coll and Tiree, which were significantly different from those on Islay, with three of five years higher and two lower. It is quite likely that the natural feeding conditions on the Inishkeas result in a

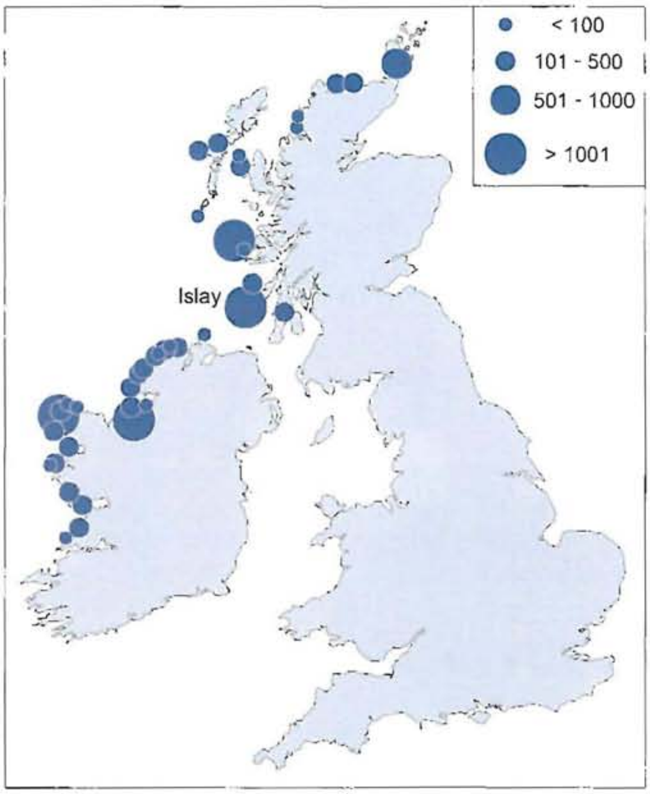

Fig. 17.1. Map of winter distribution of Greenland Barnacle Goose based on spring 1994 census. Poor conditions for counting may have led to an underestimate of the number of birds present at some of the haunts in northwest Scotland.

lower reproductive rate compared with birds feeding on the improved pastures of Islay. Although age-ratio counts were, for many years, carried out on the Inishkeas only in spring, in recent years autumn counts have also been made. In six years, two were found to be significantly lower than in the following spring, two were higher, and two showed no change. There are two factors which could influence age-ratio results throughout a winter. Firstly, higher mortality among young birds than older ones, and secondly, successful parents moving their families from areas where grass resources were depleted to better feeding grounds.

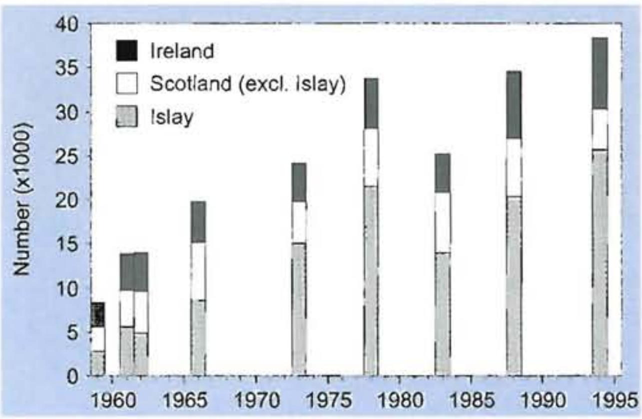

Fig. 17.2. Aerial census totals of Greenland Barnacle Geese, spring 1959-1994.

1.5 Mortality

The Barnacle Goose was a quarry species over part or all of its range until 1976 in Ireland and 1981 in Scotland. Licensed shooting continued on Islay until 1991. Hunting pressure was quite high in places, particularly Islay in the late 1970s and 1980s. Apparent crude annual adult survival, based almost exclusively on Islay census data, was a mean 86% over the period 1985/86-1994/95 (Pettifor et al. 1996). Using data from Inishkeas, crude annual adult survival has been calculated at 0.96 based on gross population counts (1961-1982) and, based on ring resightings, at 0.86 (D. Cabot pers. obs.).

2. BREEDING GROUNDS AND BREEDING ECOLOGY

2.1 Distribution

Range: Barnacle Geese breed in northeast Greenland from Kangertittivaq/Scoresby Sund north to Hertugen af Orléans Land (Fig. 17.4), a rugged strip of coastal land much cut by long, deep fjords and glacial valleys (Boertmann 1994). There are some possible breeding records from the south side of Kangertittivaq/Scoresby Sund, and from Milne Land and Renland towards its eastern end, but the principal range has its southern limit in Jameson Land (Meltofte 1976), bordering the northern shore, and then the northward facing valleys of Ørsted Dal and Flemming Dal running into Kong Oscar's Fjord, the next one to the north. Working north, Barnacle Geese have been found in most suitable lowland valleys and larger islands, including Traill Ø, Clavering Ø, Hochstetter Forland, Shannon Island, Germania Land and Hertugen af Orléans Land. Although there have been sightings in Kronprins Christian Land, the species is not thought to breed there (Hjort et al. 1987).

There has been no complete simultaneous census of this extensive range, most records coming from summer expeditions to different areas. The very limited information suggests that breeding density may be higher towards the south of the range.

The geese breed colonially, mainly on cliff ledges and outcrops above coastal plains or on the side of valleys. Colony size is apparently small, ranging from a handful of pairs to perhaps 150. A typical nest can be placed near the top of a 50-100 m sheer cliff, with a further 100-300 m of large boulder scree sloping steeply down to the valley bottom.

In Ørsted Dal in 1984, a total of 201 pairs was found breeding in nine colonies with a mean 22.3 pairs per colony (range 3-50). Mean estimated height above the valley floor was 200 m (range 80-300) and mean height above the scree 39 m (range 20-70) (Cabot et al. 1984). In Nordmarken in 1987, seven colonies held a total of 116 pairs, with a mean of 16.6 (range 3-33). Mean estimated height above the valley floor was 133 m (range 80-200) and mean height above the scree 47 m (range 30-80) (Cabot et al. 1988). The choice of nest site seems

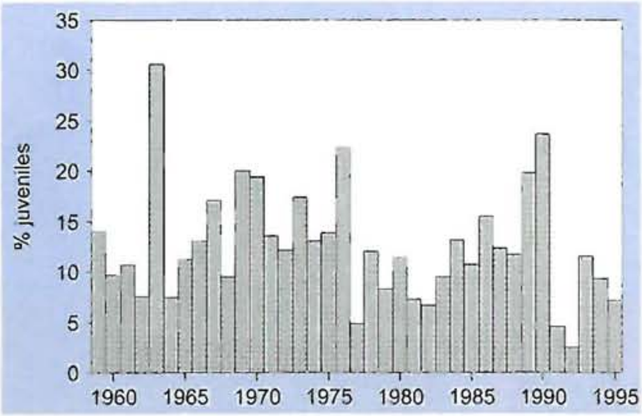

Fig. 17.3. Breeding success of Barnacle Geese on Islay, 1959-1995.

to be mainly dictated by a need to avoid predation by Arctic Foxes *Alopex lagopus*. When the young hatch they often have to undertake a hazardous journey down the cliffs and scree to reach the feeding grounds. The goslings suffer considerable predation, especially by Arctic Foxes, as they negotiate these obstacles (see section 2.3 below).

Habitat and feeding ecology: Wetland areas within the high arctic tundra are selected for feeding and rearing of young. These include mainly sedge and moss marshes, together with stands of *Eriophorum* spp. in the drier areas. Cyperaceae, such as *Carex subspathacea*, *C. saxatilis* and *C. stans*, and grasses, including *Poa* spp. and *Festuca* spp., are important food plants at least for non-breeding geese (Madsen & Mortensen 1987).

2.2 Moult migration and moulting areas

The single most important moulting area discovered for this population lies in Jameson Land, where 5000-6100 Barnacle Geese (together with 5000-5500 Pink-footed Geese *Anser brachyrhynchus*) were discovered moulting in the early 1980s (Madsen et al. 1984, Madsen & Mortensen 1987). The numbers of geese build up at the end of June, suggesting a moult migration from other parts of the breeding range, but the distances travelled are unknown.

Madsen & Mortensen (1987) presented evidence that the carrying capacity of the moulting area had been reached and that there was competition between the two species for the limited resources available.

In 1988, an aerial survey of moulting geese was carried out over most of the breeding range north of Jameson Land (Boertmann 1991). Several moulting areas were located, but none with the same order of numbers as in Jameson Land. The highest count was about 570 on Hold-with-Hope.

2.3 Research

Ringing (numbers caught in parentheses) has been undertaken on the breeding grounds in 1955 (299), 1961 (569), 1984 (644), 1985 (117), 1987 (101) and 1988 (80) (Marris & Ogilvie 1962, Cabot et al. 1984, Newton 1985, Cabot et al. 1988). The first four expeditions went to the same areas of Scoresby Land and Jameson Land, while the last three were to Traill Ø, Nordmarken and Hold-with-Hope, respectively.

The 1961 expedition marked the geese with coloured plastic neck-tags and coloured spiral leg-rings, while those since 1984 used engraved Darvic leg-rings, plus coloured spiral leg-rings in 1984 and 1987. These have produced large numbers of sightings and recoveries and helped, together with marking with Darvic leg-rings in Islay and Ireland, in calculations of mortality, and in assessing movement between wintering sites. Weights and some measurements were taken of the geese during the majority of the catches.

Detailed ecological work has been carried out during the studies of the moulting flocks in Jameson Land and included habitat and food selection, time budgets, estimation of daily food intake, and productivity of the vegetation (Madsen & Mortensen 1987).

Breeding biology studies have been carried out in Ørsted Dal, Jameson Land (Cabot et al. 1984) and Nordmarken (Cabot et al. 1988). Twenty-four-hour watches made on nests in Ørsted Dal showed that, on average, incubating females spent 3% of their time away from the nest, with mean trip duration of 37 min-

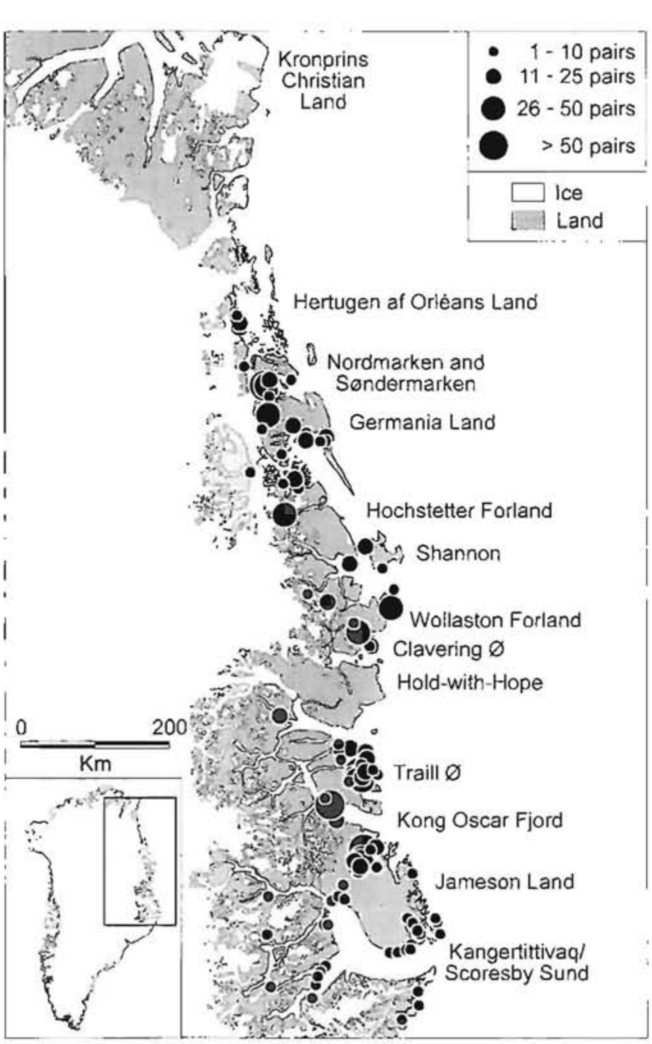

Fig. 17.4. Distribution and approximate size of Barnacle Goose colonies in northeast Greenland. In some areas, broods have been observed but the colonies have not been located, for example at Hold-with-Hope.

utes (Cabot et al. 1984). The number of feeding trips declines as hatching begins. Limited observations suggested that the goslings spent c. 42 hours on the nesting ledge after hatching. In 1987, in Germania Land, the mean time spent before departure from the nesting ledge was 41.33 h (28-62), n=11 (Cabot et al. 1988).

Of 94 goslings observed to jump from a total of 30 nests at Kap Seaforth in 1984, 26 were lost in the scree, 13 were taken by foxes and two by Glaucous Gulls *Larus hyperboreus*. This represents an overall loss of 43.6% (Cabot et al. 1984). Of 41 goslings hatching from 12 nests in Nordmarken in 1987, 16 were taken by foxes, two by Gyr Falcons *Falco rusticolus* and one each were lost in the scree and fell out of the nest. The overall loss was 62.8% (Cabot et al. 1988).

Table 17.1 shows the breeding performance from clutch size to wintering grounds in 1984 and 1987. It is difficult to extrapolate from these observations of gosling loss at two small colonies in two different years, though such mortality is clearly serious at a local level. Fox & Gitay (1991) showed, using multiple regression analysis, that up to 60% of the variance in breeding success can be explained by weather conditions in early spring in Scotland, in Iceland during staging and in Greenland on arrival.

Other research on breeding Barnacle Geese has been carried out by Meltofte (1975, 1977), who mapped the colonies in the Dove Bugt area (1969-71 and 1975) and by Forchhammer (1990) working in the same area in 1986-88. In 1974, Meltofte (1976) stayed in Ittoqqortormitt/Scoresbysund and mapped the colonies in the fjord area.

2.4 Protection and conservation

Hunting legislation: Barnacle Geese are legally protected in East Greenland from 1 June to 31 August. Born (1983) estimated that 500-1000 geese (both Barnacle Geese and Pink-footed Geese) were killed each summer by hunters of Ittoqqortormiit/Scoresby Sund, the only settlement within the main range of the Barnacle Goose. The geese are mainly shot opportunistically during spring hunting along the ice edge or caught when flightless.

Site safeguard: The Northeast Greenland National Park was established in 1974 and covers all of eastern and northern Greenland north of 72° N. Within the Park, there are strict regulations on human activities and a prohibition of hunting, except by the inhabitants of Kangertittivaq/Scoresby Sund, who are allowed Polar Bear *Ursus maritimus* hunting. The majority of the moulting Barnacle Geese are found outside the National Park, in Jameson Land, where Heden, the most important area, is designated as a Ramsar site. About 7% of the flyway population was estimated to be moulting here in 1988 (Boertmann 1991). Hochstetter Forland, inside the National Park and holding 230 moulting Barnacle Geese in 1988, is also designated as a Ramsar site.

Public awareness: The only permanent human inhabitants of the breeding range of the Barnacle Goose are an Inuit settlement on the north side near the mouth of Kangertittivaq/Scoresby Sund, and a small number of meteorological station staff to the north. Summer visitors include scientists from a number of disciplines and a small number of tourists.

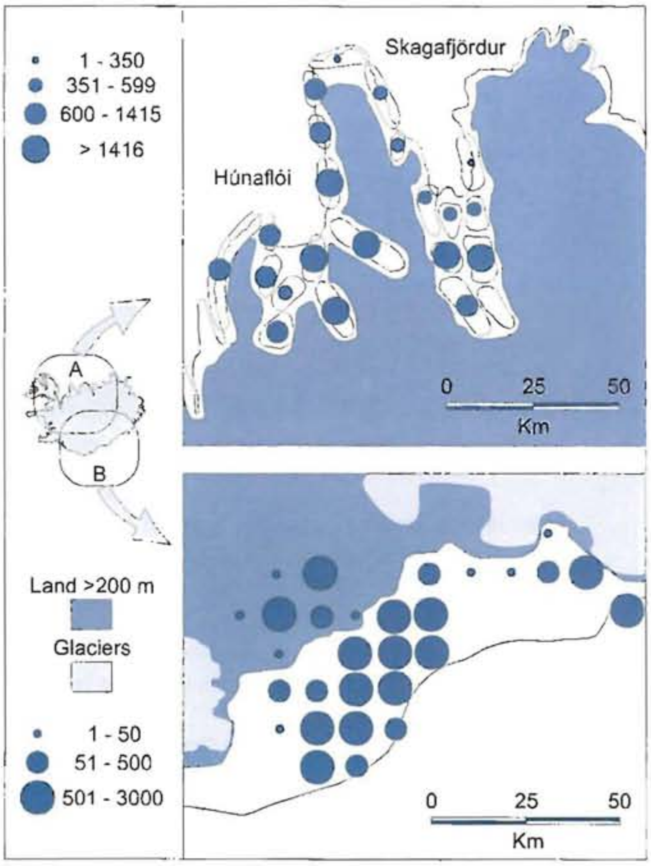

Fig. 17.5. Spring (A) and autumn (B) staging areas of Greenland Barnacle Geese in Iceland. Count data are taken from spring 1994 (lines around dots indicate areas surveyed) and autumn 1993.

3. STAGING AREAS

3A. ICELAND

3A.1 Distribution

Range: The Barnacle Geese use two discrete areas to stage on their two migratory journeys (Fig. 17.5). In spring, the main concentration occurs in the valleys of northern Iceland, in the counties of Vestur-Húnavatnssýsla, Austur-Húnavatnssýla and Skagafjarðarsýsla. On their return in autumn, they are found mainly in southeast Iceland, in the counties of Vestur-Skaftafellssysla and Austur-Skaftafellssyla, sometimes moving down to the southern lowlands depending on snow-cover and temperature in the highlands.

Barnacle Geese have attempted to breed in Iceland, a few pairs on islands in Breiðafjörður in the west, in 1964-1987, while from 1988 a few pairs have bred on islands in glacial rivers in the southeast near Hornafjörður (Æ. Petersen pers. comm.)

Habitat and feeding ecology: The principal feeding in spring is on improved agricultural pastures, with rather less on wet river meadows. Sites with greater areas of improved pasture generally support a greater number of geese (Percival & Percival 1997). In autumn, the diet is more varied and includes many seeds and berries in the uplands, e.g. Alpine Bistort *Polygonum vivipara*, sedges in lowland marshes as well as agricultural grasses.

3A.2 Abundance

Phenology: The first spring arrivals are in mid to late April, peaking with the main departure around 19-20 May and most having departed before the end of May. Return passage takes place at the very end of August and in September, with onward movement to Britain and Ireland commencing in the last few days of that month or in early October.

Trends and numbers: No complete counts exist from autumn staging areas. Two counts have been made on spring staging areas, in 1987 and 1994 (Percival et al. 1987, Percival & Percival 1994). Both counts were done in Húnavatnssýsla and Skagafjarðarsýsla, the main staging areas, and found 70-75% of the estimated total population, suggesting that the entire population stops off in Iceland during migration. The counts found 24,031 in 1987 and 25,769 in 1994.

3A.3 Research

In 1983, 1987 and 1994, observations were made on habitat use, food intake and distribution and abundance during staging (Percival et al. 1983, Percival et al. 1987, Percival & Percival 1994, 1997). In 1995, a research project on geese was started by The National Institute for Natural History focussing on effects of hunting on goose populations. The project includes examination of Barnacle Goose wings, to enable aging of shot birds and analysis of bag statistics (Sigfusson 1996).

3A.4 Protection and conservation

Hunting legislation: The main legislation relating to geese is the Bird and Mammal Protection Act of 1994 (see section 3A.4 in Mitchell et al. this volume).

Although the geese are protected in spring there may be considerable numbers killed illegally at this time. There is no limit on the hunting bag at present, but bag statistics are available from 1995 onwards, so size and extent of the kill each year may be assessed. Due to their habit of remaining in relatively remote interior regions in the autumn, the Barnacle Goose kill is relatively modest (c. 1500 in 1995 (Sigfusson 1996) and 3000 in 1997 (Sigfusson unpubl.), cf. Greylag Goose *Anser anser* Iceland population).

Site safeguard: No areas are protected specifically for Barnacle Geese.

Agricultural conflict: Although unlikely to cause significant agricultural damage, complaints are received from individual farmers. The presence of scaring devices in spring in the northern valleys increased markedly between 1987 and 1994 (S. Percival pers. obs.), with a corresponding change in the birds' distribution. However, no licences have been issued for spring shooting in order to scare the geese from cultivated areas.

Table 17.1. Comparison of breeding performance of Barnacle Geese in 1984 and 1987 (from Cabot et al. 1988).

	Ørsted Dal 1984	Nordmarken 1987
Mean clutch size	3.57 (n=30)	4.16 (n=12)
Clutch range	2-6	2-6
Mean brood size prior to jump	3.13 (n=31)	3.42 (n=12)
Mean brood size pulli in lakes (c. 2 weeks old)	2.40 (n=25)	2.33 (n=18)
Mean brood size wintering grounds (October-December)	1.86 (n=49)	2.16 (n=50)

4. WINTERING AREAS

4A. SCOTLAND

4A.1 Distribution

Range: There have been some minor range changes since the aerial surveys began in 1959, with an extension north and east to Orkney sometime in the early 1970s. A few islands have fallen out of favour over the period, usually associated with change of use, perhaps especially, the cessation of grazing by cattle or sheep which has become more widespread in the last ten years (Fox et al. 1990, Delany & Ogilvie 1994). A formerly quite regular flock on the South Uist machair near Loch Bee was apparently displaced in the early 1960s by the building of a rocket range facility. The intensification of agriculture on several larger islands within the range has enabled flocks to increase on inhabited islands, often at the expense of smaller, uninhabited and now under-grazed islands nearby.

Habitat and feeding ecology: The feeding ecology on Islay has been studied intensively over the last ten years (e.g. Patton & Frame 1981, Percival 1988, 1993, Percival & Houston 1992). The geese select for newly reseeded Italian Ryegrass *Lolium perenne* pastures and for fields which have been fertilised. They also feed on barley and oat stubbles in autumn, taking both spilt and sprouting grain as well as undersown grass.

Elsewhere in the range, there is still feeding on less or un-managed grasslands, including on merse and salt-affected coastal and island pastures where *Festuca* species are important.

4A.2 Abundance

Phenology: The first birds arrive on the wintering grounds in the last few days of September and early October, with the peak arrival period on Islay often during 5-10 October. Southerly winds in Iceland may delay arrivals until nearly the end of October or, conversely, strong northerly winds stretching all the way from Iceland to Scotland can result in an earlier peak.

Movement within the wintering range occurs, as shown by ring sightings, and spells of hard weather can, exceptionally, cause quite substantial movements, e.g. 5000+ departing from Islay for short periods in recent winters, presumably to the south. There is a small, but significant, movement of Irish and Scottish-ringed birds between Islay, Lissadell and Inishkeas between and within winters (D. Cabot pers. obs.).

Trends and numbers: Numbers on Islay have increased from around 5000 in the mid to late 1950s to c. 30,000 by the mid 1990s. At the same time, numbers elsewhere in Scotland rose from 2700 in December 1959 to 6600 in March 1966, declined to 4700 in March 1973 but returned to 6500 in April 1978 and stayed at or just above this level to March 1988. However, at the time of the last census, in March 1994, the number had fallen back to 4600 (Fig. 17.2), though this last figure may well be an underestimate.

The infrequency of the censuses makes it difficult to assess changes or trends at other haunts, though there has been a recent increase on islands where farming has become more intensive, e.g. South Walls on Orkney, Berneray, Borerary and Pabbay in the Sound of Harris, and Tiree and Coll. A number of haunts on the north and west coasts of Sutherland and Ross & Cromarty holding very small flocks (<100) have shown declines or even disappearances over the last ten years (Delany & Ogilvie 1994).

It should also be pointed out that the infrequency of the censuses and the fact that they have nearly all taken place at the same time of year, in late March/early April, in order to take advantage of longer days as well as avoiding the worst of the winter weather, means that they are simply providing a snapshot of distribution of Barnacle Geese at the time of each census and may not properly reflect the true through-the-winter distribution.

4A.3 Research

Census: The approximately five-yearly full censuses have all been carried out by The Wildfowl and Wetlands Trust (WWT), with funding from the government conservation agency, formerly Nature Conservancy Council (NCC), and now Joint Nature Conservation Committee (JNCC). Additional funding for limited surveys within Scotland has come from Scottish Natural Heritage (SNH). Regrettably, although it is recognised that these censuses provide the only possible method of assessing the total population, it has proved difficult to obtain a long-term commitment from the funding bodies and each has to be bid for individually at the time. The six-year gap between 1988 and 1994 arose because although a census was planned for 1993, the weather in the available window of the last week of March and the first week of April was unsuitable.

Counting on Islay is carried out very regularly, a minimum three times each winter, with additional counts as part of the Islay Goose Management Scheme. These counts are funded by SNH. Although future amendments to the Scheme may involve changes in the present pattern of additional counts, it is not envisaged that the full counts will fall below three per winter.

Counts of Barnacle Geese on Tiree and Coll are carried out at least twice each winter, though they are dependent upon local SNH or Royal Society for the Protection of Birds (RSPB) staff and occasional gaps do occur. Less regular counts are made on Oronsay/Colonsay and at a very few other haunts.

Age counting is carried out on a substantial sample (up to c. 40%) of the Islay population each autumn, but not, currently, elsewhere.

Ringing: Catches of Barnacle Geese have been made on Islay in four winters between 1986/87 and 1990/91, then each winter since 1992/93, with a total caught of c. 1600. All have been marked with individually engraved Darvic leg-rings, plus, in recent winters, additional colour leg-rings.

Several thousand ring sightings are made on Islay each winter (nearly 35,000 between 1984/85 and 1994/95, Percival 1996). Elsewhere, smaller numbers of sightings are made at several sites in Ireland, on Coll and Tiree, and on Orkney. This information has shown that the geese are highly site faithful. On average, 66% stay at the same site during the course of a winter, and 70% (of surviving birds) return to the same site in the following winter (Percival 1991, Pettifor et al. 1996).

Other: Considerable work has been done in the past on the agricultural impact of the Barnacle Geese on Islay (Percival 1988, Percival & Houston 1992). More recently, factors affecting distribution within Islay have been studied, looking at field type and size, distance from roost, stocking rates, etc. Detailed work on the effect of different grazing and fertilisation regimes on the RSPB Loch Gruinart Reserve on Islay is currently being written up as a doctoral thesis.

4A.4 Protection and conservation

Hunting legislation: The Greenland Barnacle Goose was a quarry species throughout its British range until the passing of the Protection of Birds Act, 1954, which gave it total protection. However, an Order in Council, passed in 1955, provided for a short open season, from 1 December to 31 January, on all islands to the west of longitude 5° W. This strange-seeming reversal of the intentions of the very recent Act was a classic example of the power of the well-placed individual, as it was brought about at the behest of a single landowner who regarded the Act as placing an unnecessary restriction on his well managed shooting of Barnacle Geese on Islay. The effect on Islay was very limited, at least to start with, as the shooting was indeed well managed and the number of birds taken each winter was probably no more than 200 out of the then total of c. 5000. However, as the numbers on Islay increased substantially through the 1960s and 1970s, goose shooting increased as well and additionally became much more readily available, including to visiting shooters from overseas. Numbers shot annually rose to over 1500 by 1980 out of what was by then a declining population of 13,000-18,000.

There may have been an adverse effect of the 1955 Order elsewhere in the range, where the many very small flocks continued to be subject to shooting. The preference of the geese away from Islay for uninhabited islands is at least partly due to shooting. The gradual movement of some of these flocks onto managed pastures on inhabited islands since total protection was afforded would seem to bear this out.

Total protection was again given to the Barnacle Goose in Britain by the passing of the Wildlife and Countryside Act, 1981, following the placing of the Barnacle Goose on Annex 1 of the European Union (EU) Wild Birds Directive. Limited shooting has continued to take place under licences issued by the Scottish Office Agriculture, Environment and Fisheries Department (SOAEFD). These are meant to be used for protection of crops from "serious agricultural damage" and issued only after consultation with Scottish Natural Heritage, as the Scottish Office's conservation advisor. In the early 1980s they were very freely issued on Islay and licence returns indicated that over the period 1982-91, a mean of 792 (range 447-1365) Barnacle Geese were shot each winter. After the introduction of the Islay Goose Management Scheme (see below), the number of licences issued fell to only one or two a winter and few if any geese were shot. There are no bag limits placed on the licences. Returns of the number shot are mandatory. There is a belief among licencees that a nil return will adversely affect the likelihood of receiving a licence the following year.

Site safeguard: The Site of Special Scientific Interest (SSSI) designation is the main site protection mechanism in Britain. Three substantial areas of Islay have been declared SSSIs principally for their feeding and roosting Barnacle Geese, one in 1963, the other two in 1971. All three have subsequently been designated as EU Special Protection Areas (SPAs) and two are also Ramsar sites. Six other Barnacle Goose haunts are currently being assessed for SPA status.

Agricultural conflict: Complaints about the damage caused to agriculture by Barnacle Geese on Islay date back to the last century. However, the problem only really became serious in the 1970s with the doubling and then trebling of the wintering population. Increased shooting during the late 1970s may have contributed to the reversal of the population growth, but this resumed in the 1980s despite the quite high level of licensed shooting.

In the late 1980s, two different scaring schemes were tried. Both treated the three SSSIs (including the RSPB Loch Gruinart reserve) as sanctuaries into which geese could be scared from more susceptible crops. Management agreements between the NCC and the tenant farmers of the SSSIs came into effect in 1988, effectively paying farmers compensation for damage done by the geese. In return, farmers undertook to continue farming in such a way as not to discourage the geese. At the same time, it was agreed that no licences would be issued for shooting within the SSSIs.

The first scheme, which operated in late winter 1987/88 and throughout winter 1988/89, used teams of unemployed local people funded by the Manpower Services Commission to keep birds on the move in areas outwith the SSSIs. The effectiveness of this was limited both by the relatively small number of people involved and by restrictions placed on their scaring efforts by landowners concerned about any adverse effect on their shooting, including, paradoxically of geese. However, despite these problems, there is evidence that the 1987/88 scaring scheme did reduce the numbers of geese using the scaring zone (Percival et al. 1997).

The second scheme, which operated from 1989/90 to 1991/92, involved payments by the NCC and SOAEFD direct to farmers, for the purchase of scaring devices, fuel for vehicles and associated expenses. This scheme was also subject to some landowner restrictions but suffered mainly from an almost complete lack of cooperation between farmers, even those on neighbouring farms sharing the same flock of feeding geese.

In 1992/93, the Islay Goose Management Scheme was put in place by SNH. This voluntary scheme offers farmers a fixed payment per goose and is based on frequent counts throughout the winter to enable the calculation of average goose use of each holding. Those joining the scheme agree to carry out certain farming practices which will ensure sympathetic management of the geese, to refrain from deliberate scaring except from individually agreed fields, e.g. very new reseeds, and not to apply for shooting licences.

This scheme has been very successful, with a near 100% take-up, and has continued through to the 1998/99 winter. Modifications have been proposed for future years, though these are still under discussion.

Barnacle Goose damage away from Islay has been claimed for a number of haunts, including Orkney, Tiree and the Outer Hebrides. Only at the first of these has any management scheme been put in place. Since 1994, payments by SNH have been made to up to 15 farmers for specific operations, e.g. reseeding and fertiliser application, to improve fields within three refuge areas totalling 55 ha. In addition, a goose scarer is employed to scare geese on to the refuge fields from surrounding areas. Thus far, the scheme has proved successful, with the 1000-1200 geese feeding for most of the time within the refuge areas.

4B. IRELAND

4B.1 Distribution

Range: The main part of the range, the scattered, mostly island, haunts down the west coast, has remained more or less unchanged, though there appears to have been an abandonment of the most southerly haunts, the Blaskets, in the last 20 years. On the east coast, there were formerly two haunts which are now deserted, the Wexford Slobs, which held up to 500 in the 1950s, and Lurgangreen, Louth, where about 100 were seen up to the mid 1940s (Kennedy et al. 1954). Lambay Island and the Skerries Island off the Dublin coast still hold a small flock, maximum 50 birds, but this appears to be declining.

As in Scotland, loss of grazing of some offshore islands has reduced their attractiveness to Barnacle Geese. Three mainland haunts, Lissadell/Ballintemple, Sheshkinmore and Dunfanaghy, have increased in importance in recent years.

Habitat and feeding ecology: Apart from the three mainland sites, where feeding is on managed pastures, most feeding is on less or un-managed grasslands, including on merse and salt-affected coastal and island pastures, where *Festuca* species are important. *Plantago* swards are used on the Inishkeas.

4B.2 Abundance

Phenology: Similar to Scotland.

Trends and numbers: After an initial increase between 1959 and 1961, numbers in Ireland remained little changed between 1962 and 1983, varying within the range 4161 and 5709. The last three censuses, however, have revealed a significant increase, to 7594 in March 1988 and 8100 in March 1993 and 1994 (Walsh & Merne 1988, Merne & Walsh 1994). The increase has not been evenly spread throughout the range, with decline of some island haunts and increases at the three mainland sites of Lissadell/Ballintemple, Sheshkinmore and Dunfanaghy.

As in Scotland, the infrequent, spring-only censuses provide the very minimum of information on winter distribution. The infrequency also makes interpretation of changes difficult, but the switch from ungrazed islands to managed grassland seems to be following the same pattern.

4B.3 Research

Census: The aerial censuses are coordinated with those in Britain and funded by the Irish National Parks and Wildlife Service. The Irish Army Air Corps provides an aircraft and pilot.

Regular counts are made at the three mainland sites of Lissadell/Ballintemple, Sheshkinmore and Dunfanaghy, and most winters there is at least one count from the principal island haunt, Inishkeas. At a few additional island sites, e.g. Mutton Island and Inishkeel, it is possible to count the geese from the adjacant mainland using a telescope.

Ringing: A total of 816 Barnacle Geese have been ringed on Inishkeas, County Mayo, between 1962 and 1996 and marked with either coloured spiral leg-rings, or individually engraved Darvic leg-rings, or both. These have given rise to over 18,000 sightings. A catch of 134 was made at Sheshkinmore, County Donegal, in November 1995 and a further 42 were caught there in November 1996. The latter were marked with individually engraved legrings.

Other: Detailed feeding ecology and goose energetics studies have been carried out on the Inishkeas over many winters (D. Cabot unpubl.).

4B.4 Protection and conservation

Hunting legislation: The Barnacle Goose was protected in Ireland by the Wildlife Act 1976. Prior to this, only very small numbers were thought to be shot annually, largely because of the relative inaccessibility of the majority of its haunts. Two mainland haunts on the west coast, Lissadell/Ballintemple, Sligo, and Sheshkinmore, Donegal, have increased in importance in recent years, suggesting that legal protection, as well as the *de facto* protection earlier existing at both sites, has helped.

Site safeguard: A total of 22 SPAs have been designated either directly for Barnacle Geese or benefitting them. In addition, a number of sites are covered by both statutory protection and management agreements.

Agricultural conflict: There are minor complaints from a few areas.

5. DISCUSSION

Population status: Although the population of the Greenland Barnacle Goose has increased substantially over the last four decades, so that it can now fairly be described as of favourable conservation status, the enormous preponderance of birds at one haunt, Islay, does give rise to continued cause for concern, especially in the face of declines and extinctions at other regular haunts. The agricultural conflict on the island still has potential for producing an extreme reaction, despite the success over the last seven winters of the goose management scheme. Farmers on Islay are not satisfied with the present level of funding, yet an increase over the present level is very unlikely and even continuation at the present level is by no means assured. The Scottish Office has very recently proposed, in a consultation paper, that "culling" should not be ruled out as a management option. The simple fact that two-thirds of the total population will be affected by whatever future measures are adopted on Islay should be borne in mind in any discussion of a solution to the Islay situation. This is not a case where local actions can be taken purely in relation to a local problem. Due regard must be had for its effect on the wider population.

Conservation issues: This topic is inextricably bound up with the previous one. The paramount need for a sustainable, and international, conservation policy has yet to be addressed. Progress is being made towards the designation of further SPAs in Scotland. Thought has also been given to establishing favourable management practices on some of the island haunts, for example, the ensuring of sufficient winter grazing, but this has so far only been put into practice at one site, En Hoan, by the RSPB.

In Ireland, the position is regarded as very satisfactory, with the species protected by law and with most of its important sites designated as SPAs.

Although no plans exist for designating protected areas for the Barnacle Goose in Iceland, the situation can be described as satisfactory (A. Sigfusson pers. obs.). During spring, when the geese are in the lowlands, they are legally protected from shooting, though illegal killing does take place, and there is no immediate threat to their grazing areas. During autumn, when shooting is allowed from 1 September, the Barnacle Geese remain in relatively inaccessible areas for most of the time before they migrate. Hunting pressure on this species is therefore comparatively low compared to that on Greylag Geese and Greenland White-fronted Geese *Anser albifrons flavirostris* (Sigfusson 1996). The small number of birds which remain in Iceland during the summer and breed might, though, be in danger of being wiped out during the early part of the shooting season because at that time they are the only Barnacle Geese in the lowlands prior to the arrival of the staging birds. Some protection was given to them through the hunting act of 1994, when the start of the shooting season was moved from 20 August to 1 September, but some added protection may be needed for the resident birds to prevent them being hunted.

The conservation situation in Greenland is, for the time being, satisfactory. However, future oil exploration in the area cannot be excluded if the price of oil rises.

Agricultural conflict: See above.

Future research needs: Compared with, for example, the Svalbard Barnacle Goose population, the Greenland birds have been studied in less detail. However, there are long runs of data, e.g. population numbers and age counts since the early 1960s, ringing since 1955, irregular for many years, but now annual, at least on Islay, and intensive studies of population dynamics and winter feeding ecology since the mid 1980s.

The following sections outline some of the major requirements, focussing on the need to build on our current knowledge:

Greenland. The basic breeding biology has been described (Cabot et al. 1984, 1988) and some important work has been done on the most important moulting area (Madsen et al. 1984, Madsen & Mortensen 1987). Although factors potentially limiting the population are poorly understood and would repay further work, the relative inaccessibility of much of the breeding range, and the expense of getting there and covering more than a small part in any one summer, are always likely to inhibit such studies. It would clearly be possible to ring more birds, especially in the already visited areas, but the contribution this would make would be of limited value, without considerable follow-up work in Iceland, Ireland, and Britain, especially away from Islay.

Iceland. Now that the basic distribution across the staging areas is known and the basic ecology has been described (Percival & Percival 1997), the main needs are to identify how the population distribution and food availability may change with an increasing population and to provide information necessary for the development of management strategies to avoid agricultural conflict. Another area of study would be to identify any future need for better conservation management, e.g. the establishment of refuge areas on the autumn staging grounds.

Islay. Ongoing studies will be necessary in order to continue to monitor the effects of the goose management scheme, and any successor policy. Their scope could reasonably be said to be limited only by available funds. Monitoring of numbers and distribution is essential, but there is still a lack of understanding of the interaction between the Greenland Barnacle Goose and the Greenland White-fronted Goose populations on the island, as well as incomplete knowledge of the behavioural and habitat factors affecting field selection. The primary need must be to provide information for conservation managers, in particular to predict the effect of different management options, e.g. scaring, shooting, habitat management, etc. There is a particular need to understand the relationship between management and immigration/emigration rates. There is a clear case for an integrated framework, including population monitoring, to optimise the use of available data and to target further research to the most needed areas.

Other wintering areas. Only very limited studies have been carried out either in Scotland or Ireland, yet management changes on Islay could have considerable knock-on effects elsewhere in the wintering range and it has to be said that we are not currently in a position to know whether or not these are already occurring. There is also a need for more information on movements between wintering haunts, factors affecting numbers that can be supported at each, including how to maintain present numbers, and what may be involved in the birds' own preference for a traditional wintering haunt as compared to the intensively managed farmland of Islay.

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18 Barnacle Goose
Branta leucopsis: Svalbard

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1. POPULATION REVIEW

1.1 Range

The Svalbard Barnacle Goose is indistinguishable morphologically from birds of the other Barnacle Goose populations, but is geographically isolated. It breeds in the Svalbard archipelago between 80° N on the northernmost coasts of the largest island, Spitsbergen, to the southern tip of the same island at 76°30' N (Prestrud et al. 1989). In late August or early September, many of the birds migrate to the southernmost island, Bjørnøya, at 74°30' N, some 250 km south of the main group of islands. They stay there for up to three weeks until favourable winds initiate migration south. Some birds probably migrate direct from Spitsbergen to the wintering grounds on the Solway Firth in northern Britain at 55° N (Owen & Gullestad 1984).

The wintering range is small, the birds staying within around five kilometres of the Solway coast and ranging along it to sites no more than 50 km apart. In late April or early May the spring migration takes the geese on a first stage to Helgeland, an area with a number of archipelagos between 65° and 67° N and up to 50 km off the western coast of mainland Norway (Gullestad et al. 1984). They make the second leg of the spring migration in the second half of May and stay in the southern part of Spitsbergen before reaching the nesting areas at the end of May. The migration routes and the time spent in the various parts of the range are shown in Figure 18.1. Their range at each stage of their life cycle has expanded in recent years as the population has increased (Owen et al. 1987, Prestrud et al. 1989, Black et al. 1991, Prop et al. in press).

1.2 Delineation of flyways

Before 1960, few Barnacle Geese of any population had been ringed; only 40 recoveries had been received before 1959, only six of these from the range of the Svalbard population. Nevertheless, the recovery pattern was so clear-cut that there was a definite indication of the geographical isolation of the different breeding groups in winter (Boyd 1961). The position was clarified in the 1960s when over 1000 geese were ringed in the Svalbard population and substantial numbers of birds from the range of the Greenland and Siberian breeders. More than 8000 birds have been individually marked in the recent studies of The Wildfowl & Wetlands Trust (WWT) and this ringing has confirmed the discreteness of the populations, with only 0.1% emigration and no recorded immigration (Owen & Black 1991a).

The spring staging area was not identified for certain until 1975, though six of the seven early recoveries from Norway in spring were from the Helgeland area. Since then it has been confirmed that all the geese visit and stage in this area in spring and that this is a vital area to prepare the geese for breeding (Gullestad et al. 1984, Black et al. 1991, Prop et al. in press).

It was not until the 1980s that the importance of Bjørnøya as a staging area was established (Owen &

Gullestad 1984). It is still unknown, however, whether all the birds visit the island or what proportion of them regularly do.

1.3 Population trends

In the early parts of this century, the Barnacle Goose was said to be a common bird on the Solway, it not being uncommon to see flocks of 6000. However, by the 1930s a drastic decline had already occurred; it was unusual to see more that 500 birds during that decade (Berry 1939). In the latter part of the 19th century, Spitsbergen was well visited but very few geese were recorded. Certainly, many of the important breeding areas nowadays had few or no Barnacle Geese in the past (Løvenskiold 1964, Norderhaug 1970). From the incidence of the leucistic gene in the population, Owen & Shimmings (1992) suggested that the population had established recently from a very few founders. It has been suggested that the large flocks on the Solway in the early years came from Greenland and the decrease at the start of the century was due to these geese 'short-stopping' in the Hebrides, particularly on Islay, as conditions improved there with intensifying agriculture (Owen et al. 1995).

The numbers of geese in the population between 1948 and 1997 are shown in Figure 18.2. In the mid-1940s there was considerable disturbance on the wintering grounds from wartime activities and heavy shooting; the lowest ever count was in 1948, when only 300 geese were found on the Solway (Owen & Norderhaug 1977). The geese were protected from shooting in Britain in 1954 and in Svalbard in 1955 and this, with the establishment of the National Nature Reserve (NNR) at Caerlaverock in 1957, led to a recovery in numbers, to 3000-4000 birds in the 1960s. Further increases occurred in the 1970s and 1980s following the establishment of WWT's reserve at Caerlaverock in 1970 and the declaration of breeding sanctuaries on the main nesting islands in Svalbard in 1973. Numbers appeared to stabilise at a level of around 12,000-14,000 in the early 1990s.

In the autumn of 1996, a total of 19,200 were counted and a further census in spring 1997 yielded 23,000 birds. These high numbers were confirmed in the autumn of 1997, when 23,500 geese were counted. No birds carrying rings from either the Greenland or Russian/Baltic populations were found, so it was clear that the birds represented the Svalbard stock. One explanation for the increase could be that the birds have been increasingly lagging behind on migration (there is increasing evidence of this) and that the traditional October count in recent years was carried out before the whole population had arrived on the Solway.

1.4 Breeding success

Breeding success has always been variable in this population; between 1958, when recording began, and 1976, the proportion of juveniles in the autumn population varied between 49.2% and 5.3% (Table 18.1). This variation was found to be dependent on the late-

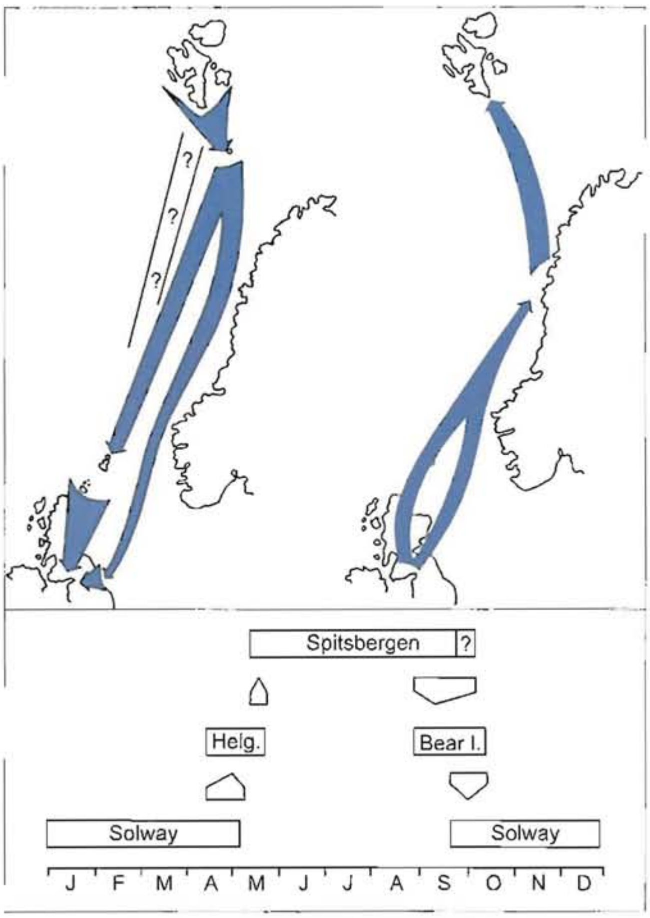

Fig. 18.1. The autumn and spring migration routes of Svalbard Barnacle Geese and the periods of time when geese are present on the various parts of the range. Overlapping times mean that birds are at more than one location. After Owen & Gullestad (1984).

ness of the spring in Svalbard; there was a highly significant correlation between the proportion of young arriving on the wintering grounds and the proportion of ground covered by snow during the laying period in late May and June (Owen & Norderhaug 1977, Prop & de Vries 1993). As the number of birds in the population has increased, so breeding success has become generally lower and, in the last period, less variable. The

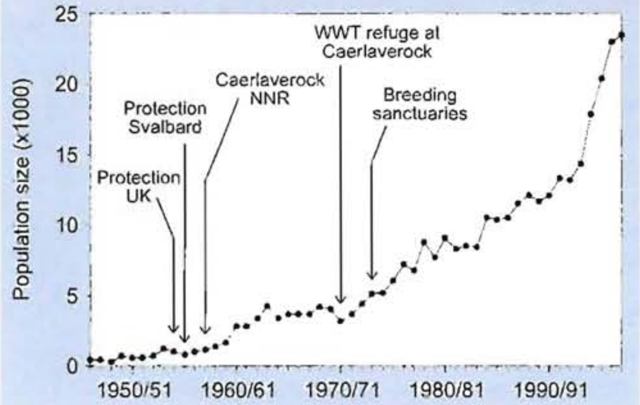

Fig. 18.2. The increase in the Svalbard Barnacle Goose population since 1948, and the conservation measures that were responsible for the changes (update of Black 1995).

Table 18.1. The proportion of young in the Solway wintering flock in autumn since records began in 1958 (12 years: 1958-69; 13 years: 1970-82; 13 years: 1983-95).

	Highest (%)	Lowest (%)	Mean	Coefficent of variation (%)
1958-69	49.2	5.3	23.7	55.9
1970-82	47.2	2.4	18.6	63.5
1983-95	26.2	5.1	12.4	39.8

proportion of young has not exceeded 26% since 1970 and has been no higher than 21% since 1984.

The population still suffers severe depression in breeding in poor years; however, productivity in the good years has declined, hence the lower coefficient of variation in period 3. The decline is brought about by competition for resources on the breeding area, which affects the proportion of birds able to breed, brood size, survival to fledging and successful migration. Hatching success varies in relation to the food resources available on nesting islands, which affects absence of the female from the nest, and the number of young reared on different breeding areas varies according to the food resources on the rearing areas (Prop et al. 1984, Owen 1987). In some years, up to 35% of young are lost on autumn migration, probably because some young are unable to lay down sufficient reserves for the journey. This is related to the hatch date of the young, limited food resources in the breeding areas and competition between families for limited food (Owen & Black 1989a).

The studies of individual birds' performance indicate a great deal of variation in productivity between individuals; the best 10% of birds produce more than a third of the young and half of the next generation's recruits are produced by only 15% of the birds (Owen & Black 1989b). The breeding success of individual birds increases with age; the most productive period being between the age of six and 11 years. Thereafter productivity decreases. The improvement at an early age is attributed to the female, probably the benefit of experience in pre-breeding fattening and nesting. The decline in old age is attributed to the male, probably his ability to establish and defend a nesting territory and declining ability to compete for feeding opportunities for the family (Black & Owen 1995).

Barnacle Geese tend to remain with the same mate for life; only 2% of all pairs ended in divorce (n = 5974 pair-years). Remaining with the same mate seems to be the most successful option available to geese given their energetically expensive lifestyles and limited time in which to breed in the arctic (Black et al. 1996). Choosing an appropriate mate can influence a bird's success in reproduction. For example, small females are more successful if they pair with a small male, and large with large etc. (Choudhury et al. 1996). It is possible that a mismatch in body size could affect a female's ability to cope with the more aggressive nature of the male. A female's build-up of fat reserves, which influences her breeding potential, is apparently related to the effort her mate puts into providing space in the flock in which she can feed without interruption (Black & Owen 1988, 1989b, Black et al. 1991).

The highest breeding performance was achieved by middle-aged males paired with middle-aged females. Young females and old males had a consistently low brood success, irrespective of their mate's age, suggesting that they limited the success of the pair. On the other hand, young males and old females could improve their reproductive success by pairing with middle-aged mates. This suggests that many birds should be attempting to gain the prime, middle-aged mates, the preferred option, to improve their own reproductive performance (Black et al. 1996).

1.5 Mortality

Clearly the decline in numbers in the early part of the century was brought about at least partly by the fact that mortality exceeded recruitment; it is widely reported that this was because of indiscriminate shooting on the Solway (Berry 1939). When the geese were protected, the mortality rate declined until, in the 1960s, the population stabilised at an annual rate of recruitment and mortality averaging about 25% (Owen & Norderhaug 1977). After 1970, mortality declined again to between 10 and 15%, allowing numbers to increase further (Owen 1982). All the changes in population size have been brought about by a change in the underlying mortality rate rather than any variation in breeding success. Indeed, in the 1980s and early 1990s, the population continued to increase despite declining productivity.

The decreases in mortality rate in the 1950s and in the 1970s have been attributed to the provision of a protected feeding area on the wintering grounds (Owen et al. 1987). The first step was the creation of the NNR at Caerlaverock. This provided the feeding refuge which supported the geese during the shooting season, making them inaccessible to illegal shooting. As the population grew, this area became insufficient and the geese overspilled and again were shot in substantial numbers, up to 500 annually (Owen 1982).

The extension of the protected feeding area and positive management for geese in the 1970s again allowed the birds to feed unmolested in the shooting season. The overspilling following increased numbers again in the 1980s did not have the effect of increasing mortality rate because a much larger absolute number of geese would have to be shot to have a measurable effect on the annual rate (Owen et al. 1987). It is also true that policing of shooting had become much more effective over the same period.

There are indications in recent years that the increases in numbers on the breeding grounds and the implied increased competition for food has affected the mortality rate of adults as well as young during the autumn migration. However, there is a need to examine mortality rates further in view of the large number of geese counted in 1996-97. Whereas mortality from shooting on the Solway has seen a relative decline in recent years, the mortality rate outside the shooting season has increased in both males and females, suggesting higher losses on migration (Owen & Black 1991b). Further analyses are required to determine in detail the changes in mortality rates in recent years and their causes.

2. BREEDING GROUNDS AND BREEDING ECOLOGY

2.1 Distribution

The distribution of breeding colonies of Barnacle Geese in Svalbard in the 1980s is shown in Figure 18.3. Although the latitudinal limits of the range have changed little, many new colonies have been established and the size of those existing in the 1960s increased dramatically. The Dunøyane and Forlandsøyane, the traditional heartlands of the geese (Norderhaug 1970) remain the most important areas in terms of nests. However colonies on the Nordenskiøldkysten have become increasingly important. The geese have established in new areas, notably Daudmannsøyra, Kongsfjorden - including at Ny Ålesund where the geese rear their broods and sometimes nest within the protection of the village, and Tusenøyane among the colonies of Light-bellied Brent Geese *Branta bernicla hrota* there (Madsen et al. 1992).

Traditionally, nests were largely on cliffs in the larger valleys but in recent decades offshore islands have become more important (Norderhaug 1970). The most recent available data indicate that 87% of nests are on islands, 6.5% on other coastal sites and 6.5% on cliffs and canyons.

During nesting the female exclusively incubates and the male stands guard. Unusually in geese, when the female leaves the nest the male remains rather than accompanying her, defending the nest against Glaucous Gulls *Larus hyperboreus* which nest on the same islands. On islands which are some distance from the shore and which have a dearth of food for incubating birds, predation rates may be high because both partners may be forced to leave together. In 1986, nesting success (at least one egg hatching) was 84% in a colony where food supplies were available on the islands themselves compared with 21% on an island which had no food and was 1.5 km from the adjacent coast, which itself provides poor feeding. An area with islands providing no food but close to good mainland feeding areas (Nordenskiøldkysten - 60% success) was intermediate (Owen 1987).

Studies on Nordenskiøldkysten over an extended period (Prop et al. 1984) showed that nest success varied according to the ability of individual females to gain sufficient food of the right quality during their short absences from the nest. Extended absences by 'poor' females led to predation of the eggs. Success also varied depending on the season; nest success varied in the same area from 18% to 74% in different years (Prop et al. 1984, Prop & de Vries 1993).

After hatching, families disperse to vegetated areas surrounding tundra lakes along the coast; family groups tend to be separate from flocks of non-breeders in the same general area.

2.2 Moult migration and moulting areas

No moult migration has been recorded. Immature geese tend to revisit their natal areas to moult; concentrations of geese around the various colonies tend to represent the breeding, non-breeding and immature birds produced by those colonies. Yearlings and non-breeding geese gather around lowland lakes which are first to thaw in the spring. They are joined by failed-breeders in large moulting flocks. Non-breeders moult 2-3 weeks before nesting geese, which do not shed their feathers until they have settled with their families on the rearing areas. Parental males time their moult according to the hatch date of their young; they remain fully flighted until their goslings are about three weeks old, at which stage they are relatively safe from avian predators (Owen & Ogilvie 1979).

2.3 Research

The first significant research on the breeding grounds was a ringing expedition to Hornsund in 1962, aimed at establishing where the Svalbard birds spent the winter (Larsen & Norderhaug 1963). A catch on the Solway in the following winter established the link between the wintering and the breeding grounds. Further catches were made in the 1960s to follow up these observations.

In 1973, a WWT expedition to Hornsund (Jackson et al. 1974) began the intensive study of the population which still continues today. More than 8000 geese have been caught in connection with this work, mostly on Svalbard. Most intensive was the expedition to the Nordenskiøldkysten in 1977, when 1241 individual geese, representing 93% of the birds summering on the coast and 18% of the whole population at that time were caught and individually marked (Owen et al. 1978). Regular expeditions since have ensured that a high proportion of the population are individually identifiable.

Detailed ecological studies of the geese on the breeding grounds by Dutch scientists began with a reconnaissance trip to the Nordenskiøldkysten in 1975 (Ebbinge & Ebbinge-Dallmeijer 1977). Observations of nesting geese were made in the same area in 1975 (Dittami et al. 1977). A four-year study of geese on the Diabasøya colony was carried out between 1978 and 1981 (Prop et al. 1981, 1984, Prop & de Vries 1993). This verified the relationship between breeding success and weather and examined in detail individual performance in relation to ecological conditions on the breeding grounds. Studies of breeding and moulting geese have also been carried out at Ny Ålesund in recent years (Tombre 1995, Loonen 1997), carrying on the productive relationship between the Dutch and Norwegian groups and the WWT, who followed up the observations with work on the wintering grounds. Other intensive work into the nesting ecology, migration and flight performance (Bishop et al. 1995) of the geese breeding at Ny Ålesund has been carried out in recent years.

2.4 Protection and conservation

Historically, the geese and other nesting wildfowl in Svalbard have been exploited by Man, largely for their eggs and down (Løvenskiold 1964, Norderhaug 1970). Shooting was also allowed during the autumn, though

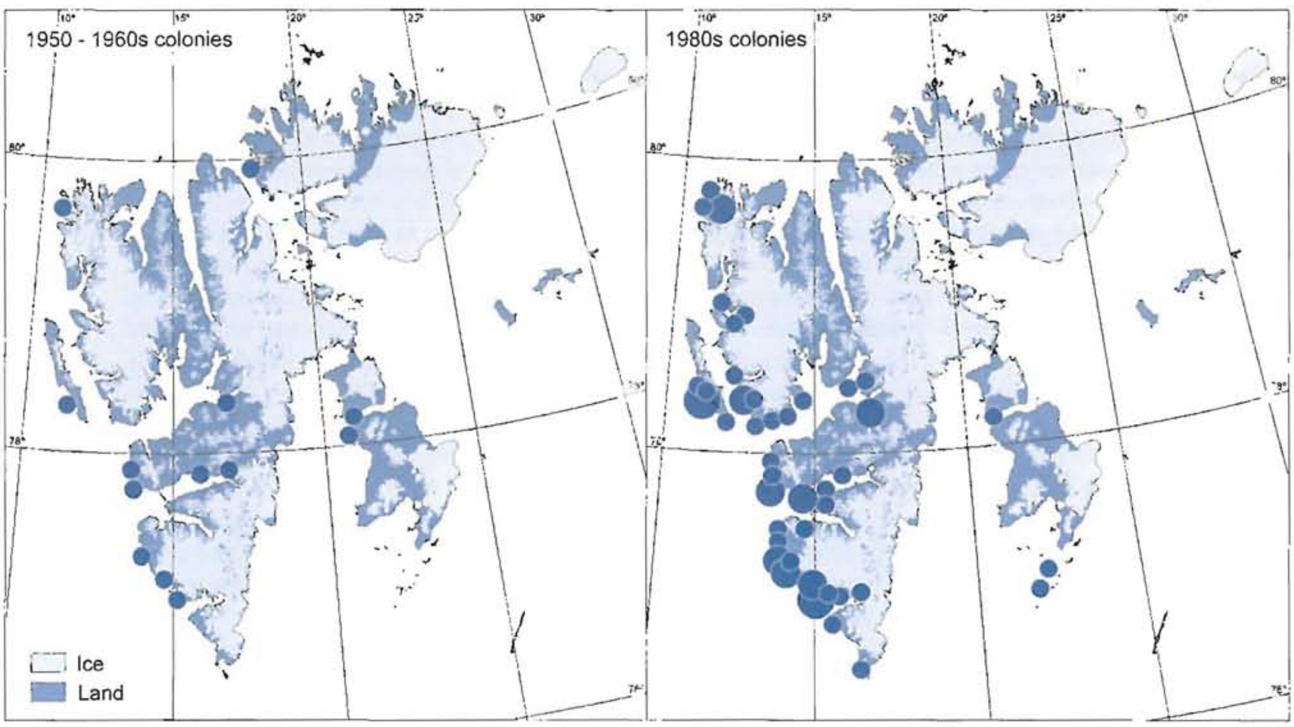

Fig. 18.3. The distribution of Barnacle Goose breeding colonies in Svalbard in the 1950s-60s and the 1980s with an indication of their size (after Prestrud et al. 1989).

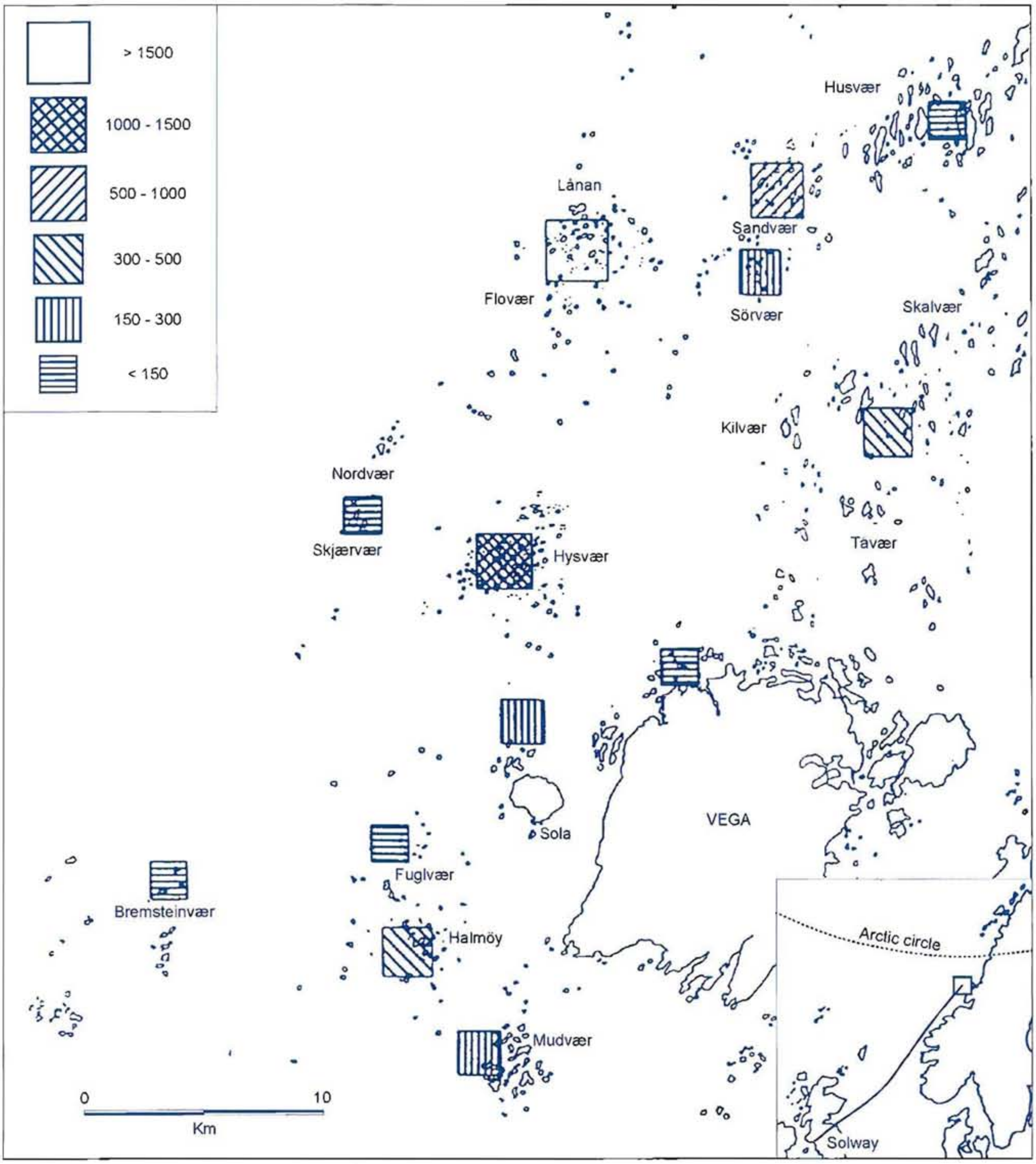

Fig. 18.4. The Helgeland spring staging area and the important archipelagos for Svalbard Barnacle Geese. After Gullestad et al. (1984).

the Pink-footed Goose *Anser brachyrhynchus* was more accessible to hunters and was the preferred quarry.

The Barnacle Goose was given full legal protection from hunting in Svalbard in 1955 and it remains protected there. In 1973, 15 bird sanctuaries were established along the west coast of Spitsbergen, with the aim of protecting the breeding sites of Eider Ducks *Somateria mollissima* and geese. Access to these sanctuaries is completely prohibited during the nesting season and is by permit only at other times during the summer. In 1982 and 1983, surveys during the nesting period established that no fewer than 70% of nesting Barnacle Geese were found within these sanctuaries (Prestrud & Børset 1984). Since that time, with the growth of populations in unprotected areas, notably the inland valleys and Nordenskiøldkysten, the proportion nesting on sanctuaries has probably decreased (Black 1998).

3. STAGING AREAS

3A. HELGELAND, NORWAY

3A.1 Distribution and abundance

The geese leave the Solway from mid April onwards and arrive in the spring staging area in Helgeland about 24 hours later. There are some geese in the area for 20-30 days, and individual birds usually stay between two and three weeks (Gullestad et al. 1984). All the geese have moved to Svalbard by the end of May.

Helgeland was surveyed during the 1970s (Gullestad et al. 1984) and the distribution of staging geese at that time is shown in Figure 18.4. A complete survey of the whole range in 1987 established that the entire population is found in Helgeland in mid May (WWT unpubl.). The centre of the staging area was the Lånan-Flovær archipelago and the adjacent Hysvær and Sandvær; as many as 2600 geese were found on Lånan-Flovær and about half the population on the three archipelagos combined. The exact distribution probably varies from year to year; in 1987, a very early summer, the southernmost archipelagos were deserted as vegetation there had passed the stage when it is palatable to geese.

In recent years, following human depopulation of the more inaccessible islands, there has been a considerable change in distribution. The geese have moved onto larger, inhabited islands, especially to Tenna/Heroy, which are northeast of the area shown in Figure 18.4. In recent years as many as 3100 geese, 25% of the population, could be found on these two islands (Black 1998). There has been a progressive desertion of the main haunt on Lånan-Flovær, not only because of the attraction of agriculturally managed habitats, but also because the habitat on that archipelago has deteriorated following an explosion in a population of Water Voles *Arvicola terrestris* (Black et al. 1991).

Studies of the behaviour and feeding ecology of the geese on the agricultural habitats and outer islands established that the birds using the former fared better (Black et al. 1991). The birds using the fertilised, managed grasslands fed on grass of higher quality which was more easily gathered than the sparse swards on the outer islands. The birds also fed for a smaller proportion of the day and spent more time resting. This difference had an effect on body condition, as assessed by abdominal profile (Owen 1981a) and preliminary results indicate that this results in significantly better breeding success for birds using the agricultural areas (Black et al. 1991, unpubl. data).

After departing Helgeland in spring, geese travelling to the northernmost breeding grounds at Ny Ålesund spend between 14-31 days in transit. These birds may stop during migration or spend some time in southern parts of Spitsbergen for refuelling (Tombre et al. 1996).

3A.2 Research

Work in Helgeland has been carried out by the WWT research team in collaboration with the Directorate for Nature Management in Norway and the local authorities, together with scientists from The University of Groningen and Norwegian universities. Early studies established the importance of the various areas and the pattern of stay of the geese (Gullestad et al. 1984). More recently, work focussed on the relationship between the geese and agriculture and on the management of the traditional areas for geese (Prop & Black 1990, Black et al. 1991, Prop et al. in press). The results of much of the work are as yet unpublished but they will be incorporated into a management plan for the Helgeland area being developed by WWT and the Norwegian authorities and into a Flyway Management Plan involving all range states which is in draft (Black 1998).

3A.3 Protection and conservation

The geese were not protected in Norway until 1971; however, the birds were not accessible to hunters during the shooting season since most do not stop on autumn migration and when they do, only briefly on remote offshore islands.

The archipelagos used in spring are also intensively managed for Eider down and are jealously guarded by their owners. The Eider Ducks come ashore to nest at the same time as the Barnacle Geese are staging, so the down farmers ensure that the islands are undisturbed, giving effective protection to the feeding areas of the geese. The Directorate for Nature Protection, with technical help from WWT are working on plans to give the area the more formal protection of a designation as a National Park (Black 1998). This would protect not only the habitats but the cultural life on these remote areas and the relationship between the human inhabitants and the wildlife.

3B. BJØRNØYA

3B.1 Distribution and abundance

Some geese arrive on the island in the last days of August and stay until early October. There are indications that non-breeding geese arrive earlier than the breeding birds (Owen & Gullestad 1984, Owen & Black 1991a); many families may stay on Spitsbergen and make the journey from there without staging on Bjørnøya. Departure from the island depends on weather conditions; the birds do not leave until the winds are northerly and favourable for migration. An analysis of weather on Bjørnøya and mass arrival patterns on the Solway indicated that the journey takes about 48 hours. Geese apparently left as soon as the wind changed to a favourable direction in the last half of September and in early October.

There are no herbivores on Bjørnøya yet the vegetation grows no taller than 2-5 cm because of the preponderance of fog, and consequent cool conditions and lack of sunshine. Very little of the island is vegetated; the geese gather on the few patches of vegetation in the river valleys and on the north and west coast. The most lush areas are headlands on the west coast where gulls rest in large numbers, fertilising the tundra with their droppings (Owen & Gullestad 1984).

3B.2 Research

Visits were made to the island by WWT scientists and Norwegian colleagues in the early 1980s to established the importance of the site for geese and assess the distribution of suitable habitats (Owen & Gullestad 1984). Follow-up visits were made in 1986 (but the geese had been driven south early by snowfall (Owen 1987)) and in the summer of 1996, when the distribution of vegetation and its use by geese (evidence from goose droppings) were confirmed. More detailed ecological studies and the use of the various areas by geese have been identified as of priority in the Flyway Management Plan (Black 1998).

3B.3 Protection and conservation

Bjørnøya is part of the Svalbard archipelago where legal protection was afforded the geese in 1955. However, policing is difficult and it is known that some shooting by the occupants of the radio station has taken place, at least in some years. The difficulty of approaching the geese and the small number of people involved means that the impact on the population has been negligible.

The island used to be inhabited - a coal mining settlement operated in the northwest; this is now derelict and the only habitation is a permanently-manned radio station in the north of the island. The only known threat in recent years was a proposal to introduce Reindeer *Rangifer tarandus* onto the island but this was successfully thwarted because of its importance for geese.

4. WINTERING AREAS

4.1 Distribution and abundance

The geese traditionally used the grazed saltmarsh (merse) habitats on the Solway, moving onto adjacent agricultural land within five kilometres of the coast. The distribution of saltmarsh and the location of the main goose haunts is shown in Figure 18.5; in each case the geese roost on sand- and mudflats adjacent to each area of merse. Three areas have been used intensively: the Caerlaverock area, Rockcliffe Marsh, and farmland around Southerness. The proportion of geese supported on the different sites has, however, varied according to the level of protection afforded the different areas and the number of geese in the population.

Following the establishment of the NNR at Caerlaverock, which was the main haunt at the beginning of each winter, the birds shifted their base to Rockcliffe in February, with Southerness area being used sporadically in mid winter (Roberts 1966). During the early 1970s when the WWT started to manage farmland for geese, the use of the Caerlaverock area increased from 30% in 1969 to 50-60% four years later (Owen & Campbell 1974). In the late 1970s and early 1980s, when the

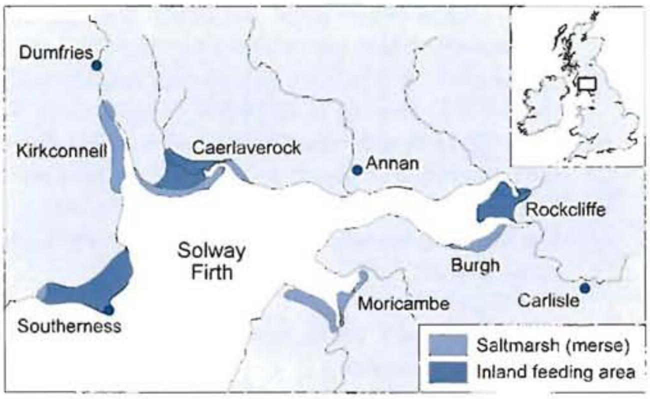

Fig. 18.5. The Solway Firth showing the areas of saltmarsh (merse) and the adjacent farmland feeding areas for Svalbard Barnacle Geese. After Owen et al. (1987).

main growth in the population occurred, the carrying capacity of the reserve was reached and the proportion of time spent at Caerlaverock declined to about 40%, with only about half on the WWT reserve. Rockcliffe accommodated a similar proportion, with Southerness assuming greater importance. In the early 1980s, better management at Caerlaverock increased the proportion of geese accommodated there and there were indications that the capacity of Rockcliffe to hold geese in the spring had been reached (Owen et al. 1987). More recently still, as numbers of geese have increased and a reserve has been created there, the Southerness area has become more important at the expense of both Caerlaverock and Rockcliffe (Shimmings et al. 1993).

The habitats used and the diet of the geese have been studied in detail (Owen & Kerbes 1971, Owen 1975, Owen et al. 1987). When on the merse, the stolons of White Clover *Trifolium repens* are the primary food in the autumn, supplemented by grasses and herbs such as *Puccinellia maritima, Festuca rubra* and *Triglochin maritima*. On pasture their diet is dominated by *Lolium perenne*, the main constituent of the sown swards in the area. In the early autumn the birds also visit stubble fields, gleaning the spilt grain.

4.2 Research

Monitoring the movements of the geese in the Caerlaverock area began with the establishment of the NNR in 1957 (Roberts 1966). WWT and the Nature Conservancy Council (NCC) began age ratio assessments from 1958. However, the coverage of the Solway and hence the assessment of the total population size was inadequate in the 1960s and population dynamics data for that period are not as reliable as later data (Owen & Norderhaug 1977).

On the arrival of WWT at Caerlaverock in 1970, monitoring was intensified and counts were made on a daily or twice-daily basis and records kept on the use of each individual field by the geese. Complete population counts and accurate age ratio estimates ensured that the population dynamics could be accurately followed. In recent years monitoring of the whole of the Solway has been instigated by Scottish Natural Heritage (SNH) in the context of new goose and habitat management schemes which have recently been put in place.

The marking of individuals with rings readable with the aid of a telescope at up to 200 m began in 1973, when 350 birds were ringed (Jackson et al. 1974). Since then, more than 70 papers and reports have been published including four PhD studies about these birds. The following is a selection of the more important scientific papers:

Techniques:
  Owen 1975, 1981a; Rees et al. 1990.

Population dynamics:
  Owen & Norderhaug 1977; Owen 1982, 1984; Owen & Black 1989a, b.

Ecology and food:
  Owen & Kerbes 1971; Owen 1981b; Owen et al. 1987, 1992; Black et al. 1991, 1992.

Management:
  Owen 1977, 1980; Black 1995, 1998.

Social evolution:
  Black 1987; Black & Owen 1987, 1988, 1989a, b, 1995; Black et al. 1996; Choudhury 1992; Choudhury & Black 1994; Choudhury et al. 1992, 1996; Owen et al. 1988.

4.3 Protection and conservation

Barnacle Geese have been protected by law in Britain since 1954, though in later years illegal shooting still accounted for some birds (Owen 1982). The policing of the various areas by conservation agencies and responsible wildfowlers has, however, improved markedly in recent years and the proportion of the population and probably the absolute number of geese taken illegally, has declined to a level which no longer impacts on the overall population.

Geese have caused problems for farmers for many years and a number of farmers have applied for licences to shoot geese in order to protect their crops; until 1994, however, these had all been refused. In the early 1990s, one farmer, despite having had applications for licences refused, took matters into his own hands and shot geese. Following an incident in 1993 he was taken to court but acquitted on the grounds that he had to take action to prevent serious damage to his crops (a loop-hole in the law which has since been closed). However, following his success, the Scottish Office granted him a licence to shoot geese in 1993-1994, 1994-1995 and 1995-1996. The number of birds shot was probably no more than 10 per year; in fact, in 1995-1996, a limit of 12 birds was imposed. It was the disturbance to the WWT Reserve and to the Special Protection Area, as well as the principle of licensing against the provisions of the European Union (EU) Birds Directive, that was of concern to WWT.

The WWT took the Scottish Office to judicial review on the grounds that the granting of the licence was unlawful under EU legislation. The matter was settled out of court in the WWT's favour in 1996, with the Scottish Office paying the major part of WWT's costs. The conditions under which WWT withdrew its petition for judicial review will probably mean that no licences will be granted in future unless the law or the conditions are changed.

The NNR was established at Caerlaverock in 1957 with the express purpose of protecting the feeding areas of the geese and this was extended in 1970 when WWT took over the lease of the major part of the reserve and the surrounding farmland. WWT has since extended its holding and now manages more than 400 ha of land at Caerlaverock. In 1994, RSPB purchased 200 ha of land at Mersehead, in the Southerness area and some of this is managed as goose pasture and has resulted in the whole area becoming more important.

In 1993 Scottish Natural Heritage, the successor of NCC in Scotland, established a Goose Management Scheme by which farmers in the main goose areas on the Solway could be paid for tolerating geese on their land and this has done much to alleviate the conflict. Another initiative - the Merse Management Scheme, pays grants to farmers to improve the grazing of the merses in order to improve their value for wildlife, including geese. These two schemes, together with that of English Nature's on the northern Solway coast, when in full operation and refined, should secure the future of the population on the Solway unless numbers increase further. Similar comprehensive managment initiatives are being planned for Helgeland, thus reducing potential conflict with farmers and providing safe havens for the geese.

5. DISCUSSION

This population is one of the most studied populations of migratory geese in the world over a period of 25 years. The studies provide a detailed understanding of the biology of the birds, their likely prospects and conservation needs in the future. They have also provided a model for other studies of geese (e.g. Black et al. 1994) and techniques developed during the work, such as faecal analysis (Owen 1975) and the Abdominal Profile Index (Owen 1981a), have been widely adopted for studies of herbivorous wildfowl.

Population status: The areas of Svalbard where breeding is possible for Barnacle Geese are not extensive; much of the archipelago is snow covered or polar desert. In view of this and following the substantial increases in numbers experienced in the 1970s, Owen & Norderhaug (1977) predicted, on the assumption that the absolute number of young produced would not increase, that the population would level out at no more than 12,000 birds. This was when the mortality rate of 10-12% resulted in a loss of geese equivalent to the average production. Twenty years later, the population started to level out at 13,000-14,000 geese, only a little higher than that predicted. The average number of recruits has in fact increased, since the density in some of the breeding areas was not at capacity in the mid 1970s and the geese have colonised new areas. One of these new sites, Ny Ålesund, is artificial, only being viable because of the protection from predators afforded by

Man. High counts in 1996 and 1997 go against this trend and the counts, productivity figures and mortality rates need to be re-examined to explain how this increase was possible.

A recent analysis of colonies established for differing numbers of years indicated that colonies may go through a cycle of increasing productivity followed by a decline as capacity is reached and the inhabitants become older (Black 1998). It is possible that as more and more colonies advance in age this will cause a drop in overall productivity which will result in a reduction in numbers. Given the slow rate of increase in recent years, it seems likely that numbers will not grow much beyond current levels. A more sophisticated computer modelling process came to a similar conclusion (Rowcliffe et al. 1995).

Future research needs: In terms of yielding scientific data and publications of high academic interest and merit, the study continues to increase in value and the WWT is committed, as far as resources allow, to continuing this work for the foreseeable future (Owen & Black 1993). The data already gathered will provide analytical work for scientists for years to come.

The priority research needs as far as conservation and management are concerned were identified in the Flyway Management Plan (Black 1998). Monitoring of the population, including the ringing programme to provide population dynamics data, should continue throughout the range. A better understanding of the use of the Bjørnøya staging area is needed if future threats are to be successfully combated.

Besides continued population monitoring, the priority for the future will be to continue detailed observations on an individually marked sample of birds and to study the long-term effects of goose grazing on tundra vegetation. With this approach we aim to investigate the proximate factors that are responsible for the density dependent decline in reproductive and survival parameters, namely the interaction between the geese themselves (social regulation and kin selection) and their food plants (foraging ecology and dynamics).

Conservation and management: In November 1995, conservation agencies in England, Scotland, Norway and met to discuss the development of a strategic plan to conserve and manage the population throughout its range. Commissioned by SNH, WWT has produced a Flyway Management Plan which has been agreed between the parties (Black 1998). The plan is in a format which will fulfil the obligations of range states under the Agreement on the Conservation of African-Eurasian Migratory Waterbirds which was signed by the United Kingdom and Norway in 1995. The framework provided by this plan will ensure coordinated international action for the protection of this population and will lead, in all range states, to action being taken to secure the protection of all the habitats and sites on which the population depends at every stage.

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19 Barnacle Goose *Branta leucopsis*: Russia/Baltic

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1. POPULATION REVIEW

1.1 Range

The Russian population of the Barnacle Goose breeds in the tundra zone of the Russian Arctic, along the coast of the Barents Sea and western Kara Sea (67 to 73° N; Fig. 19.1). Formerly confined to the islands of Novaya Zemlya and Vaygach, it is now found breeding from the Kola and Kanin Peninsulas in the west to Vaygach and Novaya Zemlya in the east, both on islands and on the Russian mainland. The much smaller Baltic population of Barnacle Geese, which established itself in the early 1970s, breeds on Swedish, Estonian, Finnish and Danish islands in the Baltic Sea (56 to 59° N; Fig. 19.1). The Russian and the Baltic populations are treated together in this chapter because they mix in winter, use the same staging areas, and the first Baltic colony most probably was founded by birds originating from the Russian population (Larsson et al. 1988, Leito 1993). The majority of each population winters in the Netherlands; only during cold winters do some birds move as far south as France (Schricke 1991). Autumn and spring staging areas are along the Wadden Sea coast of Denmark, Germany and the Netherlands (Fig. 19.1). In April/May, spring fattening areas for the arctic breeders are in Estonia and Sweden, where large concentrations are observed simultaneously in both countries. The Russian population migrates from the Baltic spring staging areas to the breeding areas via the Finnish Gulf, Lakes Ladoga and Onega, and the White Sea. The White Sea area may be used as a stopover area on both autumn and spring migration by birds breeding on Novaya Zemlya and Vaygach; in late summer of 1996, 20,000-30,000 staging Barnacle Geese were observed on the west coast of the Kanin Peninsula (P. Tolvanen pers. comm.).

1.2 Delineation of flyways

Although the two other populations of Barnacle Geese (Svalbard and Greenland breeding birds) winter not too far away in Scotland and Ireland, almost no interchange with the Russian or Baltic populations has been detected from recoveries or resightings of ringed birds (Ogilvie & Owen 1984, Ebbinge 1985).

1.3 Population trends

Because Russian and Baltic Barnacle Geese concentrate in large flocks in coastal areas in continental western Europe in winter, their total population size is easy to determine compared to other, more scattered goose populations, and annual count data are available starting in 1972/73. In the early 1950s, the Russian population was probably as low as 10,000 birds (Boyd 1961). Reliable data on the population size before 1950 do not exist, but Dement'ev and Gladkov (1952) report 'catastrophic declines' of numbers of breeding birds on Novaya Zemlya. Reports of 'large flocks' of Barnacle Geese along the German coast (summarised in Podloucky 1985 and Busche 1991) also suggest that numbers were higher in the last century; at the same time, the Netherlands were only rarely visited by Barnacle Geese in winter, and the majority of birds seem to have wintered further north (Timmerman 1962). After the 1950 low, numbers had reached nearly 20,000 in 1959-60 (Boyd 1961), and since then the population has increased steadily (Fig. 19.2). The latest available count data from January 1997 record 267,000 birds, including c. 13,000 birds from the Baltic population. Since 1960, the Russian population has thus shown an average annual increase of approximately 7%. The average annual increase in the Baltic population since its establishment in 1971 has been approximately 41%. Despite this dramatic increase of the temperate Baltic breeding population, the vast majority of the total of the two populations counted in winter still consists of Russian arctic breeders (Fig. 19.2).

1.4 Breeding success

Breeding success of Russian Barnacle Geese, measured as the percentage of young birds in wintering flocks, shows strong annual fluctuations between 1% and nearly 50%, as is typical for many high arctic breeding goose species. Annual counts of juvenile proportions have been carried out since 1960-61 (Fig. 19.3). Ebbinge (1991) reported a significant decrease in the breeding success of the population from when counts began to the late 1980s; however, this trend was mainly caused by some very high juvenile percentages in the 1960s and has not continued in the 1990s (Fig. 19.3). In the temperate-breeding Baltic population, there have been no such strong annual fluctuations in breeding success. In recent years, however, there has been a density dependent decline in the production of juveniles in the largest Baltic colony: while the number of breeding pairs has continued to increase, the total number of fledged young has stayed the same (Larsson & Forslund 1994).

1.5 Mortality

Today, the Russian and Baltic populations of Barnacle Geese are protected throughout their range. In the Netherlands, Barnacle Geese have been protected since 1950; until 1970 they could be shot under special licence at staging areas in the Baltic, and until 1977 they could be hunted in the autumn in Schleswig-Holstein, Germany (Ebbinge 1991). Analyses of annual mortality rates before and after major changes in hunting legislation revealed a decrease in the mean annual mortality rates from 25% in 1958-1969 to 12% in 1978-1984 (Ebbinge 1991). Thus, mortality rates have halved following the closure of hunting, and the overall increase of the population size must at least partly be seen as a recovery after protection from shooting.

For the Baltic population, resightings of marked birds between 1984 and 1995 yielded a calculated average annual mortality rate of only about 8% (H. van der Jeugd, K. Larsson & P. Forslund unpubl. data).

2. BREEDING GROUNDS AND BREEDING ECOLOGY

2A. RUSSIAN POPULATION

2A.1 Distribution

Range: Until the beginning of the 1980s, the only known breeding areas of Barnacle Geese in the Barents Sea region of Russia were on Novaya Zemlya and Vaygach. The majority of birds (90% estimated by Kalyakin (1995)) still breed on these islands, with probably the largest part of the population concentrated on the southern island of Novaya Zemlya. This island is very large, and suitable nesting habitat for Barnacle Geese is abundant along its east and west coasts and along rivers; in every area visited on this island, some nesting Barnacle Geese were found. On the northern island of Novaya Zemlya, abundance of Barnacle Geese is much lower. Vaygach is much smaller than the southern island of Novaya Zemlya and suitable nesting habitat for Barnacle Geese is less abundant; therefore, the total number of Barnacle Geese nesting here is probably much lower than on Novaya Zemlya.

Since 1981 new breeding sites outside Novaya Zemlya and Vaygach have been found. Today, breeding Barnacle Geese can be found in small colonies from the eastern tip of the Kola Peninsula in the west to the Yugor Peninsula in the east (Fig. 19.4). Syroechkovsky (1995a) estimated 3000-4000 pairs breeding on the lowlands and islands of the Barents Sea coast outside Novaya Zemlya and Vaygach, of which c. 1000 pairs oc-

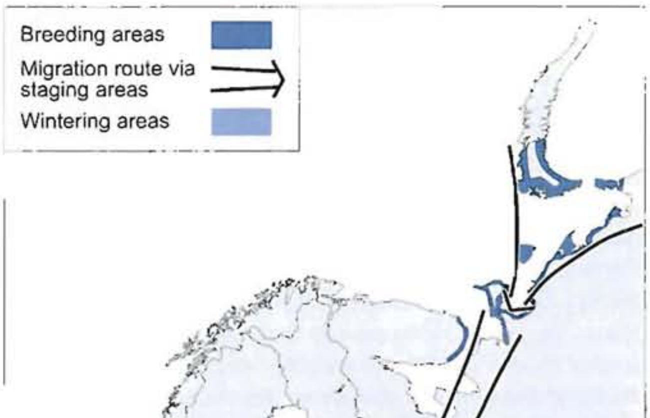

Fig. 19.1. Breeding areas, migration route and wintering areas of Russian and Baltic Barnacle Geese.

cur on Kolguyev alone. Morozov (1995) estimated 100-110 pairs of breeding Barnacle Geese on the Yugor Peninsula; recently discovered colonies on the lowland coasts and islands of the southern Barents Sea hold about 50-450 pairs (Filchagov & Leonovich 1992, Syroechkovsky 1995a).

Breeding habitat and breeding biology: 'Classic' nesting habitats of Barnacle Geese are cliff ledges, rocky outcrops and small offshore islands which are relatively safe from predation by Arctic Foxes *Alopex lagopus*. On Novaya Zemlya, only a small fraction of pairs nests on coastal cliffs or on cliffs of canyons in the interior of the island, while the majority of birds nest on abundant islands and rocks situated near the coast of the main island. Colonies on such islands may consist of up to 1000 nests. The abundance of nests in small island colonies shows strong annual fluctuations in connection with weather conditions and the presence of ice-bridges connecting the breeding islands with the mainland of Novaya Zemlya. Small islands that hold no breeding birds in a late and cold year can hold several hundred pairs in a more favourable year. Near Vaygach Island there is no such large number of small islands. The majority of Barnacle Geese on Vaygach nest in rocky river cliffs, coastal cliffs or on small rocks near the coast. In some years, nesting Barnacle Geese are also abundant in the central areas of Vaygach. In 1986-1988, the birds very rarely nested on shores of small lakes, but they began using this habitat more often in 1995. For the first time in 1996, several nests were found on flat tundra.

Barnacle Geese arrive on Vaygach Island within the first ten days of June, depending on the weather, in small flocks (up to 20-30 birds). Nest initiation begins from 5 June (1995) to 23 June (1987). On Novaya Zemlya nest initiation in 1995 began ten days later than on Vaygach. The total clutch size depends on egg dumping and can vary from 3.8±0.3 s.e. (n=15) to 4.5±0.3 s.e. (n=29) in different colonies within the same year (E.V. Syroechkovsky & K.E. Litvin unpubl. data). The incubation period is 23-24 days. Hatching success varies widely depending on the phenology of the season and on predation pressure.

Almost all nesting habitat of Barnacle Geese in the northwestern part of Vaygach is accessible to Arctic Foxes, and as a consequence annual nesting success is dependent on the status of the population of foxes and, ultimately, of lemmings (*Lemmus sibiricus and Dicrostonyx torquatus*) (Syroechkovsky et al. 1991). Thus, there are several independent sources of the strong annual fluctuations in breeding success that occur in the

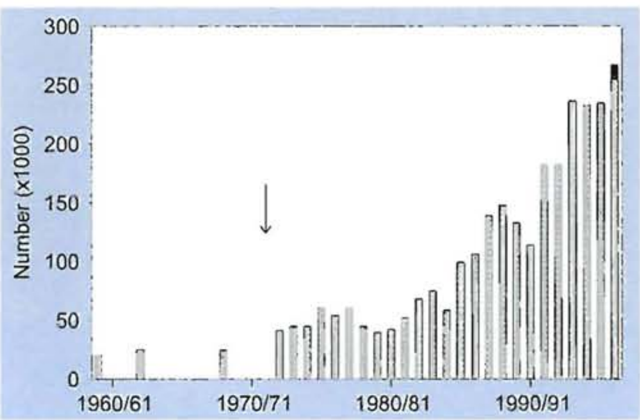

Fig. 19.2. Population totals of Russian and Baltic Barnacle Geese. Arrow indicates the first breeding pair recorded in the Baltic. In 1996/97, the fraction of the total number belonging to the Baltic population is indicated. (Data: Ebbinge 1987, Meltofte et al. 1994, Larsson & van der Jeugd 1998, SOVON 1998, Wetlands International Goose Database).

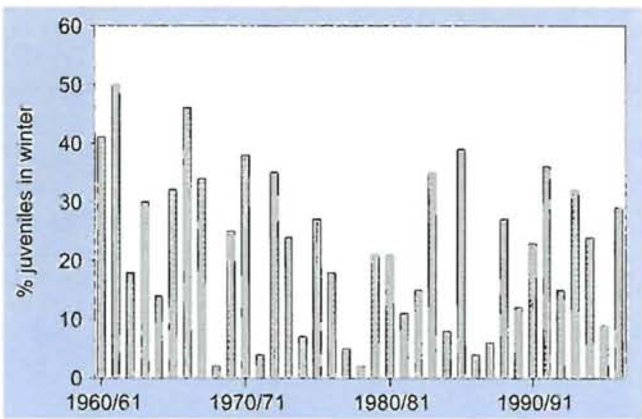

Fig. 19.3. Breeding success of Barnacle Geese wintering in Germany and the Netherlands. (Data: Ebbinge 1982, 1991, Ganzenwerkgroep 1990, Ganter 1992, Rösner 1993 and unpubl. data, SOVON 1998).

various main breeding areas, so that in some years the main fraction of recruitment to the population can come from Novaya Zemlya, while in other years it comes from Vaygach and other areas.

Nesting of Barnacle Geese in association with aerial predators (Glaucous Gull *Larus hyperboreus*, Rough-legged Buzzard *Buteo lagopus*, Peregrine Falcon *Falco peregrinus*) is common; nesting in old Rough-legged Buzzard nests has been observed (Kalyakin 1986). Uspenski (1964, 1965) also reported nesting in seabird colonies - among Guillemots *Uria aalge*, Thick-billed Murres *Uria lomvia* or Kittiwakes *Rissa tridactyla* - as common.

Recently established colonies along the Barents Sea coast can be found in habitats that are very different from those predominantly used for nesting on Novaya Zemlya and Vaygach (Syroechkovsky 1995b): sandy islands and spits with driftwood and dunes partially covered with vegetation; saltmarsh areas in the deltas and estuaries of rivers; flood plains and terraces in river valleys with tundra vegetation, on vast lowlands.

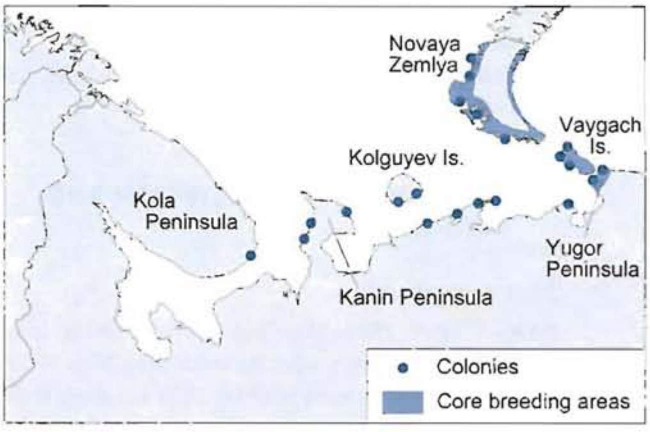

Fig. 19.4. Breeding range of Barnacle Geese in Russia as known in 1994 (after Syroechkovsky 1995a).

2A.2 Moult migration and moulting areas

Large flocks of up to several hundred moulting Barnacle Geese have only been observed on the sea near the coast of Novaya Zemlya and Vaygach. Smaller groups of broods and moulting non-breeders (20-30 broods and up to 30-40 non-breeders) sometimes moult in lakes with rocky shores in the central parts of these islands. In case of danger these flocks often move to larger lakes or to the sea shore.

2A.3 Research

Russian expeditions to the breeding areas since the 1920s have provided information on range and breeding habitat (Dement'ev and Gladkov 1952). Expeditions in the 1950s (Uspenski 1964, 1965) described the distribution of nesting sites on Novaya Zemlya and Vaygach. Detailed research into the breeding ecology of Barnacle Geese (and other species of geese and swans) has been carried out on Vaygach since 1986, and on Novaya Zemlya and the Yugor Peninsula since 1994 (Syroechkovsky et al. 1995). The Russian-Swedish Tundra Ecology -94 Expedition provided more information on the breeding range expansion along the Barents Sea lowlands and to Kolguyev Island (Syroechkovsky 1995a, b).

2A.4 Protection and conservation

Hunting legislation and public awareness: Barnacle Geese are legally fully protected in Russia, and Russian hunters and local inhabitants of the breeding areas are aware of this. At present, however, there is very little to no enforcement of hunting regulations in the range of Barnacle Geese in northern Russia, and a number of birds - perhaps some hundreds - are shot illegally, mainly during spring migration and on arrival on the breeding grounds, together with other goose species. Since Barnacle Geese have increased in numbers and are now locally as abundant as other species, public acceptance of their conservation status is decreasing. Barnacle Geese are easier to shoot than Bean Geese *Anser fabalis* or White-fronted Geese *A. albifrons*, and their ratio among all hunted goose species is probably growing. In the currently very unstable economic situation in the Russian Arctic, hunting of geese is an additional and often very substantial source of food, and one of the tendencies in recent years has been the growing interest of some local people in hunting geese including Barnacle Geese. In addition, egg collecting for food by local inhabitants of the Kanin Peninsula and Kolguyev Island may significantly reduce the local production of Barnacle Geese there (Syroechkovsky 1995a); however, the effects of this activity in the main breeding areas on Novaya Zemlya and Vaygach are probably insubstantial compared to the shooting of adult birds.

Another major effect of the current economic situation is the mass emigration of people from the Russian Arctic. Many settlements have been completely abandoned, and in the remaining ones the number of inhabitants has decreased dramatically. This depopulation of the Russian Arctic, accompanied by fuel shortages that make long-distance hunting expeditions impossible, reduces hunting pressure on all goose species including Barnacle Geese. Without special investigation, it is at present impossible to say which of these tendencies prevails and whether the current situation leads to increase or decrease of the overall hunting pressure on Barnacle Geese in the Russian Arctic, but the present hunting pressure is not controlling population size.

Site safeguard: Currently, there are no zapovedniks (strict nature reserves, IUCN category I) in the core breeding range of Russian Barnacle Geese, and almost no areas in the range have any formal protection. Exceptions are the central part of Vaygach Island and the eastern part of the Pechora Delta, which are protected as sanctuaries (IUCN category IV). Due to lack of enforcement, the sanctuary status of large parts of Vaygach does not result in any significant protection of geese. There are proposals to establish zapovedniks on parts of Novaya Zemlya and most of the Pechora Delta;

reserves of IUCN category II status are proposed for the Kanin Peninsula and Kolguyev Island (CAFF 1996). The entire region is under severe pressure from oil and gas exploration.

2B. BALTIC POPULATION: SWEDEN AND ESTONIA

2B.1 Distribution

Range: Since 1971, breeding Barnacle Geese have been reported in the temperate Baltic area (Fig. 19.5). The Baltic breeding area is about 2000 km away from and 1300 km south of the arctic breeding area of the Russian population. Larsson et al. (1988) concluded that the establishment of the first Baltic colony off the east coast of Gotland, Sweden, was natural and that the founder birds probably originated from the Russian population. The colonies which were subsequently established along the coast of Gotland and Öland, Sweden, and around Saaremaa and Muhu in western Estonia were probably to a large extent founded by birds of Baltic origin (Forslund & Larsson 1991a). Almost all of the Baltic colonies have increased rapidly since their establishment (Fig. 19.6) (Larsson & Forslund 1994). The rapid increase in the number of breeding pairs can be explained by a high reproductive output and a high degree of philopatry. The rate of increase in the oldest and largest Baltic colony, Laus holmar (2130 pairs in 1997), has decreased in recent years because of density-dependent effects on reproduction (Larsson & Forslund 1994) (Fig. 19.6). In 1997, the total number of breeding pairs was estimated to be 3490 pairs in Sweden (Gotland and Öland) and 126 pairs in western Estonia, or a total of 17,000 individuals in autumn (Larsson & van der Jeugd 1998). In recent years, some small colonies and scattered pairs have also been found along the coast of the Swedish mainland (SOF 1995), in Finland (Hilden & Laine 1991), on the island of Saltholm in the Danish Øresund (National Environmental Research Institute (NERI), Denmark, unpubl. data), and near the German Baltic coast (Bräger & Ludwichowski 1995). Some of these smaller colonies, particularly those in Finland and mainland Sweden, have most probably been founded by birds that escaped from captivity.

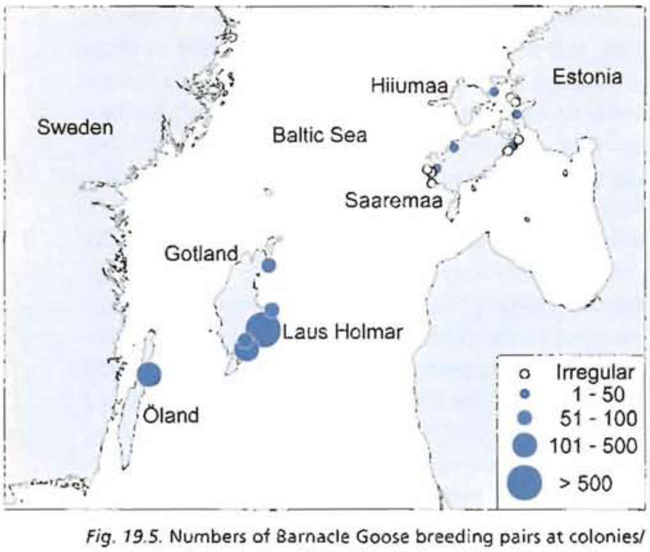

Fig. 19.5. Numbers of Barnacle Goose breeding pairs at colonies/sites in the Baltic in the 1990s (Estonia) and 1996 (Sweden).

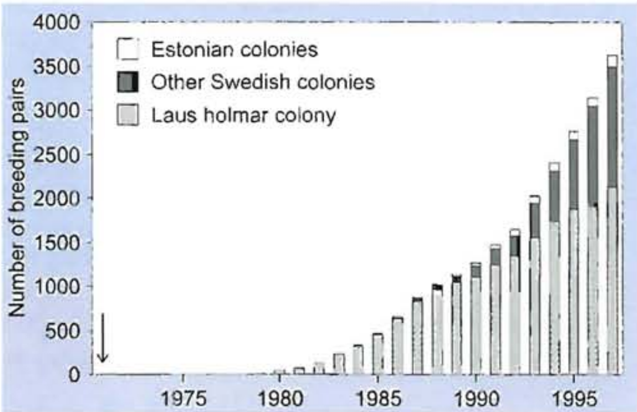

Fig. 19.6. Development of the Baltic breeding population of Barnacle Geese. Arrow indicates first breeding pair recorded in the Baltic.

Habitat and feeding ecology: All localities on Gotland and Öland and in Estonia where breeding Barnacle Geese have been recorded are also regularly used as spring staging areas by birds belonging to the arctic Russian population. The breeding colonies are situated on small (less than 300 ha) relatively flat islands. Suitable feeding areas for the geese, created by grazing cattle or sheep, are present within a few kilometres at most. Adults and goslings feed to a large extent on Red Fescue *Festuca rubra* but also on *Puccinellia maritima, Agrostis stolonifera* and *Juncus gerardii* (Larsson & Forslund 1991, van der Veen 1994).

2B.2 Moult migration and moulting areas

In 1996 there were six main moulting areas on Gotland and one on Öland. Non-breeding birds hatched on Öland have been observed moulting on Gotland and vice versa. Successful and failed breeders have been observed moulting up to 30 km away from their nesting sites. In Estonia, flocks of family groups from colonies moult around the breeding areas in July. Moulting groups of non-breeders have been seen in different regions of the West Estonian Archipelago.

2B.3 Research

Detailed research into population dynamics, behaviour and genetics of the Swedish breeding birds has been carried out since 1984 (Forslund & Larsson 1991a, b, 1992, 1995, Larsson & Forslund 1991, 1992, 1994, Larsson et al. 1995, Larsson 1993, 1996). A large proportion (c. 20%) of the population is individually colour-ringed, which has generated a large number of resightings both on the breeding grounds and at staging and wintering grounds. Resightings of colour-ringed Baltic birds during winter in Germany and the Netherlands (more than 100,000 resightings) have shown that the

Baltic population and the Russian population are almost completely mixed on the wintering grounds (Ebbinge & van Biezen 1987). A few birds marked on Gotland during the breeding season have been resighted in the Russian Arctic. There are also birds, some 75% of them males, which were marked as juveniles on Gotland and regularly observed in winter but never observed in the Baltic during summer. This indicates that there is at least a limited gene flow between the Baltic and the Russian populations. The breeding population of Barnacle Geese in Estonia has been studied since 1981 (Leito 1993).

2B.4 Protection and conservation

Hunting legislation: Between 1942 and 1969 migrating Barnacle Geese could be shot under special licence on Gotland (Thelander 1982). Between 1970 and 1986 the species was fully protected in Sweden. Since 1987 hunting has been allowed in April and May under special licence on spring staging areas on Gotland. Between 1987 and 1996, a total of 250-300 birds were shot on Gotland. In Estonia, the species has been fully protected since 1968.

Site safeguard: The three largest breeding colonies in Sweden are situated within nature reserves. The other Swedish breeding colonies have no official protection. Of the 15 islands where Barnacle Geese have nested in Estonia, eight are strictly protected as reserves and the others are partially protected as part of the West Estonian Archipelago Biosphere Reserve.

Public awareness: The Barnacle Goose and its status are well known among the public on Gotland and in Estonia. Efforts to inform the public have been made by the media in Estonia.

3. STAGING AND WINTERING AREAS

3A. ESTONIA

3A.1 Distribution

Range: Staging Barnacle Geese from the Russian population concentrate in western Estonia, mainly along the coasts of the islands Hiiumaa, Muhu and Saaremaa, and in Matsalu Bay (Fig. 19.7). The number of different sites used has increased steadily from about 20 in the 1960s to more than 100 in the early 1990s.

Habitat and feeding ecology: Formerly only natural and semi-natural marine coastal meadows and grasslands were used, the main food being *Festuca* spp. (>90% of ingested food) although other plants are eaten, such as *Juncus gerardii*, *Poa* spp., *Plantago maritima* and *Triglochin maritima* and, occasionally, *Zostera marina* (Leito & Renno 1983). With increasing numbers, the original sites have become saturated and birds are now exploiting new resources such as cultivated grassland and cereals (barley, rye and wheat). Roosting takes place mainly outside the foraging areas, particularly on small islands without foxes or human activities

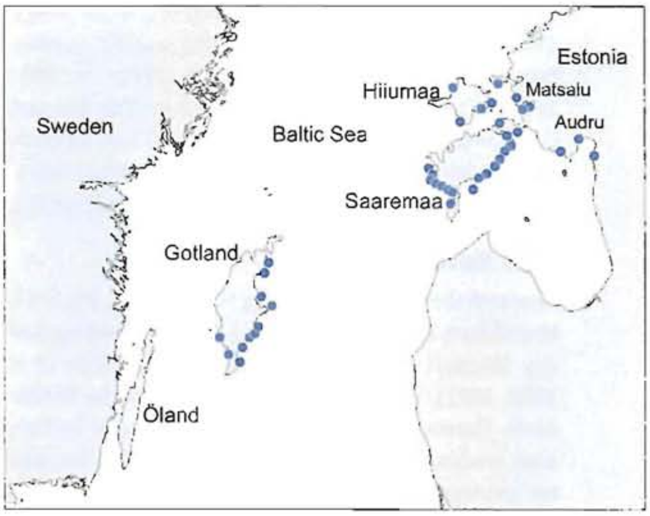

Fig. 19.7. Barnacle Goose spring staging areas in Estonia and Sweden. Only sites regularly holding over 1000 geese are shown. Smaller flocks occur along most of the coast of Gotland, Öland (temporarily), Hiiumaa, Saaremaa and the adjacent Estonian mainland.

or, where no islands are available, in shallow coastal water.

3A.2 Abundance

Phenology: Formerly, the majority of the Russian population passed over Estonia rapidly in autumn and birds stayed for only a few days in late September or early October (Leito & Renno 1983). More recently the birds have been stopping for a longer time and in larger numbers in September and October, sometimes until the beginning of November. In spring, Barnacle Geese start to arrive in Estonia at the end of March, with numbers building up throughout April and peak numbers being reached in early to mid May. Mass departure occurs from 15 May, usually between 20-25 May (Leito & Renno 1983). Resightings show some exchange of spring staging birds between Swedish and Estonian sites (Leito et al. 1986).

Trends and numbers: The numerical trend of Barnacle Geese staging in Estonia parallels that of the entire Russian and Baltic populations (Leito et al. 1991) (Fig. 19.8). Ground surveys and aerial censuses during

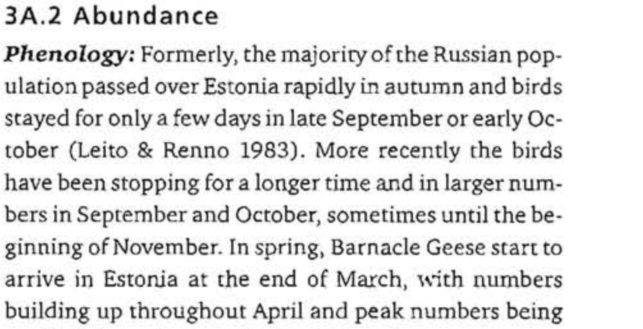

Fig. 19.8. Spring counts of Barnacle Geese in Estonia.

spring staging, carried out intermittently from 1964 to 1989, revealed an increase in spring staging numbers from 11,000 to 57,500 (Leito et al. 1991). In 1993, 102,000 and in 1996, 89,000 spring staging Barnacle Geese were counted in Estonia in total. Thus, since the 1960s a fairly constant proportion of 30-50% of the total population has been observed in Estonia in spring.

3A.3 Research

Research during spring staging has included studies of abundance, distribution, staging time and feeding ecology (Kumari 1971, Leito & Renno 1983, Leito et al. 1986, 1991). Resightings of birds ringed in the Netherlands, Germany and Sweden have been made by Estonian ornithologists. Since 1987, research has focussed on management measures to alleviate agricultural damage.

3A.4 Protection and conservation

Hunting legislation: Barnacle Geese were fully protected in Estonia from 1968 to 1996. In 1996, their status was changed to that of 'game bird'; however, shooting is limited and allowed only in areas with agricultural damage during autumn migration (Leito 1996). Special licences to alleviate agricultural damage during migration have been discussed.

Site safeguard: Feeding and roosting sites are protected in Matsalu Reserve, Vilsandi National Park, and Hiiumaa Islets State Reserve where up to 30,000 geese stage in spring. Protection is necessary since the spring distribution of staging Barnacle Geese in Estonia depends on the availability of suitable coastal meadows, which are restricted to parts of the western coast of Estonia.

Agricultural conflict: The capacity of natural habitats for staging geese in Estonia is limited, and the number using these areas is at present restricted to about 30,000 (Leito et al. 1991). Geese in excess of that number move to agricultural areas, where damage to both grassland and cereals has been reported since the mid 1980s. The severity of damage greatly depends on the age of the crops at the time of goose grazing and on the moisture content of the soil (Leito 1996). Visual-acoustic scaring devices are used to keep geese off fields. Damage is partly compensated for by the State Environmental Fund. Appropriate management of nature reserves, improving the sward and banning human disturbance, should safeguard their essential role for staging Barnacle Geese and alleviate conflict with farmers in surrounding areas (Leito et al. 1991).

3B. SWEDEN

3B.1 Distribution

Range: In spring, Barnacle Geese belonging to the arctic Russian population can be observed staging in large numbers along the coast of Gotland. There are at least ten major staging areas where thousands of arctic birds are regularly observed (Fig. 19.7). Smaller groups of staging Barnacle Geese can be seen at almost all coastal areas on Gotland and temporarily also along the coast of Öland. In recent years grazing flocks have been observed in increasing numbers on agricultural fields far from the traditional coastal spring staging sites. In autumn, the Russian Barnacle Geese pass Gotland much more quickly; hence, fewer sites host large numbers of birds. In contrast to the situation in spring, large numbers of staging Barnacle Geese can be seen on the southernmost part of Öland in autumn.

Habitat and feeding ecology: The spring staging Russian Barnacle Geese and the Baltic Barnacle Geese both feed in coastal habitats and on agricultural fields. The coastal habitats, which are intensively grazed by spring staging geese, are later grazed by cattle or sheep, and *Festuca rubra* is an important food item.

3B.2 Abundance

Phenology: The staging periods in spring and autumn parallel those in Estonia. There is an extended spring staging period, from late March to mid May, with peak numbers at the end of April or the beginning of May. In autumn, arctic birds can be seen from the beginning of October to mid November, with peak numbers usually in the third week of October.

Trends and numbers: As in Estonia, the trend in numbers in Swedish spring staging areas parallels that of the total populations. Synchronous counts on Gotland and in Estonia revealed that the Swedish sites hold about one third of the numbers observed in Estonia at the same time (Leito et al. 1986).

3B.3 Research

Monitoring of spring staging numbers by aerial counts was carried out from the beginning of the 1960s to the mid 1980s (Beinert 1982). In the spring of 1982, about 100 staging birds were individually colour-ringed for investigations of spring fattening and migration patterns between wintering and spring staging areas in the course of a comprehensive Dutch-German-Swedish project.

3B.4 Protection and conservation

Hunting legislation: In order to reduce crop damage, the County Administration on Gotland has permitted licensed hunting of staging Barnacle Geese in April and May since 1987. Up to 1996, fewer than 300 birds had been shot under this licence.

Site safeguard: Several of the major spring staging areas have reserve status. Some areas have been actively managed with the aim of improving the quality of the preferred food of the staging geese.

Agricultural conflict: Barnacle Geese may cause damage on cultivated grassland and on cereals. To reduce damage, scaring devices of various types are often used on agricultural fields. Most mechanical scaring devices lack long-term effects. Until 1995, farmers could apply for compensation for damage from governmental funds. Between 1991 and 1995, on average, 308,000 SEK was paid to farmers as compensation each year. Since 1996, farmers have been able to apply for compensation from the County administration on Gotland. It is also possible to apply for money for active management of staging areas. In 1996, approximately 200,000 SEK was paid to farmers for such active management of approximately 230 ha of grassland.

3C. DENMARK

3C.1 Distribution

Range: Only three sites in Denmark regularly support more than 1000 staging Barnacle Geese; two of these, Margrethekog/Tøndermarsken and Ballum Enge/Forland, are situated in the Wadden Sea area in southwest Denmark and as such are a northern extension of the chain of staging areas along the Wadden Sea coast of the Netherlands and Germany (Fig. 19.9). The third site, Ulvshale-Nyord, is situated on the island of Møn in southeastern Denmark and is only used regularly in autumn. Some smaller sites on the west coast of Denmark and in the Baltic archipelago support smaller numbers, regularly or irregularly, during both spring and autumn staging.

Habitat and feeding ecology: Barnacle Geese in Denmark feed on coastal saltmarshes and inland pastures on polders close to the coast; in recent years they have also increasingly been feeding on winter cereal fields.

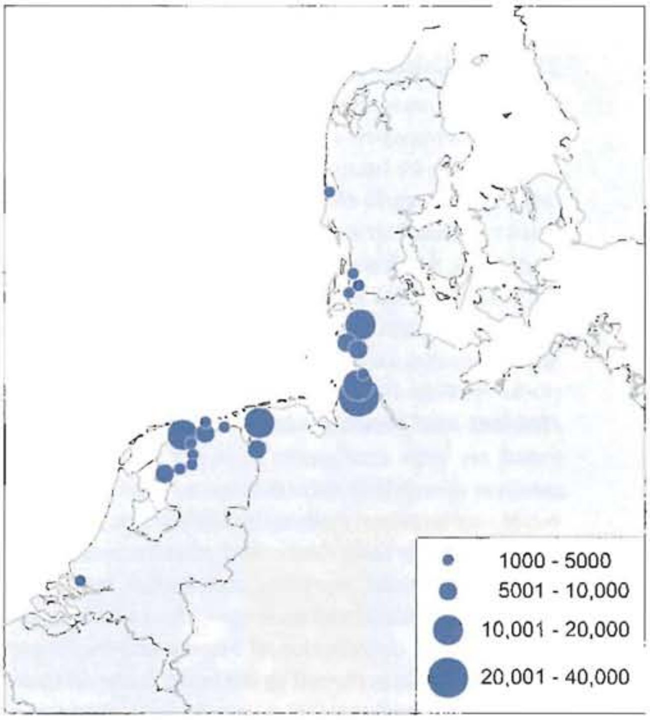

Fig. 19.9. March distribution of Barnacle Geese following mild winters. Germany, March 1990-95 (WWF-Projektbüro Wattenmeer unpubl. data, Niedersächsisches Landesamt für Ökologie unpubl. data); the Netherlands, March 1985-94 (Koffijberg, Voslamber & van Winden 1997); Denmark 1990-96 (Wetlands International Goose Database).

3C.2 Abundance

Phenology: The Danish staging sites are visited by Barnacle Geese both on autumn migration in October-November and on spring migration from February to April. The peak in numbers is higher and of shorter duration in autumn than in spring. Since the beginning of the 1990s, increasing numbers of Barnacle Geese (up to 20,000 in 1994-95) have remained in Denmark during the winter; this new phenomenon represents an expansion of the wintering range, favoured by the recent series of mild winters (1987-88 to 1994-95). In cold winters, Barnacle Geese abandon the Danish sites. During spring in the 1990s, Barnacle Geese have stayed increasingly longer in Denmark; flocks of more than 1000 can now be observed in early May.

Trends and numbers: Prior to the 1980s, the only regular staging area in Denmark was the island of Saltholm, with up to 1000 birds counted. For unknown reasons, Barnacle Geese do not use this site any longer (except for a few breeding pairs). Concurrent with the overall increase in the Russian and Baltic populations, numbers at the two main staging sites in Denmark have increased dramatically. At Ballum Enge/Forland maximum numbers have grown from a few hundred in 1975-76 to 18,000 in 1994-95. The saltmarsh area of Tøndermarsken was an important site for Barnacle Geese in the mid 1970s with maximum numbers of more than 3000 birds; when most of this saltmarsh was embanked in c. 1980, numbers dropped to a few hundred, but have since grown far beyond past maxima in the new polder of Margrethekog, reaching about 17,000 birds in 1994-95. The use of Ulvshale-Nyord started in the late 1980s, coinciding with the creation of a hunting-free refuge encompassing the saltmarshes which are the main feeding areas used by up to 6500 Barnacle Geese (Madsen 1998).

3C.3 Research

Regular censuses have taken place since 1984 at all goose staging sites in Denmark at those times of the year when the largest numbers of geese were present (Madsen 1986, Jørgensen et al. 1994, NERI unpubl. data). A study of possible interspecific competition between wintering Barnacle Geese and Pink-footed Geese *Anser brachyrhynchus* co-occurring at Ballum Enge was conducted by NERI in 1994-1996.

3C.4 Protection and conservation

Hunting legislation: The Barnacle Goose has been fully protected in Denmark since the beginning of hunting legislation.

Site safeguard: The sites used by Barnacle Geese in Denmark are all Ramsar sites and EU Special Protection Areas (SPAs).

Agricultural conflict: Since numbers of Barnacle Geese are still relatively small in Denmark, agricultural damage by this species has not yet been a major problem (van Roomen & Madsen 1992), although problems have locally exacerbated in recent years.

3D. GERMANY

3D.1 Distribution

Range: Barnacle Geese in Germany occur almost exclusively in mainland areas along the Wadden Sea coast of Schleswig-Holstein and Niedersachsen. Birds concentrate in large flocks at only a few main sites, separated by coastal areas almost devoid of Barnacle Geese (Fig. 19.9). Small numbers (up to several hundred) can also occur on some German Wadden Sea islands, on the Baltic coast of Germany and inland in the Lower Rhine area, where Barnacle Geese sometimes intersperse with flocks of White-fronted and Bean Geese.

Habitat and feeding ecology: Barnacle Geese are found on large contiguous stretches of coastal saltmarsh in areas where there is access to brackish or fresh water, and on inland pastures and fields in polders close to the coast. Barnacle Geese feed on saltmarsh grasses (mainly *Puccinellia maritima* and *Festuca rubra*), on cultivated grassland and on crops such as winter wheat and rape. The combination of marine and freshwater influence that is preferred by Barnacle Geese often occurs - if only temporarily - in newly embanked areas, and here numbers can increase rapidly (see below). The distribution between saltmarshes and inland areas follows a seasonal trend, with inland areas being used more intensively in autumn and saltmarshes in spring (Mock 1996). Roosting areas are often identical with feeding areas; at some sites sandbanks and mudflats in the vicinity of the feeding areas are used for roosting.

3D.2 Abundance

Phenology: The abundance of Barnacle Geese in Germany shows two seasonal peaks in autumn and spring. While the passage of birds through the Baltic is very rapid in autumn and only few birds stage there, large parts of the Russian and Baltic populations stop in Germany in October and November. During the second half of November most birds move on to their final wintering areas in the Netherlands, but depending on the severity of the winter several thousand birds can remain in the German staging areas throughout December and January (Busche 1977, 1991). Numbers build up gradually in the new year, and spring peak numbers are reached throughout March and in the first half of April. In late April, numbers drop when birds migrate to the spring staging areas in the Baltic.

Trends and numbers: Spring and autumn numbers of Barnacle Geese in Germany have increased parallel to the overall increase of the Russian and Baltic populations. Increase at some sites, especially in two areas in Niedersachsen, Leybucht and Dollart (Gerdes 1994), has been particularly dramatic. Outside these areas, only small numbers occur along the coast of Niedersachsen, and no new areas have been used in the last ten years. In Schleswig-Holstein, however, an expansion of sites and habitats used has taken place. Inland sites, sometimes a few kilometres away from the dike, where no Barnacle Geese used to occur are now regularly utilised in the northern part of Schleswig-Holstein. Higher maximum numbers in the most important Schleswig-Holstein staging areas have not led to a more intensive overall use in terms of bird days in those areas (Rösner 1993). Instead of increasing the pressure on traditional areas which may be filled to capacity, birds have begun to exploit new areas.

As in Denmark, the autumn peak in numbers is of shorter duration than the spring peak. In the Niedersachsen and Schleswig-Holstein parts of the Wadden Sea (which are mostly counted separately), up to 50% of the total Russian/Baltic population occurs at certain times of year. Although maximum numbers in the spring can be stable for a period of several weeks, there is considerable turnover in the flocks (Ganter 1994), and the total fraction of the Russian/Baltic population using the Schleswig-Holstein part of the Wadden Sea area is certainly much higher than 50%.

Mid winter numbers in Germany are largely dependent on the severity of the winter. Between 1989 and 1994 (all mild winters), mid January totals for Germany ranged from 5200 (1991) to 36,000 (1994); however, these do not necessarily represent the mid winter low since numbers tend to increase already from the beginning of January.

Habitat changes, such as embankment of Wadden Sea areas, can lead to short-term shifts in parts of the populations (see also section 3E.2 below). Nordstrand Bay, with a total of 3300 ha of saltmarshes and mudflats was embanked in 1987. Numbers of Barnacle Geese present in the area decreased during the first two years after embankment and then increased dramatically to peak numbers of more than 20,000 in 1989 and 1990. Birds were attracted by a mass development of *Salicornia* on the former intertidal mudflats while at the same time fresh water was available in adjacent parts of the new polder (now Beltringharder Koog). Birds using the newly embanked area came from the adjacent staging site Hamburger Hallig and used both areas alternately (Ganter 1992). From 1991 onwards numbers in the Beltringharder Koog dropped again after successional changes in the vegetation (Hötker & Kölsch 1993).

3D.3 Research

Complete censuses of Barnacle Geese on the Wadden Sea coast of Germany are carried out twice a year, once during the international waterbird census in mid January and once in late March during a trilateral count in the three Wadden Sea countries. Many of the major sites are counted year-round at least twice a month.

Individual colour-ringing of Barnacle Geese in Schleswig-Holstein was carried out by Dutch and German researchers from 1979 to 1989 (in the course of the project being conducted on the staging grounds in Sweden and in the Netherlands). Resightings of birds throughout the non-breeding season gave information on the links between staging and wintering areas. A study of phenology of Barnacle Geese in Schleswig-Holstein and movements of individuals between staging areas was carried out in 1988-90 (Ganter 1992, 1994), and local studies of distribution and behaviour were carried out both in Niedersachsen (Gerdes 1994, Jaene & Kruckenberg 1996) and in Schleswig-Holstein (Mock 1993, 1996).

3D.4 Protection and conservation

Hunting legislation: Until 1977 Barnacle Geese could be hunted in the autumn in Schleswig-Holstein; since then there has been no open season for this species in Germany. In recent years, some special shooting permits have been issued to farmers in Schleswig-Holstein for the purpose of scaring Barnacle Geese off their fields, which may result in the shooting of a few dozen birds annually (Rösner 1993). In Niedersachsen, no special shooting permits have been issued.

Site safeguard: The saltmarsh areas used by Barnacle Geese in Germany are part of the International Wadden Sea Ramsar site and of the Wadden Sea National Parks Schleswig-Holstein and Niedersachsen that were established in 1985 and 1986. This does not exclude human disturbance, competition with sheep grazing and/or coastal protection measures, but ensures general priority of natural processes and migratory bird populations above human exploitation interests. Most major inland sites used by Barnacle Geese are nature reserves.

Agricultural conflict: Although the use of pastures and crops by staging Barnacle Geese has been reported for a long time (e.g. von Hedemann 1937), increasing numbers of geese visiting the coastal areas of Germany, especially Schleswig-Holstein, have caused agricultural conflict only in recent years. Damage is reported on grasslands, winter cereals and rape. In Schleswig-Holstein, some compensation is paid for losses on winter cereals and rape (where most of the damage is caused by grazing Wigeon *Anas penelope* rather than Barnacle Geese), but not on grassland. No compensation payments are made in Niedersachsen.

3E. THE NETHERLANDS

3E.1 Distribution

Range: Major Barnacle Goose haunts in the Netherlands are located along the Wadden Sea coast of the provinces of Groningen and Friesland, including the Dollard, the Lauwersmeer area and the island of Schiermonnikoog (but none of the other Wadden Sea islands); further south and inland in the central and southern parts of the province of Friesland and the Noordoostpolder (IJsselmeer area); and in the northern Delta area (Haringvliet/Grevelingen) (Fig. 19.10). In the Dutch Delta area the Russian and Baltic populations reach the southernmost edge of their winter range, except in very cold winters when several thousand birds can move further south to Belgium and France. On the inland sites, Barnacle Geese commonly occur in mixed flocks with White-fronted or (less commonly) Bean Geese. In coastal areas, mixing with Brent Geese *Branta bernicla* is common, especially during autumn and winter.

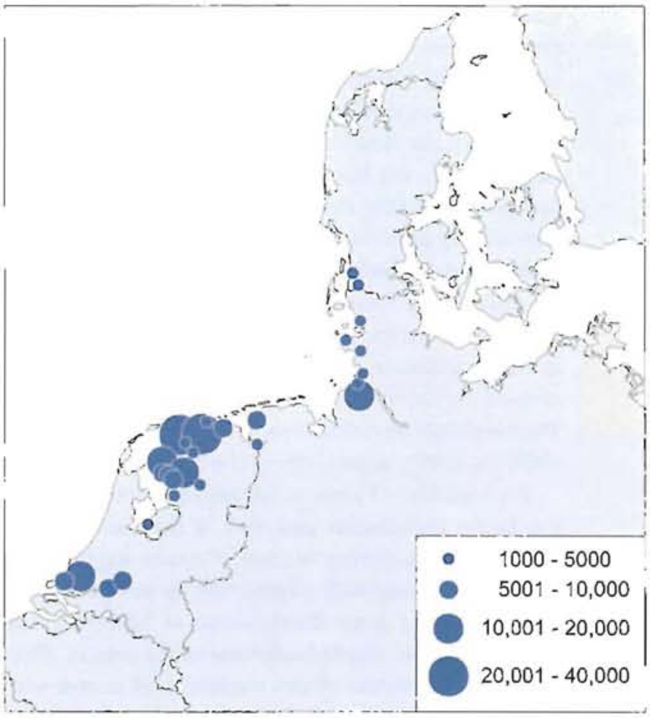

Fig. 19.10. Winter distribution of Barnacle Geese in mild winters. Germany, January 1990-95 (WWF-Projektbüro Wattenmeer unpubl. data, Niedersächsisches Landesamt für Ökologie unpubl. data); the Netherlands, January/February 1985-94 (Koffijberg, Voslamber & van Winden

Habitat and feeding ecology: In the Wadden Sea area, the main feeding areas are saltmarshes with a predominant vegetation of *Festuca rubra* on the higher terraces and *Puccinellia maritima* on the lower parts. Apart from the massive *Salicornia* fields that have developed temporarily in the Lauwersmeer-area (see below), intensively cultivated inland pastures with a predominant vegetation of *Lolium perenne, Poa pratensis* and *P. annua*, are important feeding areas in the Netherlands. Feeding on reseeded grass, winter cereals and winter rape may occur, the extent of this depends on the weather, especially snow conditions. Feeding on clover stolons (Ebbinge 1983) and stubble fields has also been observed. In autumn, the geese feed on saltmarshes as well as inland pastures, in winter almost only on inland pastures. At the end of the winter, some of the geese move to saltmarshes where they feed on *Festuca* in early spring and add *Puccinellia* to their diet when it starts growing (Prins & Ydenberg 1985). On the brackish marshes of the Dollard, the preferences of Barnacle Geese for certain areas are related to the intensity of sheep and cattle grazing on the marshes (Aerts et al. 1996).

3E.2 Abundance

Phenology: Birds arrive in autumn (October-November) in the coastal areas of the Wadden Sea; at this time almost the entire Russian and Baltic populations are concentrated here and in the German/Danish part of the Wadden Sea. Birds begin to spread out in the course of November (when more birds also arrive from staging areas in Germany and Denmark) into the central and southern parts of Friesland and the Noordoostpolder in the IJsselmeer area, as well as to the Delta area. During cold winters, almost all birds leave the Wadden Sea area and move to the more southern and inland areas. In January, the first birds start to leave in a northeasterly direction; the last birds used to leave from Schiermonnikoog and the Haringvliet area in March, but are now staying until the end of April or even longer.

Trends and numbers: During parts of the winter, almost the entire Russian and Baltic populations of Barnacle Geese are found in the Netherlands. Consequently, the population growth has been reflected in increased numbers at the various sites used by the birds. The maximum total count was 245,000 in January 1997 (SOVON 1998), nearly 90% of the total populations.

For a number of years at the beginning of the 1970s, the entire populations gathered in the Lauwersmeer area in autumn; during this time, German staging areas were almost completely passed over in autumn. In the Lauwersmeer, a mass development of *Salicornia* had taken place after the embankment of the area in 1969, and the combination of this massive food source with availability of fresh water strongly attracted Barnacle Geese and Wigeon (van Eerden 1984). Today, the Lauwersmeer has lost some of its attractiveness due to vegetational succession and cannot support the entire (now much larger) Barnacle Goose populations any more.

3E.3 Research

The Netherlands have a long tradition of goose monitoring, and counts of Barnacle Geese throughout the country have been carried out since the 1950s (Timmerman 1962). Starting in 1954, more than 4000 Barnacle Geese were caught and metal-ringed by professional goose netters, resulting in more than 500 recoveries/recaptures from western Europe, Scandinavia and Russia (Smit & Burgers 1987). Individual colour-ringing of a total of 287 Barnacle Geese was carried out from 1979 to 1983 (as part of the same study, see sections 3B.3 and 3D.3 above). In addition, Barnacle Geese have been the subject of detailed ecological studies mainly by researchers from the University of Groningen and the Institute of Forestry and Nature Research (IBN-DLO) (e.g. Ebbinge et al. 1975, Ebbinge & van Biezen 1987, Ebbinge 1991, Prins & Ydenberg 1985, Prop & Vulink 1992).

3E.4 Protection and conservation

Hunting legislation: Barnacle Geese have been fully protected in the Netherlands since 1950.

Site safeguard: Most sites used by Barnacle Geese in the Netherlands are at least partially protected. Of the 32 sites regularly used by more than 1000 Barnacle Geese (Koffijberg et al. 1997), 21 sites enjoy formal protection status (in part or all of their area) either as Protected or State Nature Reserves, or are owned and/or managed by a nature conservation organisation (van den Tempel & Osieck 1994). Eight of these sites have been designated as Ramsar sites, or are part of the large International Wadden Sea Ramsar area.

Agricultural conflict: In the Netherlands, Barnacle Geese are reported to cause crop damage both on grassland and on arable land. Compared to damage caused by other goose species (mainly White-fronted and Brent Geese) in the country, however, the problems with Barnacle Geese are minor. In winter, when Barnacle Geese are most numerous, goose grazing is not a real problem for farmers and in autumn and spring most Barnacle Geese feed on more natural vegetation, often in nature reserves. Damage caused by geese is in principle fully compensated by the Dutch government (van Eerden 1990, van Roomen & Madsen 1992).

4. DISCUSSION

Population status: Both the Russian and the Baltic population of Barnacle Geese are among those populations in the Western Palearctic that have been doing remarkably well in recent decades. Since the low in the 1950s, numbers have increased more than 25-fold, and no slowing of the growth rate is evident yet. Since the species is so conspicuous and gathers in large flocks at a limited number of sites in the non-breeding season, counts are very reliable (see Ebbinge et al. 1975) and the possibility that many birds were simply overlooked in the beginning of population-wide counts can be excluded. On the contrary, underestimation is more likely in the current situation because the number of sites used by Barnacle Geese has increased with the growth of the two populations, and they occur more often in mixed flocks with other goose species. Although the Baltic population of Barnacle Geese has increased very rapidly in the past two decades, from one breeding pair in 1971 to about 13,000 individuals in early 1997, the recent increase of wintering Barnacle Geese in the Netherlands and Germany, from about 50,000 individuals in the beginning of the 1980s to about 267,000 individuals in 1996/97, is almost entirely a result of the increase in the arctic Russian breeding population.

The reasons for this remarkable recovery are to be sought in all parts of the flyway, both in the breeding and non-breeding season. In the non-breeding season the closure of hunting, first in the principal wintering area in the Netherlands and later in Estonia, Sweden and Germany, has led to a marked reduction in mortality in the Russian population, which certainly played a major part in the recovery. Barnacle Geese have most probably also benefitted from an improved food situation especially in the wintering areas in the Netherlands, where intensive use of fertiliser has improved the availability of protein-rich grass throughout the winter.

Another key role must be ascribed to changes on the breeding grounds. Since the mid 1980s, the species has considerably extended its range in the Russian Arctic, and the obvious question is whether this is an unprecedented development or rather a reversion process towards a status before human interference. The latter is proposed by Syroechkovsky (1995a) who suggests that flat lowland breeding areas on the Barents Sea mainland coasts could be more typical for the species and that the traditionally known breeding sites on cliffs and rocks of Novaya Zemlya and Vaygach have merely acted as refugia safe from human predation when the Barents Sea coast became populated by humans. Like other arctic-breeding goose species, Barnacle Geese are especially vulnerable to human persecution during the breeding season. Egg collection and capture of goslings and moulting adults can dramatically reduce both reproduction and adult survival, while on the other hand the birds present a unique and easily obtainable food resource for humans in the arctic environment. There are no hard data on the influence of humans in reducing the numbers and restricting the range of Barnacle Geese in the Russian Arctic, but scattered reports confirm that egg collection and moult catches did take place (e.g. Kumari 1971; see also Nowak 1995). The ongoing depopulation of the Russian North in recent years may have considerably reduced the pressure on breeding goose populations across the Russian Arctic compared to, for example, the first half of this century. It is important to note, however, that in spite of the expansion of the breeding grounds the majority of the population is still concentrated in the core breeding areas on and around Novaya Zemlya and Vaygach, and most of the population increase must have taken place there.

The establishment of a breeding population in the traditional staging areas in the Baltic poses similar questions as the range extension in the Russian Arctic, but here the answers may be different. Today, Barnacle Geese are obviously well capable of breeding in temperate latitudes, and the productivity in the Baltic colonies is typically higher than that in the Arctic owing to the extended breeding season and absence of years with complete breeding failures. But in temperate areas the opportunities for breeding may have been created only through human influence, such as grazing by domestic animals on coastal areas. Such cattle and sheep grazing may, for example, keep the grass along the coast short and nutritious up to the time of brood rearing. Grazing by domestic animals along the coasts of Gotland and Öland has been common practice for a long time. It is therefore unclear why the Baltic population was founded in the 1970s and not earlier. Human persecution in the past is a possible factor.

Recent observations of Barnacle Geese breeding in Finland (Hilden & Laine 1991), mainland Sweden, Denmark, Germany (Bräger & Ludwichowski 1995, Hälterlein & Südbeck 1996) and the Netherlands (Meininger & van Swelm 1994) suggest that the breeding range expansion is still continuing. Some of these breeding birds are known, or suspected, to have escaped from captivity. However, in some cases there are no indications for formerly captive birds, and some birds originating from Gotland have also been observed at these new breeding sites. This leads to the conclusion that wild birds may begin to establish themselves even further south than the Baltic. It is not clear at present where this development will end and at what level the population numbers will eventually stabilise.

Conservation issues: The most urgent conservation needs for these currently thriving populations seem to lie on the Russian breeding grounds. Many areas on the Barents Sea coast are threatened by development of the oil and gas industry, and at present there are only two rather small areas with protection status of any kind within the breeding range of the Barnacle Goose in Russia. All the recently formed colonies are in unprotected areas. Strict reserves planned on parts of Novaya Zemlya may offer protection to part of the core breeding area. Numerous new reserves have been created in the Russian Arctic in recent years, and sites along the Barents Sea coast, including more recently established colonies of Barnacle Geese, may still be added to the list in the coming years. However, enforcement of reserve regulations will likely remain a problem considering the current situation of economy and infrastructure in the Russian North.

Agricultural conflict: The Russian and Baltic populations of the Barnacle Goose have not been causing major agricultural conflict on staging and wintering grounds, although with the growth of the populations some conflict has arisen locally in recent years. Most birds still use more or less natural coastal areas for large parts of the year, or are concentrated in areas with nature reserve status. If the number of Barnacle Geese continues to grow, so will the potential for agricultural conflict, but it is unlikely that damage caused by Barnacle Geese will reach dimensions of that caused by some other goose species.

Future research needs: As the Russian and Baltic Barnacle Geese have been undergoing dramatic population changes in recent decades and this change is still continuing, monitoring of the further development of total numbers and changes in the breeding range is urgently needed as a basis for understanding the reasons of these population changes. The relative contributions of the different breeding areas in the Russian Arctic to the success of the population need further investigation, and surveys of the annual breeding conditions in various parts of the Arctic could contribute to our understanding of the population dynamics. Ringing programmes (colour or conventional) of birds on the arctic breeding grounds would also be a valuable tool for assessing the dynamics of newly founded colonies, possible exchange between the different breeding areas, and individual performance of birds of different breeding origin. Moreover, investigations into the relative importance of factors acting on the breeding and wintering grounds would be highly desirable.

Continued monitoring of numbers and breeding success of both Russian and Baltic Barnacle Geese will be essential to the understanding of population developments in the future. Since the most recent analysis of mortality rates of the Russian population was based on data from more than a decade ago (Ebbinge et al. 1991), a new analysis of this kind is important for the interpretation of the continuing growth of the population. Ringing programmes on breeding and/or wintering grounds may be required for such an analysis.

International conservation: The Barnacle Goose is included in the Bonn Convention for the conservation of migratory wild animals and, more specifically, the African/Eurasian Waterbird Agreement (AEWA), which requires the effective conservation and sustainable use of waterfowl and their habitats throughout the flyway (Boere 1994).

With continuing population growth, it is likely that a re-opening of hunting seasons will be proposed in various countries. If so, such proposals can only be considered after careful and informed discussion on a flyway level, with all countries involved agreeing on an integrated solution. More detailed information on recent development of breeding success and mortality rates in different parts of the range will be needed as the basis for such a discussion.

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20 Dark-bellied Brent Goose *Branta bernicla bernicla*

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1. POPULATION REVIEW

1.1 Range

The nominate race of the Brent Goose, the Dark-bellied Brent Goose, breeds mainly along the coasts of the Taimyr Peninsula from 73° to 79° N, and from 75 to 122° E (Syroechkovsky & Zoeckler 1997). There are also breeding reports further north from Severnaya Zemlya (de Korte et al. 1995) and further west from the Yamal Peninsula, and a few breeding records from the Kanin Peninsula (Filchagov & Leonovich 1992). Vinogradov (1994) mentions 20 breeding pairs from the Kanin Peninsula.

This population winters exclusively along the coasts of western Europe: the Atlantic west coast of France, the south and east coasts of England, the southwestern part of the Netherlands and in the Wadden Sea from the Netherlands to Denmark (Fig. 20.1). The Wadden Sea is the main spring staging area for almost the entire population. The White Sea is used as a stopover site during spring migration and is also an important staging area during the autumn migration (Bianki 1979). A thorough review of the status and management of this population is given by van Nugteren (1997).

1.2 Delineation of flyways

Migration takes place along the Western Palearctic flyway following the coastline of northern Russia, through the White and Baltic Seas, and along the North Sea coast, the English Channel and the French Atlantic coast (Bergmann et al. 1994).

1.3 Population trends

Until the 1930s, the Dark-bellied Brent was very common along the coasts of western Europe, particularly concentrated on the vast eelgrass *Zostera* spp. beds which then existed. Following a wasting disease which decimated this food plant in the 1930s (Rasmussen 1977), the Dark-bellied Brent population crashed from several hundred thousand birds to less than 20,000 (Coombes 1957, Salomonsen 1958). Changes in Brent Goose numbers wintering in the Golfe de Morbihan, France, illustrate this crash: in the 1920s, 50,000-70,000 Brent wintered in this area but, after the wasting disease wiped out

the *Zostera*, only 5000-10,000 Brent Geese wintered there in the 1930s (Mahéo 1976). These Brent also fed inland on winter wheat and oil-seed rape. Due to excessive hunting, local numbers dropped even further to 2000-5000 in the 1950s.

The population crash associated with the *Zostera* die-back has often been attributed to starvation due to lack of appropriate food and the assumed incapability of the species to switch to other food plants. However, reports from the Netherlands indicate that even then the Brent attempted to feed inland on winter wheat and grassland, but that large numbers were shot (Mörzer Bruijns in litt.).

The first reliable population census was in the mid 1950s (Salomonsen 1958), and showed that total numbers were down to only 16,500 individuals. Numbers increased at a very low rate until 1972, when the species was temporarily protected from hunting in Denmark. From then onwards, a very rapid recovery to 250,000-300,000 birds took place (Fig. 20.2) (Ogilvie & St. Joseph 1976, St. Joseph 1982, Prokosch 1984, Ebbinge 1985, Wetlands International Goose Database unpubl.). There is still debate as to whether this population growth will continue or whether density-dependent control has set a limit at the present level (Ebbinge 1985, Summers & Underhill 1991). However, judging by the log-transformed population curve (Fig. 20.2), the rate of growth has decreased during the last 10 years.

1.4 Breeding success

Breeding success is highly variable (Fig. 20.2, lower panel) and completely failed breeding seasons with virtually no first-winter birds at the wintering grounds alternate with years when up to 50% of the wintering flocks consist of first-winter birds. These fluctuations are clearly influenced by the three-year lemming *Lemmus sibiricus* cycle on the Taimyr Peninsula (Roselaar 1979, Summers & Underhill 1987), although spring condition achieved in the temperate Wadden Sea also has an impact on subsequent breeding success (Ebbinge et al. 1982, Ebbinge & Spaans 1995). Furthermore, wind conditions during spring passage in the Baltic influence final breeding success (Ebbinge 1989).

Analyses of the proportion of first-winter birds on the wintering grounds show a significant density-dependent effect (Dekkers & Ebbinge 1997). In these age ratio assessments, a three-year cyclical pattern is clearly

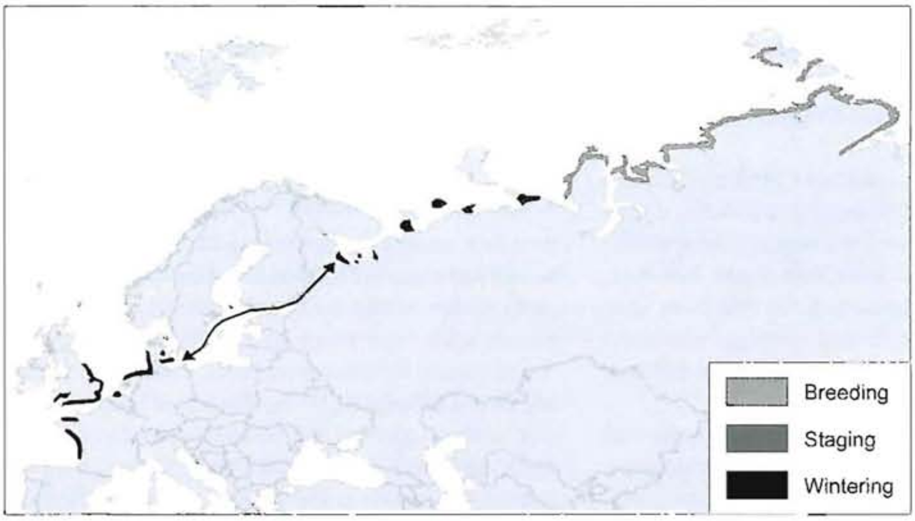

Fig. 20.1. Flyway distribution of the Dark-bellied Brent Goose. Arrows show the migration route between the Baltic and the White Sea.

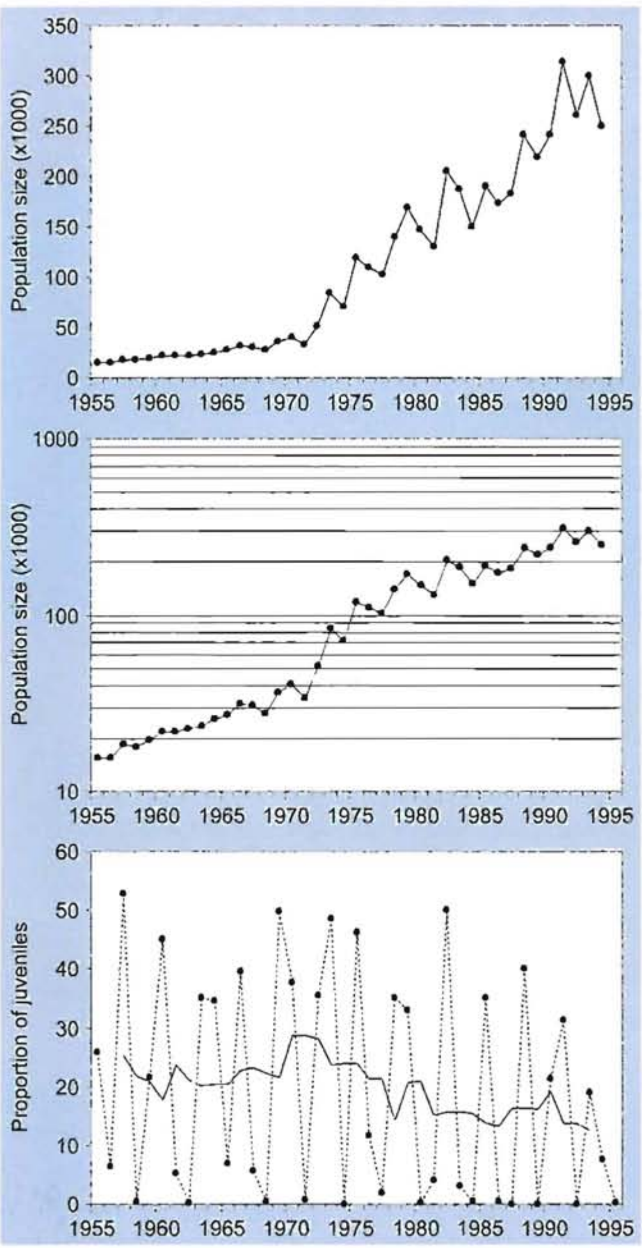

Fig. 20.2. Population size of Dark-bellied Brent Geese (upper panel) plotted on a normal as well as on a log scale. The lower panel gives breeding success as the proportion of first-winter birds in wintering flocks in western Europe. Solid line shows the 6-year running mean.

discernable and fits with the three-year cycle in lemming abundance on the arctic breeding grounds (Roselaar 1979, Summers 1986, Summers & Underhill 1987, Boyd 1987, Dhondt 1987, Ebbinge 1989, Ebbinge 1990). In years following a peak lemming year, when both Arctic Foxes *Alopex lagopus* and Snowy Owls *Nyctea scandiaca* have greatly increased in number and roam widely, Brent Geese have always failed to raise any substantial number of young. After such years in the period 1960-1995, a maximum of 7% first-winter birds (1965) were observed on the wintering grounds, the mean value being 1%. In peak lemming years, Arctic Fox numbers are still low, and both foxes and Snowy Owls breed, feeding primarily on lemmings. In these years, Brent Geese usually breed successfully, also within the safety of Snowy Owl territories (Underhill et al. 1993). The proportion of first-winter birds estimated on the wintering grounds between 1960-1995 following such years ranged from 5-50%, on average 29%. The largest concentrations of nesting Brent Geese have, however, been found on small islands within gull colonies (both Herring Gull *Larus argentatus taymyrensis* and Glaucous Gull *Larus hyperboreus*) or on barren, remote islands in the Kara Sea. The third, "unpredictable" year of the three-year cycle shows regular breeding failures, but also, especially in the 1960s and 1970s, good years with up to 50% first-winter birds, as in 1969. The average over the period 1960-1995 is similar to peak lemming years, i.e. 28% first-winter birds.

Over the period 1960-1996, concurrent with the growing population size (see Fig. 20.2), a marked reduction in breeding success in the course of time is apparent. From the 1980s onwards, a marked drop in the 6-year running means is noticeable. Six-year running means are chosen to even out the effect of the three-year lemming cycles, in this way each single point in the graph contains the same number of lemming peaks and lemming lows (Dekkers & Ebbinge 1997).

1.5 Mortality

Based on calculations from annual population censuses, age counts and known hunting bags from Denmark, annual survival (the complement of annual mortality) was estimated at 79% before the Danish hunting ban in 1972 (Prokosch 1984). Even this survival rate is most likely to be an underestimate, because hunting pressure in Denmark prior to 1972 was underestimated (Madsen et al. 1996). Since 1972, the annual survival rate is estimated to have been 86% based on population censuses and productivity estimates (Prokosch 1984, Ebbinge 1991). These levels were later confirmed by estimates from colour-ringed individuals (84%)(Ebbinge 1992). Apparently the hunting ban allowed the population to recover through a significantly increased survival rate.

According to Nowak (1995), mortality rates must have been high during 1930s-1960s due to intensive hunting and trapping in the Taimyr breeding and moulting areas. However, E.E. Syroechkovsky Jr. (pers. comm. in van Nugteren 1997) disputes that this was the case because of low densities of humans in the Brent Goose distribution area.

2. BREEDING GROUNDS AND BREEDING ECOLOGY

2.1 Distribution

Most June recoveries of birds ringed in western Europe are from the Taimyr Peninsula (Kistchinski & Vronski 1979, B.S. Ebbinge unpubl. data) The most easterly record is a British ringed Brent Goose recovered from Faddeievski Island, 145° E (E.E. Syroechkovsky Jr. in litt.). Since 1989, international biological expeditions organised by Professor E.E. Syroechkovsky have provided much information about the breeding distribution on the Taimyr Peninsula (see Fig. 20.3).

In Eastern Taimyr, earlier records mention the nesting of Black-bellied Brent Geese *Branta bernicla nigricans*, a race that winters along the coasts of the Pacific Ocean. Nowadays, only the nominate race *B.b.bernicla* is found here (Syroechkovsky 1995). It is likely that the increasing population of Dark-bellied Brent has now extended its breeding range further east. This was confirmed in 1997 by the discovery of a mixed colony of

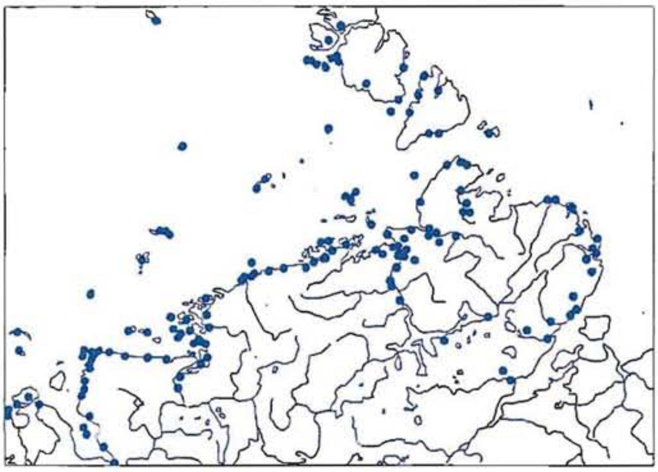

Fig. 20.3. Known breeding localities of Dark-bellied Brent Geese on the Taimyr Peninsula, northern Siberia (E. Syroechkovski Jr. unpubl.).

Dark-bellied Brent Geese and Black-bellied Brent in the Olenyok Delta, west of the Lena Delta (Syroechkovsky & Zoeckler 1997). Further west, to the Yenisey Gulf and east Yamal Peninsula, Dark-bellied Brent Geese are also said to have increased (E.E. Syroechkovsky Jr. unpubl.). A complicating factor is that these mainland nesting areas are apparently only used when lemming numbers are high. Then Brent Geese are often found nesting in association with nesting Snowy Owls (Mork et al. 1994, Syroechkovsky 1995).

Brent nest on small islets in between Herring Gull colonies (Spaans et al. 1993), in extensive low-lying river deltas, dispersed along many small streams on the mainland tundra, within the "fox-exclusion zone" of nesting Snowy Owls (Summers et al. 1994), and on remote offshore islands with extremely poor vegetation (E.E. Syroechkovsky Jr. unpubl., B. Spaans & F. Cottaar unpubl.). After hatching, most nest sites are abandoned by goose families in favour of the lush river banks of the mainland.

2.2 Moult migration and moulting areas

Moult migration has never been observed on a large scale. However, moult migration was observed at Knipovich Bay in northern Taimyr in 1990, 1991 and 1992, and near Pronchisheva Lake in eastern Taimyr in 1991 and 1992. Furthermore, visits to the Niznyaya Taimyra Delta revealed much higher moulting concentrations, up to 45,000 birds, during a non-breeding season (1989) than during a breeding seasion (1990), when only 4000 birds were found in the same area (Prokosch 1995, Syroechkovsky 1995). Large scale moult migration may thus occur mainly during non-breeding years when predators are most abundant. Up to 10,000 birds have been observed moulting in the Pyasina Delta (B.S. Ebbinge unpubl. data).

2.3 Research

Recoveries in northern Russia of birds ringed in western Europe (Denmark, Britain, the Netherlands, Germany and France) provide information on distribution in time and space during the breeding season. Since 1989, birds have also been caught and marked on the moulting grounds in late July and early August (Prokosch 1995, B.S. Ebbinge & B. Spaans unpubl. data).

Catching and ringing of Brent Geese in western Europe was started by M. Fog in the 1960s. In the 1970s, a major ringing effort was carried out in Britain by A. St. Joseph, soon followed by ringing in the Netherlands,

Table 20.1. Total number of Dark-bellied Brent Geese ringed between 1950-1996 (metal rings only and colour-rings).

	Number ringed
Denmark	173
England	1359
France	119
Germany	1464
Netherlands	3206
Russia	3347

Table 20.2. Break-down of numbers of Brent Geese colour-ringed and resighted per country 1973-1997. Note that the number of individuals observed in a particular country refers to birds ringed in any country and that the total number of resightings contains many multiple resightings of the same individual.

Country	Number ringed	Number of individuals observed	Total number of resightings
Spain		1	1
France	119	497	2191
England	1359	1883	12,652
Belgium		1	6
Netherlands	1697	2954	101,050
Germany	930	1837	18,113
Denmark		49	74
Sweden		54	114
Finland		1	1
Poland		1	2
Russia	917	204	609

Germany, France and finally, since 1989, also in Russia (Prokosch 1995). In total, almost 10,000 birds have been ringed (Table 20.1), half of which were ringed with metal rings only, and 5022 with large plastic leg-rings only. The latter yielded no less than 134,812 resightings, often many resightings of the same individual throughout its annual cycle in different countries (Table 20.2).

Detailed studies on breeding biology were carried out from 1990-1995 in the Pyasina Delta (Spaans et al. 1993). Other arctic expeditions provided information on nesting in association with gulls (Kokorev in litt.), Snowy Owls (Summers et al. 1994, K. Günther unpubl. data, Tulp et al. 1997) and on remote barren offshore islands (Bangjord et al. 1994, B. Spaans & F. Cottaar unpubl. report). Surveys to establish the entire breeding range have been carried out within the framework of the International Arctic Expeditions of the Russian Academy of Sciences and organised by Professor E.E. Syroechkovsky from 1989-1995.

2.4 Protection and conservation

Brent Geese can still legally be hunted in spring in most of the northern districts of the Russian Federation during the first ten days after arrival of the first major flocks of geese. There is also a 10-day open season for goose hunting in the Russian Federation during autumn migration. The exact timing of these hunting seasons varies from year to year, depending on decisions made by the local hunting inspection and administration. During the breeding season, the Brent are fully protected. Poaching used to occur but illegal hunting on the breeding grounds is likely to have decreased as a result of the steadily decreasing number of people inhabiting the Russian arctic. Moreover, most of the key areas within the breeding range have protected status: the Great Arctic Reserve, Taimyr Biosphere Reserve, Gydansky State Reserve.

3. STAGING AREAS

3A. WHITE SEA, RUSSIA

3A.1 Distribution

Staging sites used both during autumn (late August/September) and spring (late May/early June) are located along the tidal coasts of the White Sea (Bianki 1979, M.J.M. Poot & V.A. Andreev unpubl. report). Here, the main food plant is *Zostera marina*. In spring, the main areas are the archipelago on the west coast of Onega Bay, Unskaya Bay on the west coast of Dvina Bay and the Dry Sea (65°00' N 40°10' E) on the east coast of Dvina Bay (Fig. 20.4). In the Dry Sea area, the birds consumed some 40% of the standing crop of *Zostera marina* in 1995 and 1996, which suggests that this area may be approaching carrying capacity (P. Clausen unpubl. report). The two first mentioned areas are also well-known autumn staging areas (Bianki 1979), and especially the Onega Bay Archipelago appears to be of major importance. An additional area, Ukhta Bay (north of Onega), is known to be used by smaller numbers of Brent Geese in autumn (Kistchinski & Vronski 1979), and deserves attention in spring in future monitoring attempts because submerged vegetation appears to be present (Andreev & Poot 1994, Beekman et al. 1994).

In spring, most Brent stage for 3-5 days in the White Sea (Clausen 1997) and, by the end of May, migrate north, most likely to the Kanin Peninsula, before heading for the breeding grounds. This fits with observations of the timing of migration over Kanin (cf. Bianki 1979), as well as further east: arrival at breeding areas on the Taimyr Peninsula on 10-20 June (Spaans et al. 1993) and peak passage at Yugorski Shar Strait of birds migrating towards Taimyr on 8-15 June (Uspenski 1960).

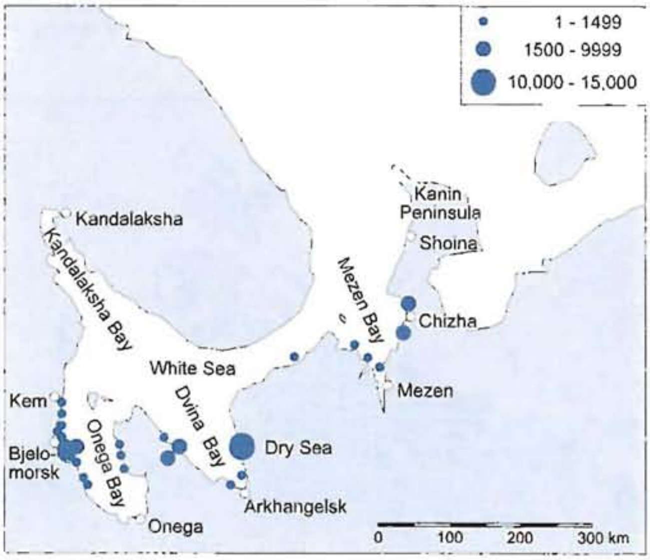

Fig. 20.4. Spring staging areas for Dark-bellied Brent Geese along the White Sea coast, Russia, based on aerial surveys 31 May to 2 June 1993 (after Clausen 1997).

3A.2 Abundance

An aerial survey in May 1993 along the coasts of the White Sea found only 30,000 birds, or 12% of the entire population of Dark-bellied Brent Geese. This is probably an underestimate of the total number staging in this area at the peak of spring migration. In the Dry Sea, a site which was well studied from 1994-1996, annual peak numbers varied from 13,000-27,000 birds staging in spring. In autumn, even larger numbers may use this important staging site during migration. In the Onega Bay Archipelago, Finnish observers counted c. 100,000 Brent feeding in autumn 1992 (Andreev & Poot 1994, A. Ohtonen pers. comm.).

3A.3 Research

Since 1994, research during spring staging has been carried out in the Dry Sea area, Dvina Bay near Arkhangelsk (University of Groningen, the Netherlands, & National Environmental Research Institute, Denmark). Turnover rates of migrating Brent and usage of the *Zostera* beds have been studied.

3A.4 Protection and conservation

There is some local hunting of migrating birds in spring, but this is not considered to have a major impact on the staging birds. It is unknown to what extent the important *Zostera* beds are or will be threatened by eutrophication from polluted water of the Dvina River. There are no conflicts with agriculture in the White Sea area because the birds feed mainly on *Zostera*, and only occasionally on the saltmarshes.

3.B BALTIC SEA

3B.1 Distribution and abundance

During autumn migration, small flocks may stage for a short time in Estonia and on the island of Öland, Sweden. Only small numbers stage during spring in the Baltic sea (e.g. several hundreds on Langenwerder, Germany), and on the east coast of Denmark. Dark-bellied Brent are only rarely seen along the Baltic coast of Poland.

During spring migration, c. 4000 Dark-bellied Brent Geese stage on the Baltic coasts of Denmark (Madsen 1986) and a few hundred on the German Baltic coast (Nehls 1979). However, the majority of the population flies over the Baltic at the end of May on a non-stop flight from the Wadden Sea to the White Sea.

Approximately 5000 Dark-bellied Brent stage in the Inner Danish Waters (Ringkøbing Fjord, Limfjorden, Kattegat) from mid March to late May, feeding mainly on submerged vegetation (mainly *Zostera*) and saltmarshes (Madsen 1986).

3B.2 Research

Observations of migrating flocks are made annually at Ottenby, Öland (Sweden), and along the southern coast of Finland (P. Saurola unpubl. data.). Detailed studies on speed during migration are carried out by the University of Lund. Studies of historic site use as well as habitat use by spring-staging Brent at Tipperne have been conducted by Madsen (1985) and Lorenzen & Madsen (1985).

3B.3 Protection and conservation

There are no conflicts with agriculture during the stops made in spring and autumn in the Baltic and Inner Danish Waters.

3C. WADDEN SEA (Denmark, Germany and the Netherlands)

3C.1 Distribution

Range: The Danish and Schleswig-Holstein part of the Wadden Sea are the first major autumn staging stops made by the Dark-bellied Brent Geese in western Europe.

Habitat and feeding ecology: During autumn, *Zostera* is the preferred food plant, although some flocks of Brent also feed on saltmarsh vegetation on Halligen. Feeding in the intertidal zone, the Brent forage intensively at low tide both during the day and at night (Madsen 1988).

In spring, saltmarshes are the most important feeding areas. The Halligen, exposed saltmarsh-islands in Schleswig-Holstein, are important spring staging areas. Here, the birds build up fat and protein reserves from mid April to mid May before departing for the White Sea (Ebbinge & Spaans 1995)(Fig. 20.6). Condition built up in the Wadden Sea is an important factor determining whether the birds will return with young from the arctic (Ebbinge & Spaans 1995)(Figs. 20.7 and 20.8). Condition is built up by feeding on the new growth of saltmarsh plants, of which dicotyledons are particularly preferred (*Plantago maritima, Trichlogin maritima, Salicornia* seedlings), but grasses such as *Puccinellia maritima* and, earlier in the season, *Festuca rubra* are also taken (Prop 1991, Prop & Deerenberg 1991, Madsen 1989). Although saltmarsh vegetation is preferred, there is, because of coastal protection schemes, too little saltmarsh left to support the present numbers of Brent Geese, so part of the population feeds on agricultural grassland in the embanked polder areas in spring. Early in the spring staging period a much higher proportion of Brent feed in these polder areas, because the saltmarsh plants shoot later than those on intensively managed grasslands. Thus the birds concentrate on the most profitable (in terms of digestibility) grass-species (Boudewijn 1984) and start to move to the saltmarshes in April. The shift from polder areas to saltmarsh may be delayed or advanced depending on the weather conditions.

3C.2 Abundance

Phenology: In autumn, failed breeders and non-breeders are usually the first to arrive, followed later by the successful breeders and their offspring. This can lead to very late first arrivals (first week of October) following an extremely good breeding season, as in 1975, but also early mass arrival (third week of September) after a complete breeding failure for the whole population. Vast numbers move on to the Dutch part of the Wadden Sea in October and also in October the first birds appear in the wintering areas in southwestern Netherlands, England and France. Numbers in the Wadden Sea decline sharply in November, and only in the western (Dutch) part do sizeable numbers overwinter (Fig. 20.5). There is a marked trend in the proportion of first-winter birds occurring in the flocks passing through the Wadden Sea in autumn. Following successful breeding, first flocks contain few young, but the proportion of first-winter birds rapidly increases, followed by a marked decline over mid winter because most families tend to winter further south (Lambeck 1990a, b).

In spring, the Wadden Sea is the major staging area of the population from late March to late May (Fig. 20.5).

Trends and numbers: In spring, almost the entire population used to concentrate in the International Wadden Sea. Only 5000-8000 birds staged in spring outside the Wadden Sea along the Danish coast (outside the Wadden Sea) and the Baltic coast of Germany. A recent development, possibly a result of the increased population size, is the staging of several thousand Brent in the southwestern part of the Netherlands until mid May (before the 1970s only known as a wintering area). In the 1970s, several thousand Brent used this area as

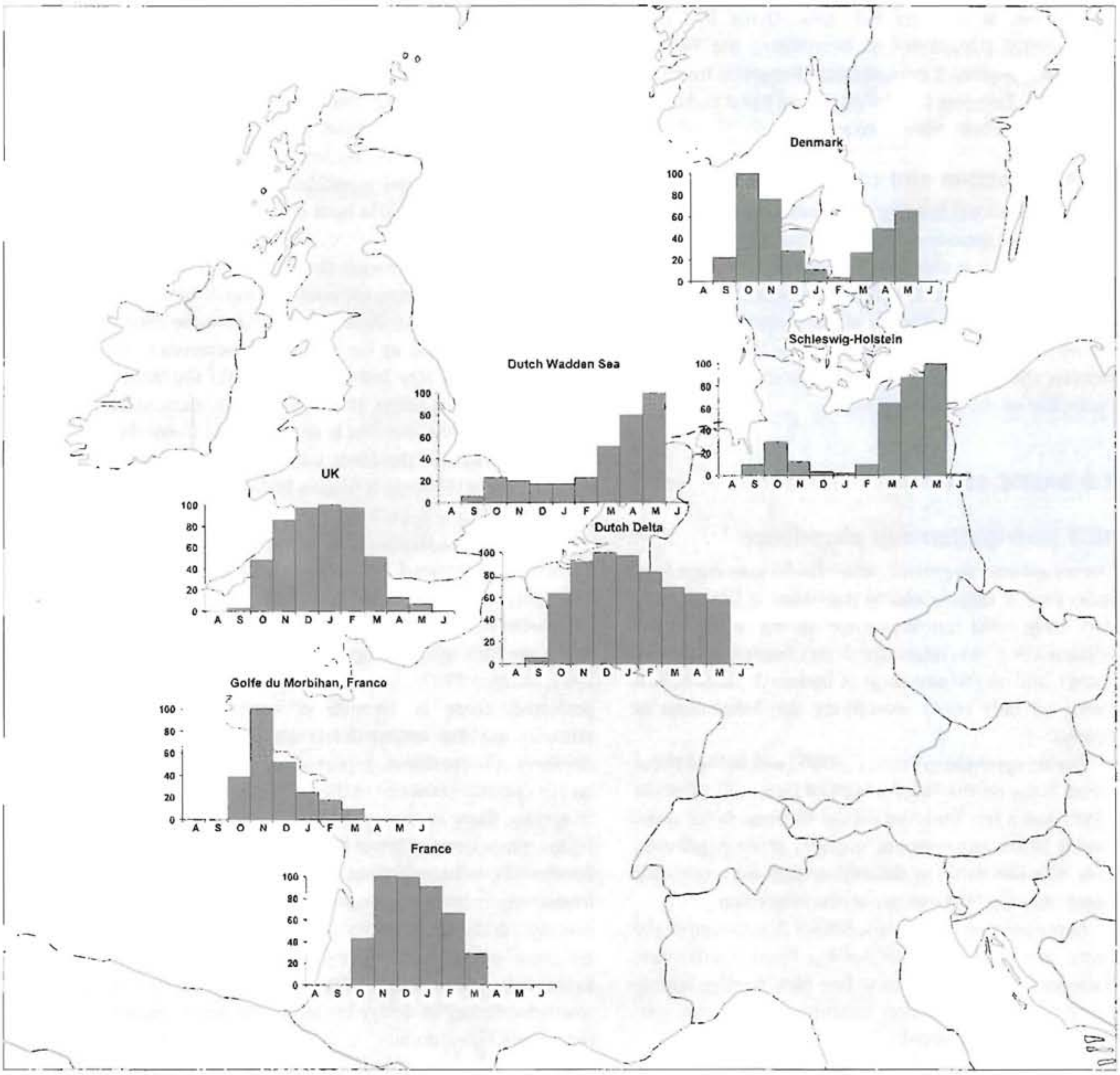

Fig. 20.5. Phenology of Dark-bellied Brent Geese in six regions in western Europe. Peak numbers per area are given as 100%, and for the other months numbers are expressed as a proportion of the month of peak occurrence. Note that the Golfe du Morbihan is also included in the total for France. In the autumn most birds concentrate on the still existing Zostera beds, of which the Golfe du Morbihan is the best example. In March the birds leave France and England, again forming concentrations in the Wadden Sea, of which Schleswig-Holstein is the best example. In the Dutch part of the Wadden Sea birds also winter. A recent development being that in England and the Dutch Delta area, an increasing number of birds stage until sometime in May.

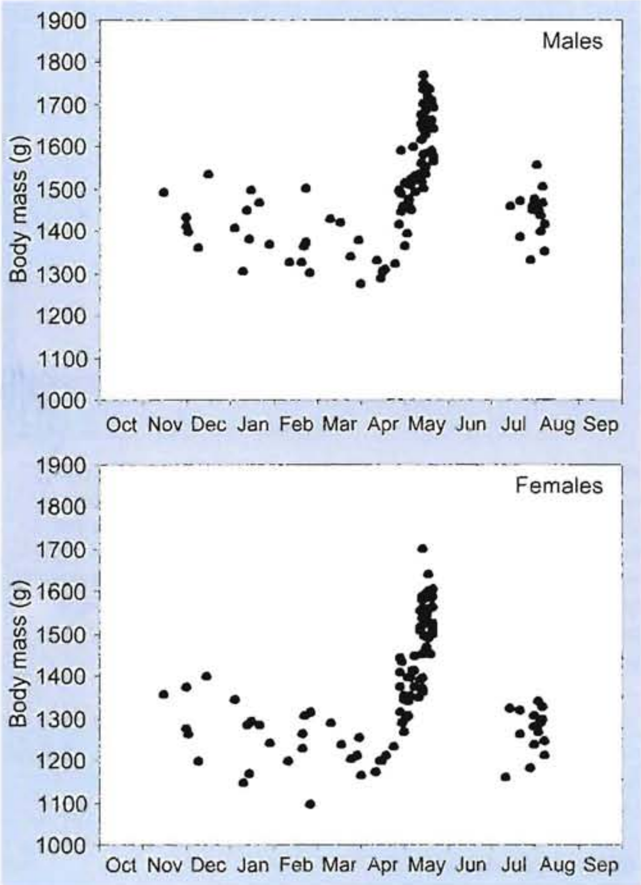

Fig. 20.6. Mass changes of adult male and female Dark-bellied Brent Geese in the course of the season (n male = 3312 and n female = 3252). Each dot is the mean value of at least six birds.

a spring staging area, since then numbers have increased to reach a more or less stable average of c. 10,500 birds in May since 1985. Prolonged staging in wintering areas is also a notable phenomenon in Britain, with up to 14,000 birds in the Wash in Norfolk in mid May during the early 1990s, and up to 3500 birds further south on the north Kent Marshes.

On the preferred saltmarsh areas, such as Boschplaat reserve on the island of Terschelling, density dependent regulation of numbers clearly occurs (Fig. 20.9)(Ebbinge 1992), and peak numbers have not increased despite a further increase in the overall population. On newly invaded grassland areas and semi-natural saltmarshes along the mainland coast in the northern Netherlands, however, numbers are still increasing parallel with the increase in the population as a whole. In the International Wadden Sea, there are major concentrations in the Dutch Wadden Sea and in Schleswig-Holstein, but much lower numbers in Niedersachsen.

3C.3 Research

Census: There are usually two full annual censuses carried out in the Wadden Sea, one in January and one in May. These censuses are internationally coordinated among the Wadden Sea countries. Additional counts are carried out nationally (see van Nugteren 1997).

Ringing: A joint Dutch-English-German colour-ringing program is run by the Dutch Institute for Forestry and Nature Research (IBN-DLO), and has revealed many details about flock composition and individual migratory strategies (Ebbinge & St. Joseph 1992).

Other: Detailed research programs on habitat use, energetics, interactions between geese and their food supplies, carrying capacity, survival rate, and individual site-use have been carried out in the Netherlands, Germany and Denmark (Bergmann et al. 1994, Boudewijn 1984, Ebbinge 1979, 1989, 1992, Ebbinge et al. 1982, Ebbinge & Spaans 1995, Madsen 1988, 1989, Prokosch 1984, Prop 1991, Prop & Deerenberg 1991, Stock 1994, Teunissen et al. 1985, van der Wal 1998)(see van Nugteren 1997 for a full review).

3C.4 Protection and conservation

Hunting legislation: Brent Geese are fully protected by law in Denmark, Niedersachsen (Germany) and the Netherlands. Only in Schleswig-Holstein (Germany) is there a short open season from 1 November to 15 January. It is estimated that 500-1500 Brent are bagged annually (van Nugteren 1997).

Agricultural conflict: In spring there are major conflicts with agriculture, because not all geese can be accommodated on the preferred saltmarshes. In Schleswig-Holstein, compensation for Brent Goose damage to livestock grazing areas is paid within the framework of the Hallig Programme, financed by the European Union (EU), Federal and State funds (Fleet 1994). In Niedersachsen (including the Hamburg part of the Wadden Sea) and in Denmark, inland feeding on crops or grassland is rare, and no major problems with agriculture are reported.

In the Dutch part of the Wadden Sea, a major reserve (110 ha) has been established on farmland on Texel, Zeeburg, where up to 10,000 Brent Geese stage in May. Earlier in spring when grass growth is only beginning, the geese disperse over adjacent farmland and, in cases of severe damage, farmers are compensated finan-

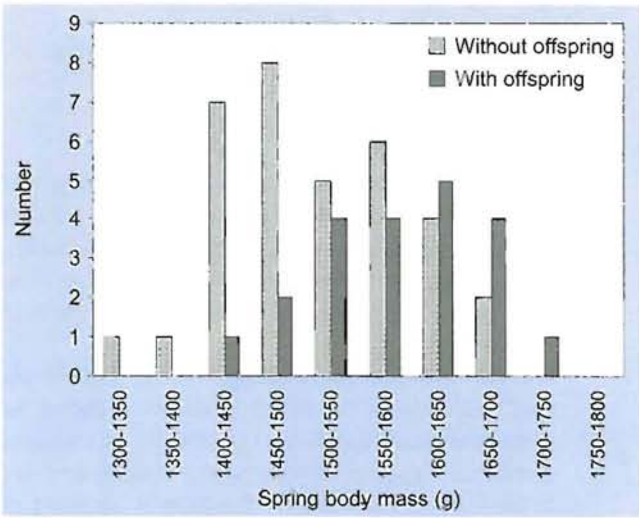

Fig. 20.7. Distribution of spring body mass of successful and failed breeders amongst female Dark-bellied Brent Geese (from Ebbinge & Spaans 1995).

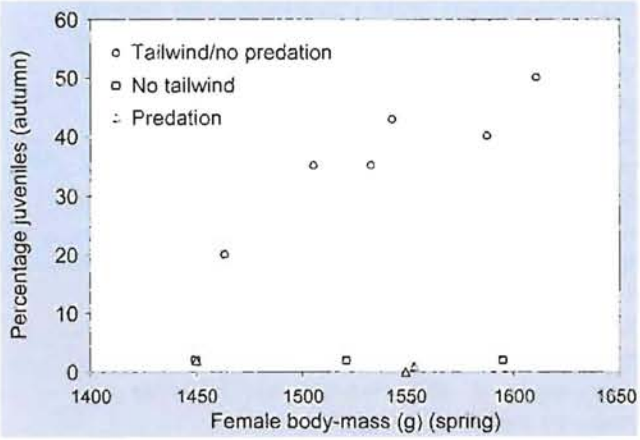

Fig. 20.8. Overall breeding success as a function of mean departure body-mass of adult female Dark-bellied Brent Geese in the preceding spring in the Wadden Sea. Squares: years without sufficient tailwinds in the Baltic during spring migration; triangles: years with abundant predators on the breeding grounds (from Ebbinge 1992, updated from Ebbinge 1989).

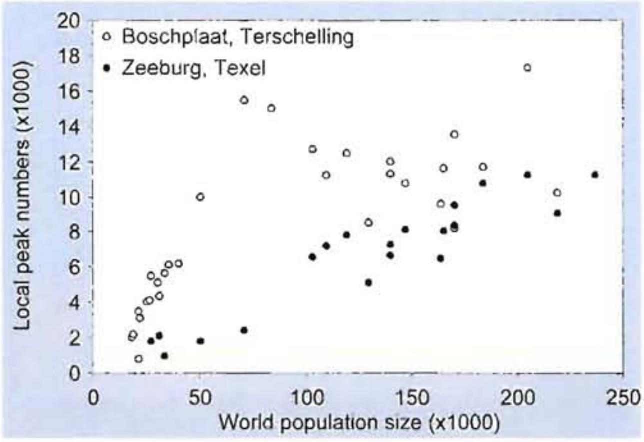

Fig. 20.9. Spring peak counts of Dark-bellied Brent Geese on two spring staging areas in the Dutch part of the Wadden Sea, as a function of the growing total population size of Dark-bellied Brent Geese. The Boschplaat is a saltmarsh, which is preferred and where numbers have reached a plateau, whereas on Texel (the Zeeburg grassland reserve), numbers only started to build up after the world population reached a level of 100,000, and where numbers have not yet levelled off (from Ebbinge 1992).

cially by the Government. On the other Dutch Wadden Sea islands, local solutions to damage are being sought. On the island of Schiermonnikoog, intensive scaring campaigns have succeeded in driving almost all geese away from this relatively small polder (300 ha) in spring. A marked increase in numbers has taken place on the adjacent island of Ameland where up to 22,000, and on average 12,000, Brent Geese occur. Financial compensation is paid for damage on Ameland but local farmers do not regard the situation as satisfactory. Nearby, on the mainland foreshore of the Friesian coast, the highest spring concentrations of Brent Geese in the Dutch Wadden Sea are found, with up to 47,000 Brent Geese.

4. WINTERING AREAS

4A. WADDEN SEA (Denmark, Germany, the Netherlands)

4A.1 Distribution

Range: During mild winters, Dark-bellied Brent Geese are distributed throughout the Wadden Sea, with the major concentrations along the Dutch coast including adjacent islands. During severe winters, the Brent Geese leave the Danish and German parts of the Wadden Sea.

Habitat and feeding ecology: Having depleted the food resources on the intertidal mudflats during autumn, the remaining Brent Geese move to improved grasslands on polders bordering the Wadden Sea, and in Germany, to the Halligen. The habit of wintering on grassland in the polders surrounding the Wadden Sea developed since 1973-74 (Ebbinge 1979). Virtually no birds spend the winter months on the saltmarshes. Only in Denmark do the majority of Brent feed on intertidal mudflats throughout the winter (Madsen et al. 1990).

4A.2 Abundance

Trends and numbers: Up to 44,000 Brent Geese may winter in the Dutch part of the Wadden Sea in mild winters. However, much lower numbers do so (up to 10,000) in the eastern part of the Wadden Sea in Germany and Denmark, with a maximum of 2000 in Niedersachsen. During severe winters, these birds leave the Wadden Sea in January or February to winter in England and France as confirmed by colour-ring re-sightings. Only a few thousand may remain in the far western end of the Wadden Sea. Of these up to 15% may die if prolonged cold spells occur (e.g. in 1984-85, Ganzenwerkgroep Nederland/België 1987).

In the early 1930s, the vast *Zostera* beds around the then island of Wieringen (now surrounded by dikes and part of the mainland in the province of Noord-Holland) and the small island of Griend held tens of thousands of Brent Geese. Among these, Light-bellied Brent were reportedly quite numerous, totalling up to 10% of the total catch (Lebret et al. 1976). The birds generally remained there throughout the winter, and only severe frost would push them further west, where "the grand armies" (Coombes 1957) joined those already wintering in England. These *Zostera* beds disappeared entirely in the 1930s as a result of the wasting disease (Rasmussen 1977), and have never recovered. In 1932, the Afsluitdijk was constructed, connecting Wieringen to the province of Friesland and closing the former Zuiderzee which eventually changed from a tidal seawater area into a freshwater lake: the IJsselmeer. It is not clear whether these changes prohibited recovery of the eelgrass *Zostera* spp. in the remaining western part of the Dutch Wadden Sea. Today, there is virtually no

Zostera left in the Dutch part of the Wadden Sea, except for a small bed of *Zostera noltii* near the island of Terschelling, which is quickly eaten out in early October.

The trend in the overall population size during the 1970s to the 1990s is reflected in the January and May numbers counted in the Netherlands (van Nugteren 1997).

4B. DENMARK (outside the Wadden Sea)

Up to 2000 Dark-bellied Brent Geese remain in the Inner Danish Waters (Kattegat) throughout mild winters. During severe winters, the geese are displaced. They primarily feed on submerged vegetation (*Zostera marina*), supplemented by saltmarsh vegetation during periods with high water levels (Madsen et al. 1990).

4C. THE NETHERLANDS (outside the Wadden Sea)

The southwestern part of the Netherlands, the Delta area (Fig. 20.5), with peak numbers occurring in November and large numbers remaining until March, is a typical wintering area for Dark-bellied Brent Geese (Rooth et al. 1981, Ebbinge et al. 1986). Here, the remaining eelgrass beds have recently undergone a rapid decrease in area, and, as soon as these are eaten out, the birds move inland to feed, foraging on grassland, seed-grass cultures and winter wheat. As in all other Brent staging areas in western Europe, the birds roost on the water in the intertidal zone. It is not known to what extent the birds feed at night in this intertidal zone; during the day they feed on green algae *Enteromorpha* spp. there.

Monthly counts are carried out in the southwestern part of the Netherlands during the winter season.

To lessen the conflict between agricultural interests and Brent Geese in this area, two reserves, Rammegors and the Slikken van de Heen, are managed especially to accommodate geese. These areas are grazed by horses and cattle to maintain an attractive sward for the geese. Other areas are also being returned to more natural habitat under the Dutch Nature Development Scheme so that the geese can also be accommodated. Solutions to the conflict between geese and agriculture are also being sought through temporary arrangements with farmers, allowing the geese to concentrate in certain areas whilst scaring them away from more vulnerable crops.

4D. GREAT BRITAIN

4D.1 Distribution

Range: Wintering sites are distributed along the southeast and south coasts of England. The famous eelgrass beds on Maplin Sands off Foulness Island and at Leigh-on-Sea, are key autumn staging areas for Brent Geese. Ring resightings have revealed that a considerable number of the birds passing through this area move on to spend the winter in France, while others move north to winter along estuaries in Essex and along the north Norfolk coast. Concurrent with the general population increase, the distribution of Brent Geese has expanded. Along the west coast of Britain, Brent Geese have now reached the coast of south Wales, where up to 1500 Dark-bellied Brent winter near Llanelli. Along the east coast flocks now occur north to the Humber estuary and Lindisfarne, sites where only Light-bellied Brent *Branta b. hrota* used to occur. Dark-bellied Brent Geese colour-ringed near Lindisfarne migrated to the Wadden Sea in March in the same season (S. Percival & B.S. Ebbinge unpubl. data), whereas marked Light-bellied Brent from Lindisfarne migrate straight to Denmark (P. Clausen unpubl. data).

Habitat and feeding ecology: During autumn, Brent Geese feed first on intertidal *Zostera* and green algae (Summers 1990a, Fox 1996). Gradually during late autumn, they move on to saltmarshes, improved grassland, winter cereals as well as golf courses (Charman & Macey 1978, Summers et al. 1993). In early spring (March), they increasingly forage on saltmarshes, prior to departure for the Wadden Sea.

4D.2 Abundance

Phenology: The first geese arrive by the end of September, and numbers peak during the winter months (Fig. 20.5). Return migration to the Wadden Sea starts from late February and the last geese leave Britain during May.

Trends and numbers: Up to 52% of the entire population occurs in Britain in mid winter, representing 90,000-120,000 during January in the 1990s. Up to 1000-1500 Dark-bellied Brent Geese - or less than 0.5 % of the entire population - winter in the Channel Islands. In Britain as a whole, wintering numbers increased during the 1980s but remained stable throughout the 1990s.

4D.3 Research

Census: Monthly counts are carried out in all major estuaries holding Brent Geese. Assessment of breeding success (percentage juveniles and brood sizes) is carried out on an annual basis (during late autumn/early winter).

Ringing: The Brent Goose colour-ringing programme was initiated in Essex, to find out what would happen to the Brent Geese if a third London Airport was built on the Maplin Sands, thus destroying the vast eelgrass beds there. From 1973-1976, 1024 Brent Geese were colour-ringed in Essex and Norfolk, and in 1979 and 1996 a further 174 were colour-ringed along the British south coast.

Other: Detailed research has been carried out in Norfolk and Essex to assess the extent of agricultural damage caused by Brent Geese, as well as the effectiveness of various scaring techniques. Studies on the east and south coasts of England have recorded significantly reduced yields in wheat, rape and grass grazed by Brent Geese (Summers 1990b, Summers & Stansfield 1991, McKay et al. 1993). There has been considerable research on the management of alternative inland feeding areas for Brent Geese, focussing on the cutting, grazing and fertilising regimes required to give optimal sward structure (Vickery & Sutherland 1992, Vickery et al. 1994a, b, McKay et al. 1996, Riddington et al. 1996, Riddington et al. 1997).

4D.4 Protection and conservation

Hunting legislation: The Brent Goose has been protected since 1954. Some geese are shot under licence to alleviate damage to crops (see below).

Agricultural conflict: In Essex, Norfolk and along the south coast of Britain, the development of the habit of feeding inland has lead to agricultural conflict in these areas (Summers & Critchley 1990, Salmon & Fox 1991, McKay et al. 1994, Vickery et al. 1995). At some locations, grassland in nature reserves is managed for Brent, providing extensive alternative feeding areas and helping to reduce conflict locally, in combination with scaring outside the reserves. Work in Norfolk on scaring techniques has indicated that the most cost-effective method is active scaring by a full-time human bird scarer, as this is the only method which is always effective in the long term (Summers & Hillman 1990, Vickery & Summers 1992). Such active scaring is most effective when backed up by the shooting of small numbers of geese, and the licence shooting scheme is intended to allow for the enhancement of scaring when no other satisfactory solution exists.

No financial compensation is paid to farmers, but licences to shoot Brent Geese in order to scare them away are readily given. Under licence, about 1000-3000 Brent are shot in southeast England annually. This is under the annual limit of 4000 set by the Ministry of Agriculture, Food and Fisheries. Because scaring is reasonably effective, the main cost to farmers lies not in damage to crops but in scaring activities. Severe damage only occurs on winter cereals and oil-seed crops, damage to permanent pasture is considered to be very low.

For scaring to be most effective, alternative feeding areas are also required, however there are few such areas outside nature reserves. Although certain agri-environment schemes have the potential to provide incentives for the toleration of Brent Geese on appropriately managed farmland (set-aside, environmentally sensitive areas), none has yet realised this potential (Rowcliffe & Mitchell 1996).

4E. FRANCE

4E.1 Distribution

Range: Dark-bellied Brent Geese are found in estuaries from the western part of the English Channel south to Bassin d'Arcachon in southwest France.

Habitat and feeding ecology: In France, almost all feeding takes place in the intertidal zone and conflicts with agriculture are minimal (Mahéo 1976). The clear preference for *Zostera* is demonstrated by the early use of the Golfe de Morbihan (Fig. 20.5). This area is, with present population numbers, already eaten out by the Brent in early November, after which the birds move on to other areas along the French coast. They may also, as revealed by colour-ring observations, return to the Dutch part of the Wadden Sea to feed on grassland as early as December.

4E.2 Abundance

Phenology: Peak numbers occur in mid winter, although in recent years a tendency towards an autumn peak has occurred, with numbers decreasing slightly already in January (Fig. 20.5). As the overall population has increased, other notable changes in the phenology of Brent Geese in France have occurred: first birds arrive 10-15 days earlier in the 1990s (15-25 September) compared with the 1980s. Most Brent leave France during March. In autumn, over 50,000 Brent occur in October, furthermore, almost all important *Zostera* sites, namely Golfe du Morbihan, Baie de Bourgneuf, Baie d'Yves, Îles de Ré and d'Oléron are now frequented simultaneously by Brent Geese, which spread from these areas as soon as most of the eelgrass leaves have been consumed. The southernmost bay, Bassin d'Arcachon, is reached about 10-15 days later by major flocks of Brent Geese.

Trends and numbers: The estuaries along the north coast of France hold up to 17,000 Dark-bellied Brent Geese in winter. The majority of Dark-bellied Brent Geese are, however, found along the Atlantic west coast, where up to 100,000 occur in January. In November numbers may be even higher as the birds concentrate on the rich eelgrass beds along this coast. Some birds return to more northerly wintering sites in England and the Netherlands as soon as these beds are eaten out, i.e. in January, although the majority migrate northwards in late March.

Of extreme importance are the Golfe de Morbihan (up to 35,000 birds), the intertidal areas between the mainland coast and Île d'Oléron and Île de Ré, even as far south as the Bassin d'Arcachon, where up to 38,000 Brent may winter (Mahéo 1971, 1982, 1991, Robreau 1996).

The trend in the overall population size during the period from the 1970s to the 1990s is reflected in the January numbers counted in France (van Nugteren 1997).

4E.3 Research

Census: Monthly counts of Brent Geese are carried out in all estuaries.

Other: The effect of goose grazing on the eelgrass beds has been studied by the University of Rennes in the Golfe du Morbihan and the Bassin d'Arcachon (Mahéo & Denis 1987, Auby 1994). Goose numbers are censused monthly along the French coast. In 1978-79, 113 Brent Geese were colour-ringed in France on the Île de

Ré and in the Baie de Bourgneuf as part of the international Brent Goose colour-ringing scheme.

4E.4. Protection and conservation

Hunting legislation: The Brent Goose has been protected since 1966.

Agricultural conflicts: Virtually none. Only at one site in the Baie de Bourgneuf have some Brent occasionally fed on winter cereals, leading to conflicts with agriculture.

5. DISCUSSION

Population status: After recovering from the extremely low population total of less than 20,000 individuals in the 1950s, the population now numbers 250,000-300,000 birds and is no longer threatened. Research on the breeding grounds indicates that predators such as Arctic Foxes, Snowy Owls and Herring Gulls restrict the available breeding area to such an extent that further increase to much higher population levels is unlikely (Syroechkovsky et al. 1991, Dekkers & Ebbinge 1997).

The overall population increase cannot be explained by improved breeding success. Since 1980, breeding success has decreased markedly (Dekkers & Ebbinge 1997) and during the last 10 years, the growth rate of the population has decreased. This decrease is interpreted as being a result of density-dependent regulation. However, it is too early to draw any conclusions about the level at which the population will stabilise.

Conservation issues: Apart from regulation of hunting (Madsen 1997) and creating alternative reserves on farmland to minimise agricultural damage (van Nugteren 1997), conservation of the natural winter and spring habitat for Brent Geese is an important issue. In particular, protection of existing eelgrass beds, still a highly preferred food resource for Brent Geese requires more attention. Eelgrass is still reported as declining in Schleswig-Holstein (Germany), in southwestern Netherlands and apparently also in the northern part of the Danish Wadden Sea (Clausen & Fischer 1994), possibly as a result of eutrophication. Further knowledge about the processes of the decline is urgently needed and a concerted research effort is needed to find out why these eelgrass beds did not recover after the 1930s. Information is also needed about the present condition of eelgrass beds in the White Sea.

Natural saltmarsh is an important spring staging habitat. There are only a few fairly large natural saltmarshes left in the Wadden Sea: the Boschplaat on the island of Terschelling, the Oosterkwelder on the island of Schiermonnikoog and Rottumerplaat. All other saltmarshes in the Wadden Sea are heavily influenced by human activity. These habitats deserve more attention and possibilities of restoring such habitats on a larger scale should be investigated.

The Brent Goose is the only goose species in western Europe whose natural coastal winter habitat still exists. Although Brent Geese have shown that they can survive the winter on alternative man-made grasslands as well, their occurrence on natural habitats is an asset in itself.

Conservation and restoration of the natural winter habitat is now of greater value than merely conserving a viable population of Brent Geese.

International conservation: Brent Geese are now protected from hunting in most of their range. Brent can be hunted legally in Russia only in spring and autumn. In the German state of Schleswig-Holstein, Brent are huntable for a restricted period in the late autumn, when most birds have already left Schleswig-Holstein. In Finland, Sweden, Denmark, Niedersachsen (Germany), the Netherlands, England, Belgium and France, the species is fully protected. However, to prevent agricultural damage, some 2000 Brent are shot annually in England. Special reserves have been created in Denmark, France, England, the Netherlands and Schleswig-Holstein, and these help to alleviate agricultural damage.

An international Dark-bellied Brent Goose Flyway Management Plan has been prepared by order of the National Reference Centre for Nature Management in the Netherlands by the Dutch Society for the Preservation of the Wadden Sea (van Nugteren 1997). So far, the Management Plan contains a description of the ecology of the population and human influences and an evaluation of the conservation status and needs as well as options for management, focussing on habitat conservation, habitat management and restoration, and reopening of shooting. At the time of writing, the Action Plan developing the necessary prescriptions to implement the objectives of the Management Plan is under preparation. The Management Plan is designed to fulfil the obligations of range states under the Agreement on the Conservation of African-Eurasian Migratory Waterbirds under the Bonn Convention.

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21 Light-bellied Brent Goose *Branta bernicla hrota*: Canada

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1. POPULATION REVIEW

1.1 Range

The common name "Light-bellied" and the subspecific name *hrota* combine at least four stocks of Brent Geese which should be considered separately for conservation purposes. Three of these breed in the High Arctic, between 75° and 82° N (Fig. 21.1). The fourth, a population breeding in Svalbard and northeastern Greenland and wintering around the North Sea, is dealt with by Clausen et al. (this volume).

The three stocks breeding in Arctic Canada winter in widely separated areas. The subject of this chapter, the "Eastern Canadian High Arctic Light-bellied Brent", breeds in the eastern Queen Elizabeth Islands from eastern Melville Island (c. 108° W) east to northern Ellesmere Island and, earlier this century, also bred in northern Greenland (Salomonsen 1950). Hjort et al. (1987) suggested that the Brent now breeding in northeastern Greenland, between 80° and 82° N in Kronprins Christian Land, are part of the Svalbard population, not the Canadian, and this has now been confirmed by satellite tracking (see Clausen et al. this volume). The Eastern Canadian High Arctic Light-bellied Brent winter almost wholly in Ireland, although up to 100 reach the Channel Islands and several hundred occur in western France (Debout & Leclerc 1990, X. Gremillet pers. comm.). Some occur in the Hebrides in western Scotland, especially in late winter and spring, and small numbers are occasionally seen elsewhere in Britain. This stock stages for several weeks in western Iceland in spring and autumn (Fig. 21.2).

The second High Arctic stock, the Grey-bellied Parry Island or "Western High Arctic Brent Goose", breeds on Melville Island, Prince Patrick Island and on several smaller islands nearby (Boyd & Maltby 1979). These geese winter on the Pacific coast of the USA, chiefly in Padilla Bay, Washington State, though a few occur further south to western Mexico, along with much larger numbers of Black Brant *B. b. orientalis* (or *nigricans*), which breed in Alaska, on Banks Island, and in small

numbers east to Queen Maud Gulf. Shields (1990) showed by DNA analysis that the Western High Arctic stock was not only genetically distinct from the Black Brant and the Eastern Canadian High Arctic Light-bellied Brent, but was older than either. Because the belly-colouring of the geese in all three stocks varies widely, it is not always practicable to assign an individual to one of the three groups on the basis of its external appearance. However, although moulting individuals from both the Irish-wintering and the Washington wintering populations have been taken in the same catches for ringing on eastern Melville Island, the two groups remain reproductively distinct (Boyd et al. 1988). Confusion was caused in the earlier literature by reference to "intergrades" between the various stocks, as if the variation in belly colour was due to interbreeding. The presence on Prince Patrick Island of moult-migrant Black Brant from northeastern Siberia in some, but not all, years has added to the confusion.

The third *hrota* stock is the "Atlantic Brant", which breeds in eastern Canada, from Queen Maud Gulf (100° W) east to Baffin Island (71° W) and from Southampton Island (63° N 85° W) to Somerset Island (73° N). This stock winters on the Atlantic coast of the USA, from Massachusetts south to the Carolinas, staging in James Bay, especially in late May. Though Atlantic Brant are not distinguishable from Eastern Canadian High Arctic Light-bellied Brent in the field, their present breeding ranges are separate. Whether they are separable genetically and historically remains to be demonstrated, as does the difference between these two groups and the Svalbard group.

These four stocks of Light-bellied Brent differ considerably in abundance (Madsen et al. 1996). The Svalbard group numbers 4000-6000; the Eastern Canadian High Arctic Light-bellied group (the subject of this chapter) numbers 19,000-24,000; the Parry Island group numbers 8000-11,000; and the Atlantic Brant numbers 100,000-130,000.

1.2 Delineation of flyways

Light-bellied Brent Geese stage in western Iceland between late April and mid May. The entire population may cross the Greenland icecap in spring as there is no evidence to suggest any Brent fly direct from Ireland to Cape Farewell (Alerstam et al. 1986, 1990, Gudmundsson et al. 1995). Our understanding of the flyways of the trans-Atlantic Light-bellied Brent is based on ringing recovery data, mainly from geese ringed on the Canadian breeding grounds; on observations on numbers and throughput at the Icelandic staging areas; on observations in Greenland; and on satellite telemetry and radar work (Salomonsen 1967, Maltby-Prevett et al. 1975, Gardarsson 1979, Gudmundsson et al. 1995, Gardarsson & Gudmundsson 1997).

1.3 Population trends

No estimates of the size of the Eastern Canadian High Arctic Light-bellied Brent population were made before the 1950s, when numbers wintering in Ireland were estimated at c. 6000 birds (Kennedy et al. 1954, Ruttledge & Hall Watt 1958). The first complete Irish census (made in 1960-61) found 11,900 Brent Geese. Counts during the 1960s varied between 7300 (1965) and over

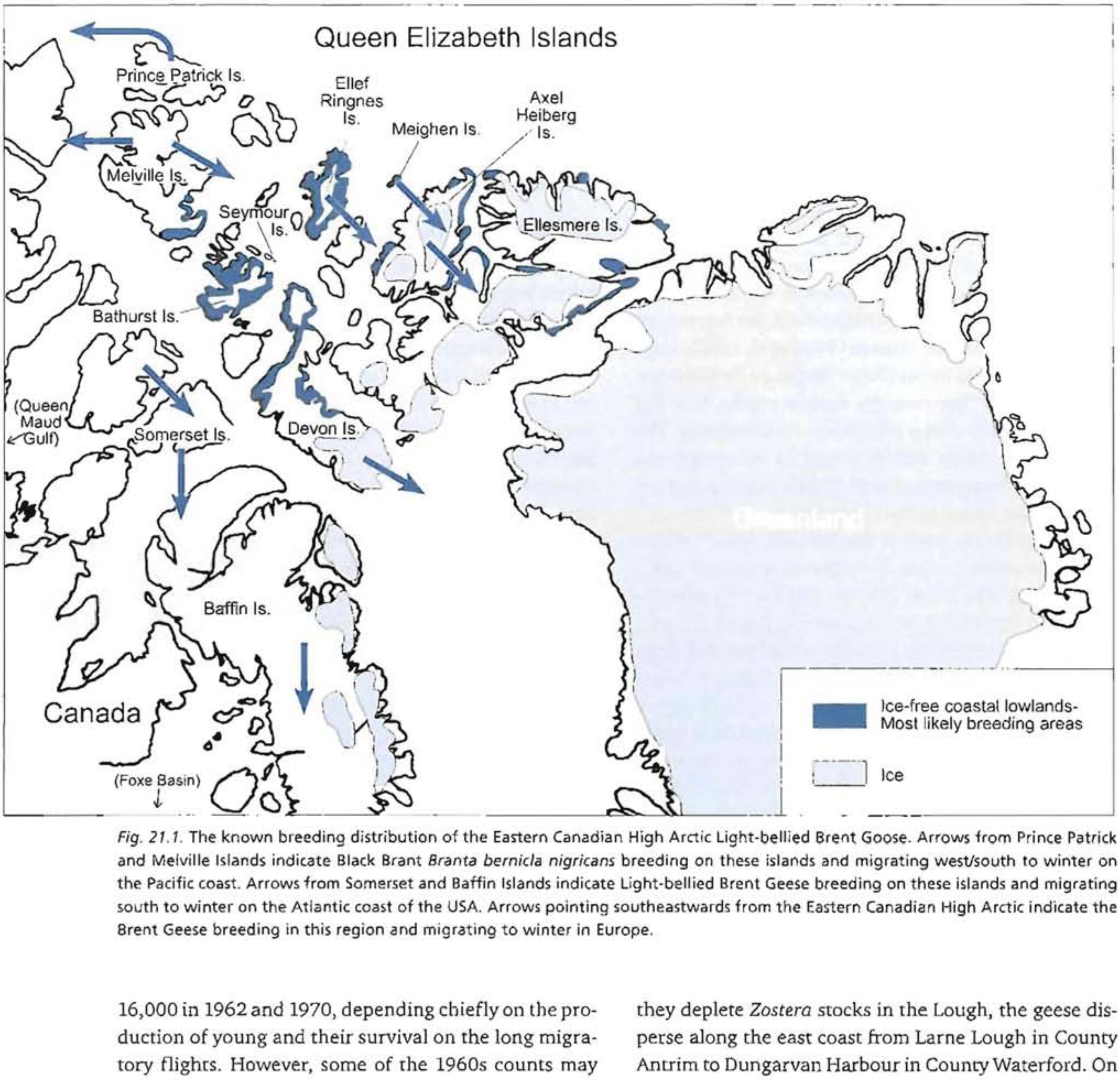

Fig. 21.1. The known breeding distribution of the Eastern Canadian High Arctic Light-bellied Brent Goose. Arrows from Prince Patrick and Melville Islands indicate Black Brant *Branta bernicla nigricans* breeding on these islands and migrating west/south to winter on the Pacific coast. Arrows from Somerset and Baffin Islands indicate Light-bellied Brent Geese breeding on these islands and migrating south to winter on the Atlantic coast of the USA. Arrows pointing southeastwards from the Eastern Canadian High Arctic indicate the Brent Geese breeding in this region and migrating to winter in Europe.

16,000 in 1962 and 1970, depending chiefly on the production of young and their survival on the long migratory flights. However, some of the 1960s counts may have been incomplete, and most brood size and proportion of young samples were small. The picture changed little during the 1970s, although survey precision and accuracy improved by making the censuses in early winter when the geese were mostly concentrated at Strangford Lough and a few other easily accessible and well-known sites. Larger samples of broods and juveniles were also obtained. As a result of three highly successful breeding seasons in 1983, 1984 and 1985, the population increased rapidly to just under 25,000 birds. This growth was not sustained through the remainder of the 1980s and early 1990s, when numbers declined to under 20,000 birds. The Irish counts are summarised in Table 21.1.

May counts from Iceland (Gardarsson & Gudmundsson 1997) in four years compare well with those in Ireland in preceeding winters, confirming that almost the entire population can be found in either country on suitable dates.

In Ireland, more than 75% of the population occurs at Strangford Lough in autumn and early winter and, as they deplete *Zostera* stocks in the Lough, the geese disperse along the east coast from Larne Lough in County Antrim to Dungarvan Harbour in County Waterford. On the west coast they occur from Lough Foyle (Counties Derry and Donegal) to the large County Kerry bays. Nowadays, 26 Irish sites are internationally important for Light-bellied Brent, regularly supporting 1% or more of the flyway population (Fig. 21.3) (Delany 1996).

1.4 Breeding success

The breeding success of Brent in the Queen Elizabeth Islands (as estimated after their arrival in Ireland) shows wide variations between years. Annual precipitation is very low throughout most of the archipelago, and occurs mostly in July-October, yet delayed snowmelt in June sometimes prevents nesting, or makes it easier for predators - Arctic Foxes *Alopex lagopus*, Polar Bears *Ursus maritimus*, gulls *Larus* spp., skuas *Stercorarius* spp. and Ravens *Corvus corax* - to find nests. Though lemmings *Dicrostonyx* spp. are often numerous, there does not seem to be a cyclic relationship between them and predators in the archipelago (Gray 1990), so that the intensity of predation on birds' nests is not readily predictable. The scarcity of snow in

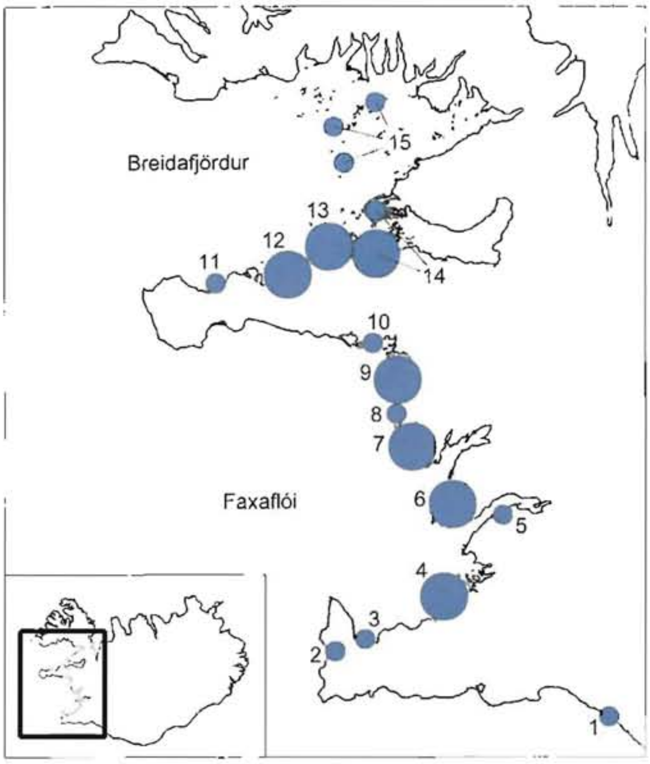

Fig. 21.2. Staging areas of Eastern Canadian High Arctic Light-bellied Brent Geese in Iceland 1974-95 (after Gardarsson & Gudmundsson (1997)). Sites: 1. Stokkseyri, 2. Ósar, 3. Njarðvík, 4. Álftanes-Seltjarnarnes, 5. Laxárvogur, 6. Grunnafjörður-Blautos, 7. Hjörsey-Straumfjörður, 8. Traðir-Vogur, 9. Akraós, 10. Löngufjörður, 11. Brimilsvellir, 12. Grundarfjörður-Hraunsfjörður, 13. Hofstaðavogur, 14. Vigrafjörður-Hvammsfjörður, 15. Northwest Breiðafjörður.

some winters, ice-storms in spring, and cold summers may all damage, or reduce the growth of, vegetation that Brent can use. This may force the geese to move elsewhere in search of food, and, quite often, not to attempt breeding in some parts of the range.

Studies conducted by the Canadian Museum of Nature, the Canadian Wildlife Service (CWS) and the Irish Brent Goose Study between 1968 and 1989 provided direct information from Bathurst and Seymour Islands, situated in the core area of the breeding range of Eastern Canadian High Arctic Light-bellied Brent (M. Ó Briain, A. Reed & S.D. MacDonald unpubl. data). In most years Brent Geese arrived in Polar Bear Pass on Bathurst Island during the first few days of June, before dispersing to nesting areas on the same or adjacent islands. During ten years of intensive study (1974-77 and 1984-89) breeding success was variable. In the three coldest summers (1974, 1986, 1988), when the mean temperature for the period 1-20 June was below -3°C, Brent did not even attempt to nest. In the remaining seven years they nested and produced fledged young in at least four of them. However, in one nesting year (1987), Arctic Foxes were abundant on Bathurst Island and preyed so heavily on eggs that no young were fledged there. Although based on a relatively short run of years, this information suggests that low temperatures in the first three weeks of June provoked the most serious failures, presumably because late thaw in critical spring feeding areas on or near the breeding grounds prevented the geese from replenishing nutrient reserves required for egg production. Fox predation was also responsible for important losses but because peaks of fox abundance are not synchronous throughout the Brent Goose breeding range, and because some geese nest on fox-free islands, the effects on productivity were probably not as widespread as those caused by temperature.

Annual productivity has been estimated in Ireland in most years since 1960 (Ó Briain 1989, unpubl. data). For the three decades 1960-61 to 1989-90, the mean percentage of first-winter Brent Geese was 16.6% (range 0-47%) with large fluctuations between years (Table 21.1). Twelve seasons were poor, with less than 10% first-winter birds, 11 were moderate, with between 10% and 30% first-winter birds; and seven were good, with over 30% first-winter birds in the population. For each of the three decades, the mean percentage of first-winter birds in the population was: 1960-1969: 16.5%; 1970-1979: 17.1%, 1980-1989: 16.4%. Thus no long-term change in productivity is evident (Ó Briain 1989).

The frequency of "boom" and "bust" breeding success was more pronounced in the earlier years. It is probable, in some instances at least, that earlier productivity estimates were inaccurate due to small sample sizes, and problems of sample bias such as edge effects were not fully appreciated by all observers. However, many of the age counts were conducted by experienced observers in the final wintering areas at a time when the population was much smaller than now, and when the problems of differential dispersal of social groups was less likely to be pronounced.

An alternative explanation for higher variability in

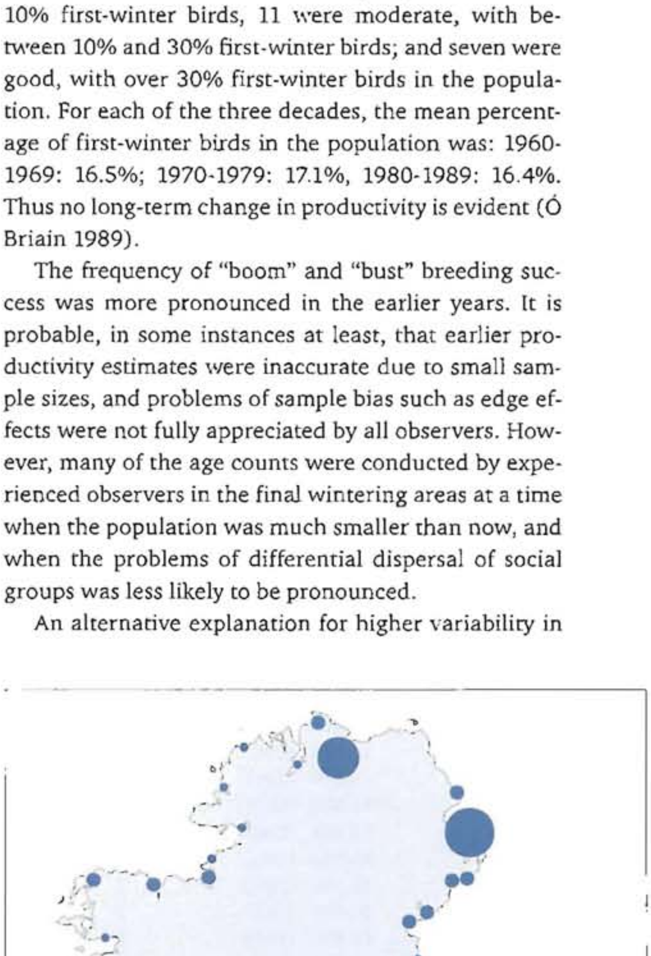

Fig. 21.3. Regular staging and wintering areas of Eastern Canadian High Arctic Light-bellied Brent Geese in Ireland. Sources: Hutchinson (1979), Sheppard (1993), Delany (1996) and O. Merne (unpubl. data).

Table 21.1. Censuses of Eastern Canadian High Arctic Light-bellied Brent Geese in Ireland.

Winter	Total (month)	Source	% juvenile (sample)	Source	Mean brood (sample)	Source
1960-61	11,910	1	40	2		
	11,909 (Nov)	5				
	10,952 (Jan)	5				
1961-62	12,050	1	1	2		
	12,052	5				
1962-63			39	2		
1963-64			33	2		
1964-65			6	2		
1965-66	7350	1	1	2		
	7348 (Nov)	5				
	5523 (Feb)	5				
1966-67	8060	1	16	2		
	8058 (Nov)	5				
	6209 (Feb)	5				
1967-68	8310	1	5	2		
	8314 (Nov)	5				
	7540 (Feb)	5				
1968-69	7770	1	2	2		
	7765 (Nov)	5				
1969-70	12,950	1	47	1		
			22	2		
1970-71	12,000	1	32	2		
	12,057 (Nov)	5				
1971-72	14,600* (Nov)	5	26	1		
			33	2		
1972-73	11,170	1	very poor	1		
			1	2		
	13,825 (Nov)	5				
1973-74	16,140	1	very good	1		
			9	2		
1974-75	11,600	1	<1	1		
			0	2		
1975-76			39.2 (1231)	1		
1976-77			15.1 (1324)	3		
			24.2 (540)	2		
1977-78	9449 (Jan)	3	20.9 (3942)	2	2.82 (75)	3
	9300 (Jan)	5				
1978-79	8443 (Jan)	3	8.8 (1733)	3	2.33 (51)	3
	8193-8443 (Jan)	5				
1979-80	6161 (Jan)	3	2.4 (3603)	3	1.66 (18)	3
	6161-7661 (Jan)	5				
1980-81	17,892 (Oct)	2	20.4 (6340)	4		
	9869 (Jan)	3	15.3 (2715)	3	2.76 (54)	3
1981-82	14,625 (Oct)	2	16	2		
1982-83	10,300 (Oct)	2	11	2		
1983-84	14,900 (Oct)	2	46.6 (5862)	2		
	13,740 (Nov)	5				
1984-85	16,871 (Oct)	2	18.0 (16,277)	2	3.10 (115)	2
	18,255 (Nov)	2	29.7 (2417)	2		
	17,354 (Nov)	5				
	14,823 (Jan)	5				
	14,261 (Mar)	5				
1985-86	24,684 (Oct)	2	22.7 (20,131)	2	3.15 (464)	2
	24,102 (Nov)	5				
1986-87	19,684 (Oct)	2	1.2 (15,301)	2	2.44 (41)	2
	19,633 (Nov)	5				
1987-88	20,690 (Oct)	2	16.3	2	2.68 (87)	2
1988-89	19,500 (Oct)	2	4.5	2	2.79 (42)	2
1989-90	19,100 (Oct)	2	12.5	2	2.46 (67)	2
1990-91			5	2		
1991-92	19,105	5				
	18,320	2	9 (6880)	2	2.8	2
1992-93			8	2		
1993-94			32	2		
1996-97	14,562 (Oct)	6	2.5 (10,058)	6		

* Strangford Lough and Kerry only.

Sources: 1. Ogilvie (1978); 2. M. Ó Briain (unpubl. data); 3. O. Merne (unpubl. data); 4. A. St. Joseph (unpubl. data); 5. Hutchinson (1979); 6. Delany (1996).

breeding performance in earlier years may lie in the fact that summer weather in the Queen Elizabeth Islands was more variable between 1950 and 1975 than it has been since, and its impact on Brent Geese may have been more marked.

1.5 Mortality

There are no direct measures of mortality rates on the wintering grounds, on migration, or in the breeding areas. However, the general upward trend of this population in recent decades indicates that mortality has been lower than the mean recruitment rate during this period.

Prior to the late 1950s, Brent Geese were hunted regularly at many sites around the Irish coast, sometimes with punt guns, but no information exists on overall numbers killed. Since Brent Goose monitoring began in Ireland in 1960-61 the species has been fully protected. Some illegal shooting has taken place from time to time, but it is believed that this has been very localised and small-scale. It is unlikely to have contributed significantly to overall mortality during the winter period.

Mortality due to severe weather on the wintering grounds is thought exceptional as winters in Ireland are relatively mild, especially on the coast. Freezing of the intertidal flats, saltmarshes and sheltered bay and estuary waters has occurred only once (in 1962-63) since Brent Goose monitoring began. A few anecdotal reports of Brent Geese among dead waterfowl on the shore were received, but not enough to quantify the impact of this exceptionally severe winter. Unfortunately, no counts were carried out during the following two winters.

The increasing use of inland feeding habitats in Ireland has enabled Brent Geese to overcome potential food shortages in traditional intertidal and saltmarsh habitats in mid and late winter. However, this could make the birds more vulnerable to weather-induced mortality. For example, in January 1987, when there was widespread snowfall throughout Ireland for several days, Brent Geese feeding inland in County Dublin were forced back to local intertidal areas until conditions improved (Ó Briain & Healy 1991).

The *Zostera* wasting disease is considered to have been the major factor responsible for a decrease of the species along most parts of the Irish coast early this century (Kennedy et al. 1954). The decline of *Zostera marina* at Strangford Lough in the early 1930s was documented by Lynn (1936) who noted a simultaneous "precipitous and alarming decrease" in numbers of Brent Geese on the Lough. However, it is likely that other factors such as poor breeding seasons and overhunting also contributed to the decrease in the population.

By the 1950s, Irish-wintering Brent were feeding on abundant green algae and saltmarsh grasses, and since the mid 1970s on agricultural grasslands and cereals. It now seems unlikely that food shortages would be a factor contributing to winter mortality.

No direct information is available on migration mortality but there is good evidence to suggest a significantly higher juvenile than adult mortality on autumn migration, based on the resighting rate in Ireland of different age categories of Brent Geese ringed on Bathurst Island in summers 1984 and 1985 (Ó Briain 1989). In each of these two years, when birds of all ages were ringed, the loss rate of juveniles was greater than 25%, whereas adult mortality was less than 5%. Although the precise causes are unknown, the long migration of Brent, including the crossing of the 3000 m high Greenland icecap and the extended sea crossing between Iceland and Ireland, is likely to inflict significantly heavier losses on juveniles.

2. BREEDING GROUNDS AND BREEDING ECOLOGY

2.1 Distribution

Range: It is difficult to define the western limit of the breeding range of the Eastern Canadian High Arctic Light-bellied Brent because it merges with the range of Pacific Black Brant and intermediate birds occur on Melville Island, around 75° N, 110° W (Fig. 21.1). Light-bellied Brent ringed on Melville (west to 108°), Bathurst, Axel Heiberg, Ellesmere and Seymour Islands during the 1970s and 1980s were subsequently recorded in Ireland. Nesting *hrota* considered to be from this population have also been seen on the islands of Ellef Rignes, Meighen and Devon (Boyd & Maltby 1979, S.D. MacDonald unpubl. data). Within this area, Brent are highly dispersed, breeding and moulting at low densities. Only a relatively small proportion of the population has been located on the breeding grounds so far. Light-bellied Brent which breed to the south, mainly on Baffin, Southampton and islands in the Foxe Basin, winter in the eastern United States.

The Greenland breeding segment of the population has decreased seriously since early this century, when it was reported breeding in northwest, north and northeast Greenland (Salomonsen 1950). Recently a small population was discovered at Kilen, Kronprins Christian Land, northeast Greenland (Hjort et al. 1987, Hjort 1995), but remaining parts of the former breeding range are now probably deserted (Meltofte 1976, Meltofte et al. 1981). It has now been confirmed that the present Greenland breeding population forms part of the Svalbard population rather than the Canadian one (Hjort et al. 1987, Hjort 1995, Clausen et al. this volume).

It was thought that most Irish birds originated from north Greenland, but later surveys and ringing, together with the decline in Greenland, indicate that the majority (if not all, see above) now come from the Canadian islands (Boyd 1980).

Habitat and feeding ecology: Studies on the Canadian breeding grounds (M. Ó Briain, A. Reed & S.D. MacDonald unpubl. data, Ó Briain 1988a, b) have identified three critical habitats used during the breeding cycle: pre-nesting "staging" areas used for feeding from spring arrival to just before clutch initiation; nesting areas; and brood-rearing areas.

Upon arrival at Polar Bear Pass on Bathurst Island, usually in the first days of June, Brent Geese fed heavily in wet sedge meadows which melted earlier than surrounding wetlands, being located below south-facing hills. In winter, dust blown off the hills collects there, absorbing solar energy and hastening spring melt. These sedge meadows were often the only feeding areas available to geese during the first week after arrival. Usually, Brent Geese began to disperse to nesting areas during the second week in June.

Most Brent Geese nested singly, widely dispersed, usually associated with freshwater lakes or braided river beds. Exceptionally, some nested in small colonies on small offshore islands. All nests were exposed with no concealing cover, although in some cases adjacent rocks probably provided some protection. On Seymour Island, a small rocky offshore island inhabited by nesting Ivory Gulls *Pagophila eburnea*, Brent Goose nests were typically located on gravel ridges, often near a large rock. On Bathurst Island, 10 of 12 nests were on low gravel islands along braided streams. The others were on a small islet in a pond and a gravel beach 20 m from a lake. First eggs were usually laid on 13 June, with peak nest initiation about 16 June. Mean clutch size was 4.5 eggs (n=24) and mean incubation period was 23 days (n=7).

Most hatchings occurred 11-14 July. On Bathurst Island the shorelines of lakes, estuaries and rivers were used for brood-rearing. On Seymour Island broods were raised along shore leads in the sea ice and near freshwater ponds. On lakes, broods were raised singly or in loose groups of 2-3 families (each accompanied by both parents), whereas in rivers and estuaries groups of up to 15 families were observed. The rearing habitats on both islands were generally characterised by narrow mossy lake margins, occasional small patches of wet sedge meadow in lowlands, upland areas with a sparse cover dominated by forbs, and a few areas of estuarine saltmarsh. Broods relied on a variety of sparsely distributed graminoids and other fleshy plants and mosses; only those using a few estuarine saltmarshes would appear to have access to relatively dense swards of the arctic graminoids *Carex subspathacea* and *Puccinellia phryganodes*, known to be important for Brent Goose goslings in more southerly breeding populations.

The former breeding habitats in Greenland were mainly small offshore islands, often also inhabited by Eiders *Somateria mollissima* (Salomonsen 1950). The breeding habitat in the present range is barren plains, usually close to the coast (Hjort et al. 1987, Hjort 1995). In Greenland, Brent Geese fed on *Ranunculus nivalis, R. sulphureus, Eriophorum scheuchzeri* and *Cerastium alpinum* (Salomonsen 1950). Recent studies in north-east Greenland (Hjort et al. 1987) found *Papaver radicatum* and *Alopecurus alpinus* to be the main food, in company with *Ranunculus sabinei, Cochlearia groenlandica* and *C. regelii*. In another study (Hjort 1995) *Papaver radicatum* was the only plant available.

2.2 Moult migration and moulting areas

Within the known Canadian range of the Eastern High Arctic Light-bellied Brent, no large numbers of moulters have been found away from breeding sites. On Bathurst Island, non-breeding adults assembled during June in small flocks to moult around nearby inland lakes, in river valleys, and at the mouths of estuaries (Ó Briain 1988a, b, M. Ó Briain, A. Reed, & S.D. MacDonald unpubl. data). In cold summers when ice cover persisted at inland sites, south-facing estuaries offered some open water and were used intensively by moulting geese. The flightless period began about 6 July and lasted 20-22 days. Recapture of ringed birds at moulting sites indicated that many failed breeders moulted in the vicinity of their breeding sites and many moulting geese returned to the same site in subsequent years. No evidence of moult migration was obtained, but in years of heavy ice cover birds may wander more widely in search of a suitable moulting site.

2.3 Research

Research on Brent Geese in Greenland was summarised by Salomonsen (1950, 1967), and more recently by Hjort et al. (1987), Hjort (1995) and Boertmann et al. (1997). The emphasis has been on numbers, distribution, feeding and migration.

In the early 1970s, extensive oil and gas exploration in the Queen Elizabeth Islands in Canada was centred on Rae Point, on the east coast of Melville Island. In connection with the potential environmental hazards associated with this, the federal departments of Environment and of Energy, Mines and Resources funded many biophysical inventories. These included the assessment of the amounts of habitat suitable for geese in the western islands summarised by Boyd & Maltby (1979). The most important finding was that lakes, ponds and braided channels occupied only 1% of the area of the island and that the wet meadows which provide suitable feeding places for Brent occupied only 1.3%, so that the total "carrying capacity" is extremely limited. Because of the scarcity of soil over most of the archipelago, that would remain the case even if global warming increased seasonal temperatures and precipitation in the region.

Surveys and ringing of Brent were extended north-east to Axel Heiberg Island. Recoveries from this marking (which included the use of metal collars with visible alphanumeric codes) established the links with Iceland and Ireland (Maltby-Prevett et al. 1975, Ruttledge 1976, 1977).

From 1968 to 1989, staff of the Canadian Museum of Nature recorded observations on arrival dates, nesting (habitat, egg-laying dates, clutch size, hatch dates, brood size, etc.), and departure dates of Brent Geese, as part of their routine zoological investigations at the Polar Bear Pass research station on Bathurst Island (and on Seymour Island, 1974-77). More detailed studies of the summer ecology and behaviour of the Brent Goose were carried out mainly in an area south of Bracebridge Inlet, Bathurst Island, by the Irish Brent Goose Expeditions from University College Dublin (UCD), in 1984 (31 May to 19 August), 1986 (6 July to 8 August) and

1987 (30 May to 25 June), with assistance from CWS staff in 1986 and 1987. Ringing of Brent Geese was undertaken by CWS and UCD parties in July or August 1984-1986. The collaborative efforts of the Canadian Museum of Nature, the Irish Brent Goose Expeditions and the CWS have provided most of the information currently available on the breeding ecology of the Eastern Canadian High Arctic Light-bellied Brent Goose (M. Ó Briain, A. Reed & S.D. MacDonald unpubl. data, Reed et al. in press).

2.4 Protection and conservation

Hunting legislation: The Brent Goose has been fully protected in Greenland since 1978. However, some geese (few) are shot during spring and autumn migration as hunting regulations are often not observed by Greenland hunters.

The Eastern Canadian High Arctic Light-bellied Brent come under the general protection afforded by the Migratory Birds Convention Act (1917), which prohibits shooting of migratory birds between 10 March and 1 September. Canada and the USA recently signed a Protocol to the Migratory Birds Convention, which awaits ratification by the US Senate before it comes into effect. If it is ratified, spring shooting by northern indigenous peoples may be authorised. This would be unlikely to affect this stock of Brent, because there are only two Inuit settlements within its breeding range, neither close to substantial numbers of geese.

Site safeguard: In Canada, Polar Bear Pass, which runs west to east across Bathurst Island, was declared a National Wildlife Area (NWA) in 1982. Important pre-laying staging areas occur there and some Brent nest near its eastern border; others nest beyond its western limits. One of the least known (and so far barren) accomplishments in circumpolar wildfowl conservation occurred in 1989, when the CWS, Environment Canada, signed a Memorandum of Understanding with the Irish National Parks & Wildlife Service twinning Polar Bear Pass NWA with three Nature Reserves in County Dublin (North Bull Island, Rogerstown Estuary and Baldoyle Estuary) as "Sister Reserves". In the same year the CWS, the Northern Ireland Department of the Environment and the Northern Ireland National Trust signed a Statement of Intent linking Polar Bear Pass NWA with areas in Strangford Lough protected by the Strangford Lough Wildlife Scheme. Both these agreements were to hold for five years in the first instance: they have not yet been formally renewed.

In October 1996, the Government of Canada announced its intention to make the whole of Bathurst Island north of the NWA into a National Park. The park would include the existing Migratory Bird Sanctuary on Seymour Island, created in 1975 to protect one of the few then known Canadian breeding colonies of Ivory Gulls.

The Ellesmere Island National Park Reserve (already operational) protects the breeding areas of Brent on the north end of the island.

Public awareness: Little or none.

3. STAGING AREAS

3A. ICELAND

3A.1 Distribution

Range: Analysis of counts, ringing recoveries and re-sightings show that large concentrations of Brent Geese stage in western Iceland during both spring and autumn. Because of the possibility of turnover in staging birds it is not possible to determine what proportion of the total population stops off in Iceland. The major concentrations of Brent Geese are in the intertidal zone in the bays and fjords of the Faxaflói Bight between Reykjavik and the Snaefellsness Peninsula, and in the southern fjords of the Breiðafjörður (Fig. 21.2)(Gardarsson & Gudmundsson 1997). Spring staging in Iceland is of crucial importance in preparing the geese for migration across the Greenland icecap and a further 1100-2000 km to their breeding places.

With the exception of the pre-laying staging areas described above (section 2.1), no staging areas for this stock of Brent Geese have been identified in Canada, though some may exist, as many of the geese leave their breeding and moulting sites soon after the adults regain their powers of flight in early August and the young begin to fly, usually a few days later. There is a period of four to five weeks after these movements in the islands begin before many Brent appear in Iceland or Ireland.

Habitat and feeding ecology: In Iceland, Brent Geese feed on *Zostera marina*, *Puccinellia* spp. and green algae (Gardarsson 1982). They also feed to some extent on reseeded grasslands (A. Sigfusson pers. obs.).

3A.2 Abundance

Phenology: The first Brent Geese arrive in Iceland in late April, most arriving in the first week of May. No departures have been observed prior to 23 May and there is no evidence of a high turnover rate (Gardarsson & Gudmundsson 1997). Arrivals on the east Canadian breeding grounds usually occur in early June (M. Ó Briain, A. Reed & S.D. MacDonald unpubl. data). In autumn, the first Brent Geese arrive in Iceland at the beginning of September, but no information exists on departure dates although most of them have left by the end of October (A. Sigfusson pers. obs.).

Trends and numbers: Up to 17,000 Brent Geese have been recorded at any one time during spring staging in Iceland (Fig. 21.2)(Gardarsson & Gudmundsson 1997). Assuming some turnover, it is likely that numbers staging in western Iceland are higher than this. Since some Brent Geese arrive in Ireland in late August, before they start to appear in Iceland, some geese from eastern Canada may fly down the west coast of Greenland as far as Cape Farewell and thence direct to Ireland, passing south of Iceland. This may be a regular feature of the autumn migration, but seems unlikely to occur in spring. In mid May 1996, 17,416 Brent Geese were counted in western Iceland during an aerial survey, a figure probably not far short of the 1995-96 Irish wintering population total.

Censuses (aerial, supplemented by ground counts) were carried out at the main staging areas in western Iceland in spring (mid May) in 1974, 1986, 1990, 1995 and 1996. In 1974, 7175 Brent Geese were recorded, while in the later censuses numbers have ranged between 13,835 and 17,416 (Gardarsson & Gudmundsson 1997).

3A.3 Research

Most of the research at staging areas in Iceland has concentrated on questions related to migration in spring (Alerstam et al. 1990, Gudmundsson et al. 1995, Maltby-Prevett et al. 1975). Studies of numbers staging in spring have also been carried out (Gardarsson 1979, Gardarsson & Gudmundsson 1997).

3A.4 Protection and conservation

Hunting legislation: The Brent Goose has been on the Icelandic list of protected species since 1966. Before that there was a hunting season during the autumn migration, from 20 August to 31 October.

Site safeguard: Grunnafjörður in Faxaflói, an important staging area for Brent Geese, has been a protected area since 1994 under the Nature Conservation Act, and was designated a Ramsar Site in 1996. An act conferring protection on the Breiðafjörður area from 1995 gives protection to important habitat for Brent Geese in that area. There are also plans for protecting the shoreline at Alftanes, just south of Reykjavik, which is an important staging area for Brent Geese and migrating waders.

Agricultural conflict: The Brent Goose is unlikely to cause any significant agricultural damage in Iceland, although some individual farmers have complained about grazing by Brent. No licences to kill Brent Geese to prevent damage have been issued in recent decades.

3B. GREENLAND

3B.1 Distribution

Range: Boertmann et al. (1997) have made observations on the autumn passage of Brent Geese in northwest Greenland, and have summarised historical information, including recoveries of ringed geese. Autumn staging Brent have been recorded regularly in small numbers in the Thule District in the extreme northwest, and also in the mid west between Upernavik District and Disko Bugt.

Habitat and feeding ecology: Some of the Brent Geese staging in autumn in northwest Greenland have been observed at saltmarshes, presumably feeding on saltmarsh plants (Boertmann et al. 1997).

3B.2 Abundance

Phenology: Autumn staging in northwest Greenland occurs mainly from late August to mid September (Boertmann et al. 1997).

Trends and numbers: There is no information on trends. Maximum numbers recorded in northwest Greenland were 580 in 1992, 444 in 1994 and 574 in 1995 (Boertmann et al. 1997).

3B.3 Research

No research has yet been carried out in northwest Greenland other than recording numbers of Brent Geese found during the course of extensive surveys (mainly aerial) for environmental impact purposes relating to oil/gas and mineral exploration (Boertmann et al. 1997).

3B.4 Protection and conservation

Hunting legislation: Brent Geese are legally protected in Greenland, but there is evidence of some illegal shooting taking place (Boertmann et al. 1997).

Site safeguard: At this stage, so little is known about the importance and regularity of use of staging areas in northwest Greenland that it is premature to consider specific site safeguards. As many of the staging Brent Geese have been observed resting on the sea, the species would be vulnerable to oil spills. However, their scattered distribution and small numbers would result in a very minor impact on the population in the event of an oil spill (Boertmann et al. 1997).

Agricultural conflict: There is no agriculture in the areas used by Brent Geese for autumn staging.

4. STAGING AND WINTERING AREAS

4A. IRELAND, REPUBLIC OF AND NORTHERN

4A.1 Distribution

Range: In Ireland, five estuaries where extensive swards of *Zostera* occur are used by the population as autumn staging areas (Ó Briain & Healy 1991). Strangford Lough in Northern Ireland, where up to 75% of the population is regularly counted each autumn, is the most important site, although Lough Foyle on the north coast has become increasingly important. Smaller numbers use Sligo and Killala Bays in the west and Castlemaine Harbour in the southwest as staging areas. These sites are also used by smaller numbers of Brent Geese as wintering areas. There are no pre-migratory staging areas in Ireland in spring.

The vast majority of Eastern Canadian High Arctic Light-bellied Brent winter in Ireland. With the exception of most of the County Cork and south County Kerry coasts in the extreme southwest, wintering Brent Geese occur on all coasts where apparently suitable habitat exists. Strangford Lough and Lough Foyle, although principally used as autumn staging areas, continue to support smaller numbers of Brent Geese throughout the winter. Elsewhere in Northern Ireland the main wintering areas are Larne Lough, Dundrum Bay and Carlingford Lough. Carlingford Lough and Lough Foyle are cross-border sites shared with the Republic of Ireland.

In the Republic, there are clusters of important sites on the east coast (Dundalk Bay, Rogerstown and Malahide Estuaries, Baldoyle Bay, Dublin Bay and Kilcoole Marshes), in the southeast (Wexford Slobs and Harbour, Tacumshin Lake, The Cull, Bannow Bay, Tramore Back Strand and Dungarvan Harbour), and in the southwest (Castlemaine Harbour, Rossbehy, Tralee Bay, Barrow Harbour and the Shannon Estuary). Other important sites in the west and northwest are Inner Galway Bay, Blacksod Bay/Broad Haven, Killala Bay, Sligo Bay (Ballysadare Bay, Cummeen Strand and Drumcliff Bay), Inner Donegal Bay, Ballyness Bay, Lough Swilly and Trawbreaga Bay (Fig. 21.3).

The birds disperse increasingly as winter progresses, mainly on a local scale within the wintering regions. Small parties of geese can be encountered in small bays, estuaries and open coasts not frequented earlier in the winter. With the increase in the population in the mid 1980s some late winter sites such as east County Cork and Kilcoole, County Wicklow, are increasingly used throughout the winter. Everywhere, Brent Geese keep to the intertidal zone and grassland immediately adjacent to the shore, although very recently (1995-96) up to 300 geese have been flying over the centre of Dublin City from Dublin Bay to recreational grasslands 10 km from the tide-line (O. Merne pers. obs.). However, inland feeding Brent Geese still return to coastal areas to roost.

Habitat and feeding ecology: The distribution of Brent Geese at autumn staging sites in Ireland closely corresponds with that of *Zostera*, with over 90% of the population recorded using this habitat (Ó Briain & Healy 1991). Both *Z. noltii* and *Z. angustifolia* are important food plants, but their relative abundances vary between staging sites (R. Nairn & M. Ó Briain unpubl.). The depletion of *Zostera* stocks is the major cause of autumn redistribution of the population in Ireland, both within and between sites (Brown 1988, Ó Briain 1991, Ó Briain & Healy 1991).

Before the wasting disease wiped out many Irish *Zostera* beds in the late 1920s and early 1930s, it is thought the wintering Brent Geese relied very heavily (possibly exclusively) on *Zostera* for winter food. Since then, and up to the mid 1970s, their diet consisted of a mix of *Zostera*, intertidal green algae (*Enteromorpha* and *Ulva*) and saltmarsh plants, especially *Festuca* and *Puccinellia*. This limited diet restricted the Brent to intertidal areas of mud and sand flats in sheltered bays and estuaries, and to adjacent saltmarshes.

Seasonal changes in habitat use have been documented by Ó Briain and Healy (1991). There is a clear sequential pattern of use of habitats in response to depletion of favoured foods within the final wintering range. After the autumn depletion of *Zostera* most birds use intertidal estuaries and bays where green algae are the main food. Where adjacent saltmarshes exist, they provide high-tide grazing areas.

The phenomenon of inland feeding developed within this population in the mid 1970s. In 1976 exceptionally high water levels at Tacumshin Lake (a lagoon on the south County Wexford coast) inundated the traditional grazing habitat of the c. 600 Brent Geese wintering there, forcing them to feed on adjacent fields of improved grassland. The habit of feeding above the high water mark seems to have spread steadily from this small beginning, especially in the southeast and east. Now, an estimated 25% of the Irish wintering population spends much of its time feeding on managed grasslands. In the southeast and northeast, these grasslands are agricultural, but in Dublin they are mainly recreational or amenity grasslands (golf courses, playing fields, parks, etc.). Small numbers of Brent Geese have also been recorded feeding on rough grassland on offshore islands on the east (Skerries, Lambay Island and Ireland's Eye) and southeast (Keeraghs) coasts in mid to late winter.

Nowadays, internationally important flocks of these high arctic geese can be seen grazing against a background of buildings, streets, traffic, and people walking, cycling, exercising dogs and pushing prams. In a few areas (eg the Wexford Slobs and Dungarvan Harbour), Brent Geese have been recorded feeding on cereal grains (both waste in autumn stubbles and spring seed) (Ruttledge 1985) and waste potatoes (Smiddy 1987). In spite of abundant and high quality food being available in these areas in spring, some geese (in Dublin Bay at least) return to the saltmarshes to exploit the fresh growth there before spring departure as happens with Dark-bellied Brent *Branta bernicla bernicla* in the Wadden Sea area (Madsen 1989, Prop 1991).

4A.2 Abundance

Phenology: Small numbers of Brent Geese, possibly failed or non-breeders, appear at the County Kerry sites (and sometimes also at Strangford Lough) as early as late August in some years (Hutchinson 1989), but the main arrival in Ireland is in late September and early October. For about six to eight weeks each autumn the great majority of Brent Geese in Ireland use Strangford Lough. Formerly the annual peak occurred there in November, but in more recent years it has taken place in mid October, with most birds arriving in late September and early October (Ó Briain & Healy 1991, Fox et al. 1994). The majority of these birds have moved on to final wintering areas by early December. Observations of colour-ringed birds have shown that there is an autumn turnover at Strangford Lough, with some individuals moving on to wintering areas at the beginning of October before the peak numbers occur at Strangford (Ó Briain & Healy 1991, Ó Briain et al. 1986). One third-winter Brent was seen during a seven day period in early October 1985 at Strangford Lough in the northeast, Dublin Bay in the east and the Kerry Bays in the southwest, where it eventually wintered (Ó Briain et al. 1986).

With the exception of five sites which are principally used as staging areas in autumn, all other areas used by Brent Geese in autumn assume increasing importance throughout the winter and spring, and probably act as final wintering areas for most birds that resort to them (Ó Briain and Healy 1991). There is no large-scale movement of the population between mid winter and spring, although local dispersal of wintering flocks takes place. The geese remain in Ireland until mid April when the return migration commences. Most birds have gone by the end of the month or the first few days in May.

Trends and numbers: With the exception of small numbers in France, the Channel Isles and western Britain, virtually the entire Western Palearctic wintering population of the East Canadian High Arctic breeding Light-bellied Brent is located in Ireland. Quantitative data prior to 1960-61 are non-existent. The old literature (e.g. Payne Gallwey 1882, Ussher & Warren 1900) uses expressions such as "plenty", "abounding", "darkening the sky", "prodigious numbers" but numbers were "greatly diminished" between 1850 and 1900, and this decline was considered to have continued, due to the disappearance of *Zostera* (Kennedy et al. 1954), until the 1950s, when Ruttledge (1975) estimated the population to be 6000. The long-term decline during 1850-1950 was probably due to a combination of heavy hunting and loss of *Zostera*, although the real reasons will never be known. Variation in numbers relating to breeding success/failure, together with some early problems with coverage and counting methodology, slightly obscure the overall picture, but numbers may have doubled from 6000 in 1950 to 11,000-12,000 in the early 1960s. This was followed by a sudden drop to 7000-8000 in the late 1960s, due to poor breeding years, and possibly severe winter weather in 1962-63. The early 1970s showed a recovery to 12,000-16,000 Brent Geese, but this was followed by a decline to 7500-10,000 in the late 1970s. Brent Geese have fared better in the 1980s and 1990s, reaching a peak of 24,000 in 1985-86, and the population now seems to have stabilised at around 20,000 birds.

4A.3 Research

Census: Annual censuses were initiated by R.F. Ruttledge in 1960-61 and were then continued by the Irish Wildfowl Committee/Irish Wildbird Conservancy (Cabot 1965, 1966, 1967, 1968, 1973, 1974, 1975). They lapsed in the mid 1970s but were reactivated by the Forest & Wildlife Service (Merne 1978, unpubl. data). M. Ó Briain established the Irish Brent Goose Study in 1983 and organised the national censuses up to the early 1990s. Since 1996 censuses have been organised by the Irish Brent Goose Research Group under the aegis of the UK Wetland Bird Survey (WeBS) and the Irish Wetland Bird Survey (I-WeBS).

Ringing: Apart from a small cannon-net catch at Strangford Lough in February 1989, the only ringing, colour-ringing and neck-banding carried out so far on the Irish wintering Brent Geese has been done on the breeding grounds (see section 2.3 above). Cannon-netting equipment and expertise are now available in Ireland and the Irish Brent Goose Research Group is planning to catch and ring Brent Geese on the wintering grounds in the near future.

Other: The social organization, population ecology and distribution of Light-bellied Brent wintering in Ireland has been investigated for a PhD and allied studies (Ó Briain 1989). This benefitted from the presence of leg-ringed birds, trapped on Bathurst Island, which could be individually identified in the field, thus enabling detailed insights to be gained into the movements of different social classes in relation to habitat use and patterns of site-fidelity on the wintering grounds.

Studies on feeding ecology, impacts of disturbance, and competition with Wigeon *Anas penelope* have been, or are being carried out at Strangford Lough (Brown 1988, Fox et al. 1994). Studies of *Zostera* are also being carried out there (J. Furphy pers. comm.).

4A.4 Protection and conservation

Hunting legislation: In the Republic of Ireland, Brent Geese were legitimately hunted during the winter open season until the late 1950s, by which time it was clear that their numbers had declined to very low levels (c. 6000). The Light-bellied Brent Goose was removed from the list of huntable species and it has remained off the list ever since. There has been very little pressure from hunters, and none from farmers, to reinstate it. Prior to 1976 the relevant legislation was the 1930 Game Preservation Act, and since then it has been the 1976 Wildlife Act.

In Northern Ireland, Brent Geese have been protected since the 1930s. Current legislation there is the 1985 Nature Conservation and Amenity Lands (Northern Ireland) Order.

The Light-bellied Brent Goose is not included in Annex I of the European Union (EU) Birds Directive (Council Directive 79/409/EEC). The species *Branta bernicla* is included in Annex II/2 of the Directive and as such may only be hunted in the EU in those Member States for which it is indicated. There is no provision in this Annex for hunting Brent Geese in the United Kingdom (UK), Ireland or France, and therefore this population is protected from hunting under the Directive throughout its entire wintering range.

The African-Eurasian Migratory Waterbird Agreement (AEWA), opened for signature since 15 August 1996, lists *Branta bernicla hrota* - the Irish wintering population - as Category 2 in Column A of Table 1 of the Action Plan of the Agreement. This means it is recognised as a population limited in numbers to 10,000-25,000 individuals, which requires protection from hunting and significant disturbance. Trade in the species is also prohibited. Ireland, the UK and the EU have signed the AEWA; France has not done so yet.

Site safeguard: Based on the Ramsar Convention 1% of population criterion, some 26 sites in Ireland qualify for recognition as internationally important for Light-bellied Brent Geese (Ó Briain & Healy 1991, Way et al. 1993). Nearly all the sites in the Republic of Ireland which are internationally important for Brent Geese have been designated as Special Protection Areas (SPAs) under the EU Birds Directive. It is expected that the remaining key sites for the population will soon receive this designation as the Irish Government has announced its intention to proceed with such designation. None of the internationally important sites for Brent Geese in Northern Ireland have been designated as SPAs.

Since June 1994 all areas classified as SPAs are subject to the protection regime defined in Article 6 (2), (3) and (4) of Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora. In addition to requiring the avoidance of significant disturbance of birds and deterioration of their habitats, this also provides a procedure under which any development proposal which may affect the site must be evaluated. These internationally important sites also qualify for designation as Ramsar Sites, and a number have been formally designated as such already. It is expected that many of the remainder will be designated in due course. Another category of designation under EU legislation will be Special Areas of Conservation (SAC) under the Habitats Directive (see above). Various habitats used by Brent Geese (saltmarshes, estuaries, mudflats) are listed in Annex I of this Directive and designation of such SACs in Ireland will benefit Brent Geese.

The North Bull Island, a major Brent Goose site in Dublin Bay, has been designated a Biosphere Reserve under the UNESCO Man and the Biosphere (MAB) Programme.

The CWS has proposed the establishment of a network of "Sister Reserves" linking Canadian breeding grounds of Light-bellied Brent Geese with their main Irish wintering grounds, and Memoranda of Understanding between Canada and the Republic of Ireland and Northern Ireland were signed in 1988. A modification of this proposal, to include Icelandic staging areas, is receiving consideration in Northern Ireland, the Republic of Ireland and Iceland.

National legislation in the Republic of Ireland and Northern Ireland also provides for site safeguards, e.g. statutory Nature Reserves, Refuges for Fauna, Areas of Special Scientific Interest. A number of Brent sites are already covered by such designations (e.g. Strangford, Larne and Carlingford Loughs in Northern Ireland, and Rogerstown Estuary, Baldoyle Bay, North Bull Island, North Slob, The Cull, Castlemaine Harbour, Tralee Bay, Drumcliff Bay in the Republic of Ireland) and these complement the safeguards provided by SPA/SAC, Ramsar and other international designations. In Northern Ireland, the National Trust established the Strangford Lough Wildlife Scheme in 1966, which has greatly benefitted the Brent at that very important site.

Agricultural conflict: Thus far, agricultural conflict has not arisen through most of the wintering range in Ireland, even though c. 25% of the population now grazes on managed grassland. About half of this segment of the population utilises only recreational/amenity grassland, so the overall numbers on agricultural grassland are relatively small. In the Wexford Harbour area between 1200 and 2000 Brent Geese feed on the agricultural grasslands at the Wexford Wildfowl Reserve on the North Slob polder, where they are welcome: when they occasionally stray outside the reserve, or visit the South Slob, they are not so welcome! At The Cull, Tacumshin Lake and Kilcoole Marshes there have been some grumblings from farmers but no serious antipathy towards the Brent so far. Brent Geese now feed on agricultural grasslands beside Strangford Lough in Northern Ireland. Compensation for goose damage is not paid, but where there is a real problem it is possible to put in place a management agreement allowing geese to be accommodated on the farmland.

4B. SCOTLAND

Until the late 1930s, some Light-bellied Brent wintered on Islay and other Hebridean islands with suitable mudflats (Berry 1939). Now they occur there only briefly on passage, chiefly in April and early May, and few large flocks have been reported (St. Joseph 1986, Thom 1986, Elliott 1989).

4C. FRANCE/CHANNEL ISLANDS

Some few hundred Eastern Canadian High Arctic Light-bellied Brent move on from Ireland to the Channel Isles, Brittany and the west coast of France (Debout & Leclerc 1990).

5. DISCUSSION

Population status: After a period of 100 years (1850-1950) of steady decline, perhaps due to over hunting and loss of winter food when *Zostera* beds were lost in the late 1920s and early 1930s, the Irish wintering population of Light-bellied Brent recovered somewhat, from a low of c. 6000 in 1950 to c. 20,000 nowadays (peak of 24,700 in 1985-86). This is still a small and vulnerable population and the conservation objective remains to at least maintain the present population.

Much has been done on the wintering grounds in Ireland and staging grounds in Iceland: the species is protected from hunting, and increasing numbers of sites have been designated as SPAs, or are soon to be. Furthermore, Brent Geese themselves have overcome their apparent former dependance on *Zostera* and now exploit intertidal green algae, saltmarsh grasses and other plants, and in the last twenty years have taken to "inland" feeding on agricultural lands and recreational/amenity areas.

Unpredictable weather conditions on the high arctic breeding grounds can cause dramatic changes in the population due to breeding failure and possibly adult mortality. Climate change due to global warming may or may not benefit the geese in the high arctic: only time will tell. Studies in the Canadian arctic islands (S. Edlund unpubl. report) have shown that the short-term effects of warming are unhelpful: melting of the upper permafrost occurs first under the vegetated areas that geese use, which leads to soil slumping that destroys most of the existing vegetation.

Conservation issues: Assuming Light-bellied Brent Geese continue to enjoy protection from hunting on their wintering grounds, and their sites are safeguarded by conservation designations and maintenance of the quality of the favoured intertidal habitats, prospects for Brent Geese in Ireland look good. As inland feeding continues or spreads, the potential for conflict with agriculture may increase and measures to reduce this will need to be taken. If numbers increase substantially, there may be a growing demand to have the species reinstated on the hunting list. This will have to be considered by the authorities in the context of the species' status in relation to the EU Birds Directive and the AEWA and, if hunting is allowed, it will have to be in a strictly controlled fashion, taking into account the principle of sustainability, and managed in the context of a species management plan.

Many of the internationally important sites for Brent Geese in the Republic of Ireland are also being used increasingly for the development of intertidal shellfish culture, particularly for clam and oyster cultivation (Ó Briain 1993). Such activities, if unregulated, could result in loss and deterioration of feeding and roosting habitats as well as significant disturbance of birds. In order to avoid such threats the National Parks & Wildlife Service, with financial support from the EU's LIFE programme, is preparing aquaculture plans for most of the internationally important bays and estuaries used by Brent Geese which have been classified as SPAs. Having largely completed its programme of legally designating SPAs in the Republic of Ireland, the National Parks & Wildlife Service, again with financial support from the EU's LIFE programme, has moved on to prepare management plans to ensure the effective conservation of these sites, which include many areas important for Brent Geese.

In the staging areas in Iceland the prospects for Brent Geese also appear good. Increasing numbers of important staging areas are being protected, and there is no pressure from the Icelandic Hunting Association for reinstating the Brent Goose on the hunting list.

In spite of the vast breeding range of the Eastern High Arctic Light-bellied Brent in Canada, the number of suitable breeding areas is quite limited. This can be concluded from what is known about their breeding distribution and habitat requirements, from an examination of the geography and topography of the range, and from the small size of the population. Allowing for first-winter and immature geese (and probably some non-breeding adults) the total population of c. 20,000 birds may comprise less than 10,000 breeding adults (less than 5000 breeding pairs). If any of the rather few known breeding areas are threatened or destroyed (e.g. by oil/gas exploration or development) this could have serious consequences for the Brent Geese (Boyd 1980).

Future research needs: In Ireland, detailed research on disturbance, competition with Wigeon *Anas penelope* for *Zostera* at Strangford Lough (Brown 1988, Fox et al. 1994), and on social organisation, population ecology and distribution (Ó Briain 1989) have been the main investigations so far. There is clearly scope for research on other aspects of the biology and ecology of the Light-bellied Brent on the wintering grounds. As the species increasingly utilises managed grasslands, research into the nutritional value of this new food resource, as well as the impact of the geese on the grasslands, would be particularly useful. Reactivation of individual marking will open the way for studies on social structure of flocks and movements through the winter season.

Western Iceland is clearly very important as a staging area for the Irish wintering Brent Geese. The phenology of staging is quite well established, but there is scope for research into turnover and post-arrival/pre-departure feeding ecology. The presence of individually-marked birds in the population would aid such studies, while catching birds in Iceland would produce useful data on weights during migration.

Unfortunately, extensive aerial surveys within the known breeding range would be prohibitively costly and unlikely to add greatly to our knowledge of numbers and distribution of breeding colonies, although they might locate moulting flocks. Ringing of adults and young on the breeding grounds should be reactivated to aid studies of survival in different parts of the range.

International conservation: This population of Light-bellied Brent is restricted to six range states: Canada, Greenland, Iceland, the UK (mainly Northern Ireland), Ireland and France. Its effective conservation depends very much on safeguarding the breeding, staging and wintering areas used by the geese, as well as ensuring that any hunting is carried out sustainably. Each of the range states has a contribution to make in these regards, and it would seem desirable to put in place a population action/management plan. The AEWA, whose Area of Agreement (in spite of the name) covers Greenland and those parts of eastern arctic Canada where the Irish wintering Light-bellied Brent breed, would appear to provide a suitable vehicle for the development of such an action/management plan.

The CWS's "Sister Reserves" project could contribute to the international conservation of these geese if it was extended to cover a number of key breeding, staging and wintering areas. There is also scope for designating more areas as Ramsar Sites: all the range states are parties to the Ramsar Convention.

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22 Light-bellied Brent Goose *Branta bernicla hrota*: Svalbard

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1. POPULATION REVIEW

1.1 Range

The East-Atlantic flyway population of Light-bellied Brent Geese breeds on Svalbard and Franz Josef Land (Fig. 22.1)(Madsen 1987). A recently discovered population breeding at Kilen in northeast Greenland has been suggested to belong to this population as well (Fig. 22.1)(Hjort et al. 1987), and this was confirmed by a satellite telemetry study in 1997 (Clausen & Bustnes 1998). In late August to late September they migrate down the Norwegian west coast to winter in Denmark and at Lindisfarne in Northumberland, England (Fig. 22.1). In severe winters, when Danish coastal waters become icebound, some birds also disperse to winter in the Netherlands (Lambeck 1981a, van den Berg 1984, 1986, Berrevoets 1988).

1.2 Delineation of flyways

The first known recovery of a Light-bellied Brent Goose originating from Svalbard is that of one marked by Russians in summer 1933 at Spitsbergen, and recovered in the Moray Firth, North Scotland, in early 1934 (Webbe 1959).

Seventy-four birds were ringed with metal bands on Svalbard by the British (Sherborne-Cambridge) Spitsbergen Expedition in summer 1954 (Goodhart et al. 1955), one bird was marked in Denmark in 1961, one on Svalbard in 1963 and nine on Svalbard in 1968 (Fog 1967, Holgersen 1964, 1969). Subsequent recoveries of 34 of these birds from Denmark and Lindisfarne identified the link between the Light-bellied Brent Geese known to winter on either side of the North Sea, as well as the sequential use of sites in autumn and winter (at a time when birds could still be shot in Denmark) (Holgersen 1956, 1961, Fog 1965, 1967, Anker-Nilssen & Jensen 1981).

Sixty birds were ringed with metal bands and a single colour-ring at Nissum Fjord in Denmark in May 1979. Subsequent recoveries and sightings of colour-ringed birds links all the areas described as belonging to this flyway (Fig. 22.1), and showed that influxes to the Netherlands come from this population as well (van den Berg 1984, Berrevoets 1988).

Scarce observations of Canadian marked Light-bellied Brent Geese, i.e. one neck-banded migrating via Lindisfarne to the Netherlands in 1975 (Lambeck 1977) and one with an engraved darvic leg-band seen at Lindisfarne in 1990/91 (S. Percival unpubl. data) reveals that some exchange occurs between the Eastern Canadian-Irish flyway population (Merne et al. this volume) and the East-Atlantic flyway population. However, with 550 birds banded during 1984-86 in Canada in a population of 20,000 birds (Ó Briain & Healy 1991) this latter resight suggests that interchange between the populations is negligible, as it is the only bird observed during nine years of intensive resighting work at Lindisfarne and in Denmark during 1989-97.

1.3 Population trends

The Svalbard Brent Goose population suffered a major decline in size during the first part of this century as did most Atlantic Brent Goose populations. Several factors have been proposed to explain the decline, and these probably acted in combination: the "wasting disease", a *Labyrinthula* slime-mould induced epidemic, which wiped out *Zostera marina* stands throughout western Europe in the early 1930s, thereby removing the main food resource for the Brent Geese; uncontrolled egg and down collection by fishermen and sailors from Norwegian ships visiting the Svalbard coasts; and intensive hunting of Brent Geese, especially in Denmark (for reviews, see Salomonsen 1958, Madsen 1987). The size of the population prior to the decline may have been in the range of 40,000-50,000 birds (Salomonsen 1958; a rough estimate based on observations of autumn migration along the southwest coast of Norway in 1891). The first reliable estimate of population size is that of Salomonsen (1958), who estimated a population size of c. 4000 individuals for the late 1940s and early 1950s. Norderhaug (1969) estimated a population of

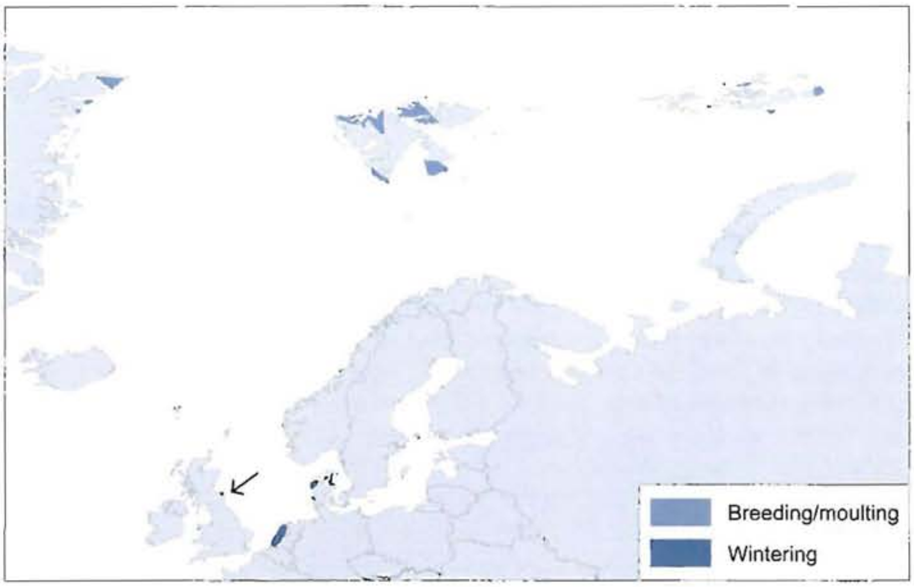

Fig. 22.1. Overall distribution of the Svalbard Light-bellied Brent Goose, with breeding areas in Svalbard, Northeast Greenland and Franz Josef Land and wintering areas in the North Sea region.

2750 for the 1965/66 wintering season, and Fog (1972) estimated 1600-2000 birds for the years 1967-71. Coordinated counts covering the whole population in autumn/early winter for the remaining years of the 1970s are not available, but counts from the two spring staging areas at Nissum Fjord and Agerø showed a steady increase in numbers during the 1970s (Clausen et al. 1998). Since 1980, annual coordinated counts have been made at the sites used by the geese in late autumn/mid winter, and have shown a steady but slow population increase from 3450-4000 individuals in the early 1980s to 4000-5800 individuals in the early 1990s (Clausen et al. 1998) (Fig. 22.2).

1.4 Breeding success

Two independent samples of breeding success in the 1978/79 season (i.e. 30% among birds seen in the Netherlands and 25% among 60 birds caught in Denmark in May 1979; Lambeck 1981b, National Environmental Research Institute, Denmark, unpubl. data) are the first productivity estimates for the population, and suggest a good breeding season in the summer of 1978. Systematic survey of breeding success began in 1980/81 and has been carried out annually since then (Madsen 1984, Clausen et al. 1998). Breeding success is highly variable - ranging from 1.5 to 33.9% with an overall mean of 15.0% in the period 1980-96 (Fig. 22.2), and without any significant trend (simple regression, F=0.004, P=0.95). In years when the population has been sampled at Lindisfarne as well as Denmark in autumn, there is no significant difference between the proportion of juveniles on either side of the North Sea.

Clutch size ranges from 2 to 6 eggs, with reported averages of 3.9 in 1963, 4.0 in 1987, 4.0 in 1991 and 3.6 in 1995 (all data from Svalbard: Nyholm 1965, Madsen et al. 1989, J. Madsen unpubl. data, Bustnes et al. 1995). Average brood sizes have been reported from Tusenøyane, Svalbard (3.0 in 1987, 2.36 in 1989 and 2.93 in 1995) (Madsen et al. 1989, 1992, Bustnes et al. 1995) and from Kilen in northeast Greenland (3.44 in 1985) (Hjort et al. 1987). After arrival in the wintering areas average brood size ranged from 2.3 to 2.9 (P. Clausen unpubl. data).

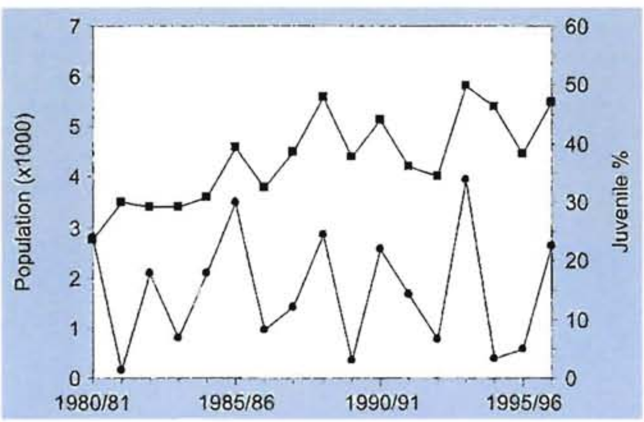

Fig. 22.2. Population development (squares) and productivity (% juveniles in autumn/early winter) (filled circles) of the Svalbard Light-bellied Brent Goose population 1980-96.

1.5 Mortality

Prior to 1972 the Light-bellied Brent Geese was a quarry species in Denmark. Boyd (1959) used recoveries (in fact most birds were reported as shot) of the birds marked on Spitsbergen in 1954 to calculate an annual survival rate of 83±8% (based on the Haldane maximum-likelihood method). Thirty of the 85 birds marked with metal rings during the 1950s and 1960s were later reported as shot in Denmark (references above in section 1.2), and Fog (1972) estimated an annual harvest ranging from 150 to 300 individuals, equivalent to a range of 8-18% of the then known population size of 1600-2000 individuals, but that estimate of harvest is conservative (J. Madsen unpubl. data). After 1972, since when the population has been fully protected, Clausen et al. (1998) calculated an apparent annual survival rate of 87% for the period 1981-95 (based on population counts).

By comparing proportions of juveniles in autumn and spring, Clausen et al. (1998) found that the population suffers major over-winter juvenile mortality in some winters. It has not yet been established whether the adult segment of the population is affected in the same winters.

2. BREEDING GROUNDS

2.1 Distribution

Range: The Svalbard breeding areas are fairly well known. Prior to the population decline in the first part of this century, several important breeding areas were found along the coasts of West-Spitsbergen, where the Brent Geese bred on small islands (to avoid predation from Arctic Foxes *Alopex lagopus*). Most of these breeding areas had, however, been abandoned during the 1950s, when the most important breeding areas remaining were to be found on islands north and west of Nordaustlandet (Løvenskiold 1963). The main breeding area today is the archipelago of Tusenøyane, situated southwest of Edgeøya (Fig. 22.3). A post-breeding population of 600-750 birds, equivalent to 30-40% of the population, was estimated to inhabit this area in 1969 (Norderhaug 1974). A survey in 1985 found 435-600 breeding pairs in the archipelago (Persen 1986), which accounted for 30-41% of the potential breeders that summer (i.e. 2950 adults and yearlings alive during 1984/85, cf. Clausen et al. 1998). Surveys in the same area in 1989 found 11 pairs and 425 failed/non-breeding birds (Madsen et al. 1992) and in 1995, 67 pairs and 376 failed/non-breeding birds (Bustnes et al. 1995), i.e. close to 500 birds in both years or about 10% of the potential breeders. Both these years were, however, almost complete breeding failures with 3% and 4% juveniles, respectively, in the following winter populations, which may suggest that a lot of birds could have dispersed to moult in other parts of Svalbard. A comparison of the number of breeding pairs at Tusenøyane with the number of successful breeding pairs in the whole population demonstrates that most of the population's successful breeders come from Tusenøyane (Table 22.1). Moffen, a small island north of West-Spitsbergen (Fig. 22.3), is the only other known area with a concentration of >10 breeding pairs on Svalbard, with records of 43 breeding pairs in 1993 (F. Mehlum unpubl. data) and 218 adults with c. 100 goslings in 1996 (Bangjord 1998). Approximately 20 pairs nest scattered on islets off the west coast of Spitsbergen.

Compared to Svalbard, survey information from Franz Josef Land remains inadequate. During the last eighty years only six ornithological surveys have been conducted in the area, and three of them only refer to a single island. Breeding of isolated pairs of Light-bellied Brent Geese were reported on Aljer, Jackson, Elisabeth and Hooker islands, and "geese" were reported in spring on Aleksandra Land and Rudolph Island (Uspenski & Tomkovitch 1987 and references therein). Systematic aerial surveys were conducted in the 1980 and 1981 breeding seasons, and ground field work carried out in 1981 on Hooker and Graham Bell islands (Tomkovitch 1984, Uspenski & Tomkovitch 1987, Uspenski et al. 1987). A 460 km² periglacial area was covered during June to September 1981 on Graham Bell Island, during which two isolated pairs were observed during the first ten days of July, and 20 adults with 15

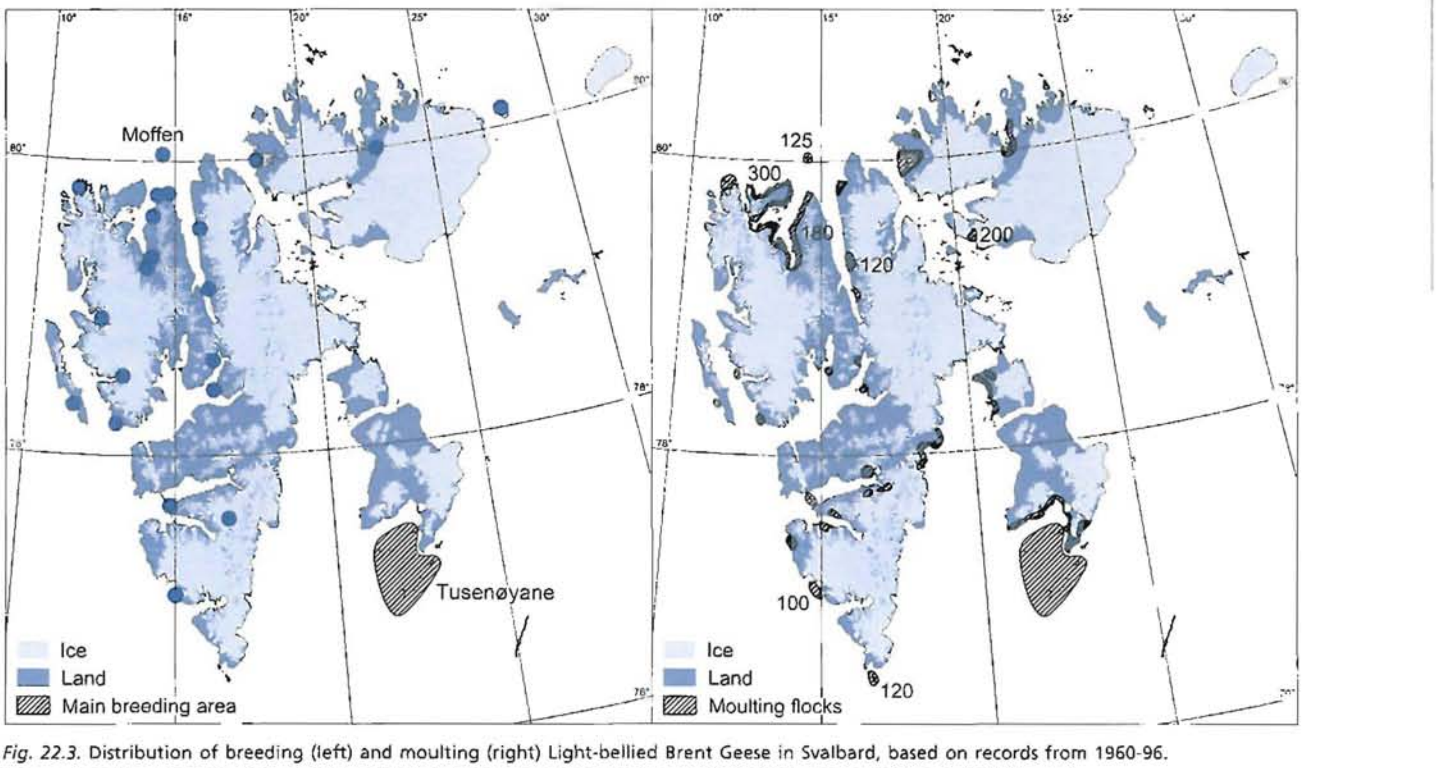

Fig. 22.3. Distribution of breeding (left) and moulting (right) Light-bellied Brent Geese in Svalbard, based on records from 1960-96. Known breeding sites are given as dots and moult areas are hatched (with associated main concentrations in bold figures).

Table 22.1. A comparison between the number of Light-bellied Brent Goose breeding pairs and goslings recorded during years with complete surveys of the Tusenøyane archipelago, Svalbard, and the number of successful breeding pairs monitored in the autumn population (calculated as the number of juveniles in autumn divided by the average brood size in autumn). For 1995 some additional records of successful breeding pairs from other parts of Svalbard are included.

Breeding season	Site	Breeding pairs recorded	Goslings recorded	Juveniles in following autumn	Brood size in following autumn	Successful breeding pairs in population
1985	Tusenøyane	435-600	not determined	1380	2.3-2.9*	476-600
1989	Tusenøyane	11	26	132	2.7**	49
1995	Tusenøyane	67	190	223	2.3-2.9*	77-97
	Moffen	2-3#	7			
	Kap Wijk	6	16			

* range of average brood sizes recorded in autumns 1988-91; ** average brood size in 1989; # assuming a brood size of approximately three goslings (16 adults recorded on Moffen).
Sources: Breeding surveys on Tusenøyane 1985 (Persen 1986), 1989 (Madsen et al. 1992) and 1995 (Bustnes et al. 1995); other sites 1995 (Bangjord 1997). Juveniles in following autumn from Clausen et al. (1998). Brood sizes in following autumn recorded in Denmark (P. Clausen unpubl. data).

full-grown juveniles were recorded on 9 August (Tomkovitch 1984). Based on this survey, the Light-bellied Brent Goose population of Franz Josef Land was tentatively estimated to be at most 1000 individuals (Uspenski & Tomkovitch 1987).

Ship and ground surveys were organised by the Marine Murmansk Biological Institute during the breeding seasons of 1991 and 1992, with particular attention to the status of Light-bellied Brent Geese (D. Vangeluwe unpubl. data). A 1350 km transect was conducted by boat between the islands in the southern part of the archipelago (the northern part of Franz Josef Land is almost permanently surrounded by pack ice (Fig. 22.4). Fourteen islands were visited of which 470 km² were surveyed for Brent Geese (c. 20% of the area not covered by glaciers). Graham Bell Island was not visited. Light-bellied Brent Geese were rarely encountered - one adult was observed on Vilczek Island and fresh tracks (droppings and moulted feathers) were found on Mabel and Klagenfurt islands. The suitability of Franz Josef Land as a breeding area for the Light-bellied Brent Goose was evaluated by combining existing knowledge of breeding biology and nutrition during summer (Nyholm 1965, Madsen et al. 1989) with maps of the physical characteristics and botanical records within the archipelago (Aleksandrova 1983, Uspenski et al. 1987, Marine Murmansk Biological Institute unpubl. data). Most of the archipelago is covered by glaciers (85%, 2413 km² glacier free area). The glacier free areas are dominated by polar desert where bare ground alternate with patches with lichens, mosses, and vascular plants. On the basis of recent observations of densities of potential breeding birds and the available vegetated area, the Franz Josef Land population of Light-bellied Brent Geese is estimated to be between 28 and 44 pairs (D. Vangeluwe unpubl. data). This range could, however, be an underestimate if high densities of birds occur on the poorly surveyed Aleksandra Land and George Land, where better breeding conditions may occur (larger surface of suitable breeding habitats, milder climate due to location on the western edge of the archipelago). Like most of the areas surveyed in Franz Josef Land,

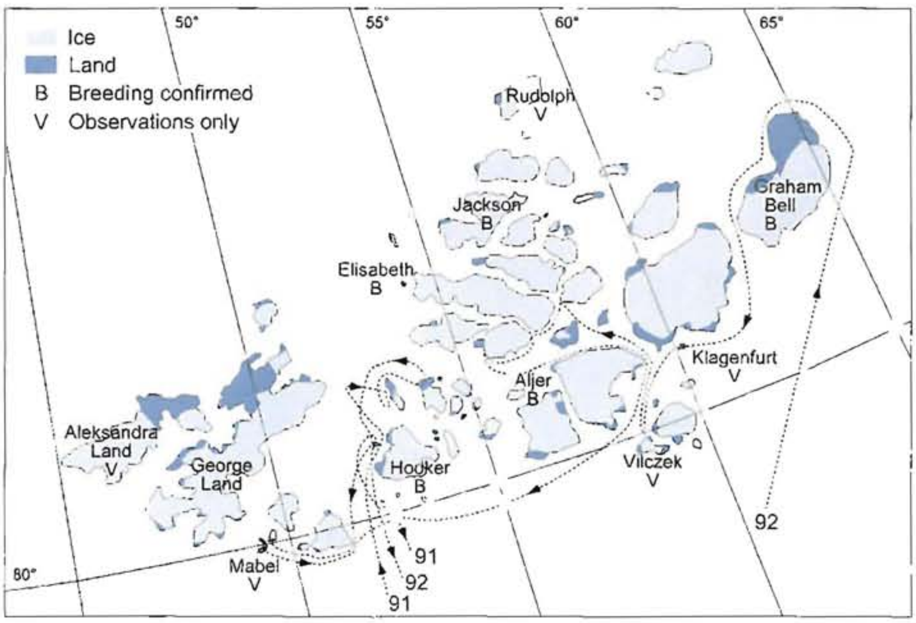

Fig. 22.4. Franz Josef Land with all known breeding areas of Light-bellied Brent Geese. The transects surveyed during 1991-92 are given as hatched lines.

both Aleksandra Land and George Land have high densities of Polar Bear *Ursus maritimus* dens (Uspenski et al. 1987), and therefore probably contributes very little to the overall breeding success of the flyway population.

By comparison, Svalbard offers better breeding conditions, with only 60% of the archipelago covered by glaciers and with a vegetated area of 8300 km^2 (Norderhaug 1989). The climate is milder, with average temperatures above zero in June, July and August, contrasting with an average temperature of -0.8°C in July (the warmest month) in Franz Josef Land.

The main breeding concentration within the recently discovered breeding area in northeast Greenland is found in the Kilen area, a triangular tundra area totally surrounded by glaciers, where 850 birds were recorded during summer 1985 (Hjort et al. 1987). Of these 850 birds, an estimated 40% were juveniles (equivalent to 340 juveniles) which would represent 99 successful breeding pairs with the recorded average brood size of 3.44 goslings per successful breeding pair (Hjort et al. 1987). The remaining 312 birds would then be non-breeding adults. Outside Kilen a few scattered pairs have been found in recent years, and Hjort (1995) has estimated the total Northeast Greenland population to approximately 1000 birds.

Habitat and feeding ecology: The tundra on the Tusenøyane breeding islands is polar desert, the vegetation being dominated by lichens and mosses with very few species of dicotelydons and monocotyledons. When the geese arrive on Tusenøyane in early June, most of the tundra is snow covered and the Light-bellied Brent Geese feed on flower buds of *Saxifraga* spp. and mosses in snow free patches (Madsen et al. 1998a). When the snows melts, boggy marshes covered with mosses progressively emerge and the geese primarily feed on mosses and protruding *Cochlearia officinalis* which are grazed or up-rooted from the moss carpet (Madsen et al. 1989). Post-hatching, families primarily feed on mosses, *Cochlearia* and *Saxifraga*. The breeding birds on Kilen primarily feed on *Papaver radicatum* and *Alopecurus alpinus* (Hjort et al. 1987).

Breeding biology: The Light-bellied Brent Geese arrive on Tusenøyane during the first ten days of June and start egg-laying between 8 and 16 June (median dates in 1987 and 1991 were 10 and 12 June respectively; Madsen et al. 1998a). Nests are located on snow free patches. Males defend a territory around the nest (mean size of 25 territories in 1987 was 2.0 ha). Average clutch size is 4.0 eggs (n=12). During three years of study, nest success was poor due to heavy predation pressure. In two years (1987 and 1991), Polar Bears were the main cause of egg loss, either due to direct predation of eggs or to the flushing of females from nests causing subsequent predation by Arctic Skuas *Stercorarius parasiticus* (Madsen et al. 1989, Madsen et al. 1998a). In those years, 25% (1987) and 13% (1991) of the eggs produced hatched. Because most of the tundra is snow covered in mid June, Polar Bears searching for nests (of both geese and other nesting birds) could easily locate nests by walking from one snow free patch to another. In 1989, Arctic Foxes were abundant on most islets of Tusenøyane, and Brent Geese only attempted to nest on the few islands without foxes (Madsen et al. 1992). After hatching, which takes place in early July (median date in 1987 was 7 July) very few young are lost due to predation (Madsen et al. 1989, Bregnballe & Madsen 1990).

2.2 Moulting areas

In 1987, non-breeders/failed breeders started to shed remiges 13-16 July, whereas parents started to moult 15-22 July (Madsen et al. 1989). On Tusenøyane, small flocks of non-breeding Brent Geese aggregate to moult in July (in 1989, 425 individuals), but in years with poor breeding success it seems that most non-breeders/failed breeders leave the archipelago to moult elsewhere. In the northern fjords of Spitsbergen, a few hundred non-breeding moulting Brent Geese have been found in July (Norwegian Polar Institute unpubl. data)(Fig. 22.3), but the moulting grounds of more than 3000 individuals (in poor breeding years) are not known. The surveys in Franz Josef Land in 1991 and 1992 found no direct evidence of larger moult concentrations there. During two surveys conducted during August 1994 and August 1995, high densities of droppings were found on Graham Bell Island (1994, H. Meltofte pers. comm.) and on Hall Island (1995, P. Baldwin pers. comm.), suggesting the presence of moulting flocks.

2.3 Research

Until recently, research on Svalbard has been restricted to survey of the breeding distribution (e.g. Løvenskiold 1963, Norderhaug 1974, Persen 1986, Bustnes et al. 1995), with a minor contribution on breeding biology and feeding ecology contributed by Nyholm (1965). In 1987 a study was initiated aimed at improving the understanding of factors regulating the reproductive output of the Brent Geese, with studies being carried out in 1987, 1989 and 1991 so far (Madsen et al. 1989, Bregnballe & Madsen 1990, Madsen et al. 1992, Madsen et al. 1998a). Eleven birds have been ringed with individually recognisable ring combinations, one in 1986 and 10 in 1989.

2.4 Protection and conservation

Hunting legislation: The Light-bellied Brent is a protected species in Svalbard.

Site safeguard: On the breeding grounds, a very high protective status has been given to all areas used by the Light-bellied Brent Geese on Svalbard. In total, 57% of all land areas on Svalbard are included in national parks or nature reserves, which includes the main breeding areas of Tusenøyane and Moffen as well as the main known moulting areas (Haga & Bjørge 1986).

In contrast, no protection exists on Franz Josef Land. Uspenski et al. (1987) propose a protectional zoning, including a large national park and three preserves, which if implemented would bring the protective status up to Svalbard standards.

The Kilen breeding area is included in the North and East Greenland National Park, and Kilen itself is designated as a Ramsar site.

3. STAGING AREAS

3A. NORWAY

Light-bellied Brent Geese have rarely been observed staging along the Norwegian coast either in spring or in autumn, and the cases reported only accounted for a few hundred birds. Hence the birds are not believed to stop on migration through Norway (Haftorn 1971, Direktoratet for Naturforvaltning 1996).

Detailed counts during spring migration have been carried out by observers from Lista Bird Observatory during 1991-97, which revealed that migration takes place during the period 20 April to 2 June, with mass migration between 26 May and 31 May (90% of all birds observed 1991-97, n=13,204)(Olsen 1993, R. Jåbekk & N.H. Lorentzen unpubl. data).

In 1991, coordinated observations were made of departures from Denmark (i.e. declines in staging numbers, since departing flocks are rarely observed), northbound migration at Lista, and arrival to Tusenøyane (Fig. 22.5). A total of 3150 birds were observed migrating north off Lista on 26 May (2122 birds) and 27 May (1030 birds), and 2250 birds were also observed on northbound migration along the Sotra-Skogsøya area northwest of Bergen on 26 May (i.e. virtually the same birds as those observed at Lista)(A.T. Mjøs unpubl. data). Major arrival at the breeding areas on Tusenøyane took place during 5-8 June (J. Madsen unpubl. data). Given a flight speed of 70 km/hour (Lindell 1977; 90 km/hour, corrected for wind assistance of 5-6 m/s tailwind = 18-21.6 km/hour) the Brent could fly the distance of 2500 km between Denmark and Tusenøyane in 35 hours. The evidence compiled during 1991 hence revealed a gap in time of approximately 7-10 days from mass departure from Denmark to mass arrival on Tusenøyane (Fig. 22.5), i.e. the birds must have stopped to re-fuel a few days somewhere *en route* between the spring fattening areas in Denmark and the breeding grounds on Svalbard.

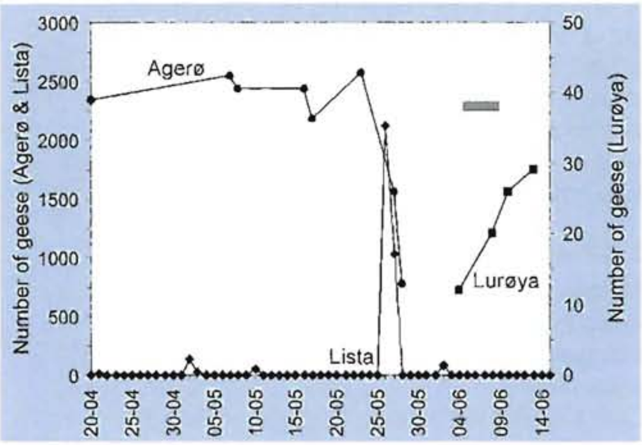

Fig. 22.5. Graph exposing the gap in time between mass departure from the spring staging areas, exemplified by Agerø (representing 70% of the birds staging in Denmark, spring 1991) and observations of northbound migration at Lista, southwest Norway (67% of the 1990/91 population was observed on migration in spring 1991) to mass arrival to the breeding grounds, exemplified by the numbers of birds arriving to breed on Lurøya in the Tusenøyane archipelago June 1991 (J. Madsen unpubl. data). The grey bar notes dates when flocks were observed on migration over the island.

A satellite telemetry study was conducted during spring 1997 to assess whether this stop was made along the Norwegian coast somewhere north of Bergen (as the Svalbard breeding Pink-footed Geese *Anser brachyrhynchus* and Barnacle Geese *Branta leucopsis* are known to do), or alternatively elsewhere on Bjørnøya or Svalbard (Clausen & Bustnes 1998). The few birds studied migrated almost directly to the Arctic, and only stopped along the Norwegian coast for a short time, probably to roost and drink (Clausen & Bustnes 1998). The satellite telemetry study thus suggests that the majority of birds migrate directly to the Arctic, without stopping along the Norwegian coast, at least in a year when most birds migrate late (80% of the observed birds departed from Denmark on 30 May 1997).

Observational evidence, however, suggest that a significant proportion of the population in some years migrate north to stage along the Norwegian coast. In 1991, 326 birds were counted on northward migration at Lista between 21 April and 11 May. The earliest known record from Svalbard is from 29 April (Heintz & Norderhaug 1966), but most flocks arrive during the last few days of May and first days of June (Løvenskiold 1963, Norderhaug 1989). Hence it seems unlikely that these birds would have travelled directly to the arctic areas. Clausen et al. (1998) found that almost half of the counted autumn population was not accounted for at the Danish staging areas in the springs of 1989 and 1990, and argued that it was unlikely this many birds could have been overlooked in Denmark. These two springs were extremely mild, with growth starting early in February on the saltmarshes, compared to mid-late March in "normal" years (Clausen 1998). If migration is commenced when birds reach a certain body condition, this would explain a very early departure in those years.

Records of autumn migration along the Norwegian west coast are less common than spring observations (Haftorn 1971), hence timing may be based on observations of departure from the breeding areas and arrival at wintering areas. Records of actual departures from Svalbard are few, but flocks of >200 birds have been seen as late as 15 September, and smaller groups or single individuals until 20 October (Løvenskiold 1963). Flocks arriving in Denmark have been observed from late August until early October, with a median arrival date ranging from 4-25 September (1980-92, based on years with >500 arriving birds counted; Clausen & Fischer 1994). Hence birds may migrate directly from Svalbard to the wintering quarters.

3B. SVALBARD/BJØRNØYA

Small flocks of up to 23 individuals have been reported on Bjørnøya in the last week of May in the 1960s, up to 95 in mid September 1983 and 350 in mid September 1984, but the island is poorly covered during these periods of the year (Mehlum 1998, F. Mehlum unpubl. data), and could be an important pre-breeding as well as post-moult staging area.

Two birds followed by satellite telemetry to Svalbard in 1997 staged for a few days in early June on southwest Spitsbergen and on Edgeøya, respectively, before continuing their migration to breeding or moulting areas on the north coast of Svalbard (Clausen & Bustnes 1998). Mehlum (1998) compiled available observations of flocks from the pre-breeding period collected during 1960-96. These observations, together with the historical evidence (Løvenskiold 1963), suggest that the Brent Geese spend one to two weeks c. 1 June feeding on the tundra either on sites along the fjords of the western coast of Spitsbergen or on Edgeøya. From there the birds disperse to their breeding or moulting areas. Staging areas used after the moult on Svalbard are poorly known. One satellite tracked bird flew from Greenland to stage on Sørkappøya, the southernmost island in the Svalbard archipelago, from 25 August - 8 September (Clausen & Bustnes 1998). This island is where the largest post-moult group of Brent Geese has been observed (120 birds 31 August 1963, Heintz & Norderhaug 1966, Mehlum 1998), and may be an important post-moult staging area, together with Dunøyane in southwest Spitsbergen (Mehlum 1998).

4. WINTERING AREAS

4A. DENMARK

4A.1 Distribution

Range: The present range of the subspecies is similar to that known before the population decline in the first half of this century. Specimens from the Zoological Museum of Copenhagen collected last century and early this century showed a distribution concentrated in the western and northern parts of Jutland, while other parts of the country were mainly used by Dark-bellied Brent Geese (Fog 1967). There is some evidence that Light-bellied Brents may also have wintered in eastern Denmark. Schiøler (1925) refers to 24 specimens of which 11 were shot in the east while the remaining 13 came from within the present range; there is little doubt that he would have distinguished correctly between the subspecies, but it is unclear whether these collected birds were shot from regularly staging flocks.

Since the 1950s, three sites have been used regularly, i.e. the Danish Wadden Sea east of the islands of Fanø and Mandø, Mariager & Randers Fjords, and Nissum Fjord (Salomonsen 1958, Fog 1967)(Fig. 22.6). In the late 1960s, birds were observed in Nissum Bredning (Fog 1972), and in the early 1970s birds began to use

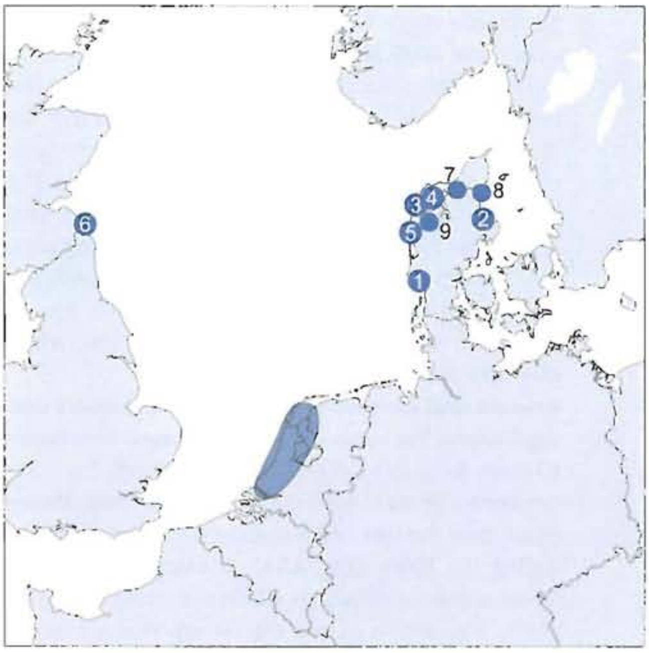

Fig. 22.6. Position of the six wintering sites regularly used by Svalbard Light-bellied Brent Geese within the last two decades, i.e. 1) the Danish Wadden Sea, 2) Mariager & Randers Fjords, 3) Nissum Bredning, 4) the Agerø area, 5) Nissum Fjord and 6) Lindisfarne, as well as three new sites taken in use in the late 1980s and early 1990s, 7) Nibe & Gjøl Bredninger, 8) the Northern Kattegat coast, and 9) Venø. The main areas used in the Netherlands during cold spell influxes is shaded.

the area around the island of Agerø (Madsen 1984). During the 1990s three new sites have been used by the geese, the northern Kattegat coast, Nibe & Gjøl Bredninger and the island of Venø (Jørgensen et al. 1994)(Fig. 22.6).

Habitat and feeding ecology: Until the late 1980s, subtidal and intertidal *Zostera, Ruppia, Enteromorpha* and *Ulva* beds and saltmarshes were the only habitats used by the geese, apart from occasional visits to pastures in late winter at Nissum Fjord (Madsen 1984, Clausen & Percival 1998). Since then there has been some change in habitat utilisation. Natural habitats are still the most extensively used, but many birds have begun to use bait sites (i.e. pasture areas where grain is put out in spring to attract Pink-footed Geese, thereby avoiding agricultural conflict), and spring sown barley fields and winter cereal fields have also been used in the late 1980s and 1990s (Clausen & Percival 1998, Percival & Anderson 1998).

4A.2 Abundance

Phenology: The first birds arrive in late August/early September, with mass arrival in mid September; in good breeding years arrival is approximately one week later than in poor years (Clausen & Fischer 1994). During the 1970s and early 1980s, the geese visited the five regularly used sites almost in succession, with the birds arriving in the Wadden Sea in autumn, moving to Mariager & Randers Fjords in late autumn, and moving via Nissum Bredning in late winter to spring staging at Nissum Fjord and Agerø (Fig. 22.7). Since then there has been a major change in phenological use of sites, with some birds making a very short stopover in the Wadden Sea, some arriving directly in Mariager and Randers Fjords apparently without first visiting the Wadden Sea, and some birds arriving in late autumn to winter around Agerø and Nissum Bredning (Fig. 22.7)(Clausen et al. 1998). Two of the sites first used during the 1990s are used as mid winter staging areas (the northern Kattegat coast, Nibe & Gjøl Bredninger). During April-May the birds divide between Nissum Fjord, the Agerø area and (since 1991) Venø, where they stay until departure in late May.

Trends and numbers: The population increase during 1980-96 has caused a general increase in numbers of geese using most of the sites in Denmark, but there has been a general decrease in numbers using Nissum Fjord since the mid 1980s and the Danish Wadden Sea during the 1990s (Fig. 22.8). Nissum Fjord was believed to host the whole population in spring during the 1960s (Fog 1967), as was the Danish Wadden Sea in early autumn, and this was most likely the case until the mid 1980s (Madsen 1984, Clausen et al. 1998). The proportional use of these areas has declined since then, with a regular 20% of the population visiting Nissum Fjord each spring during the 1990s, and an apparently still declining proportion (15% during autumn 1995) using the Danish Wadden Sea (Fig. 22.8). In contrast, an increasing proportion of the population has been using Agerø (increase from 25% to 75% from the early 1980s to present), Nibe & Gjøl Bredninger (25% in autumn 1995), and the northern Kattegat coast (20% in autumn 1995) as staging areas. Numbers at the remaining major sites, i.e. Mariager & Randers Fjords (50-80%) and Nissum Bredning (10-50%), fluctuate with no clear trend (Fig. 22.8).

4A.3 Research

Census: All sites regularly used by the Light-bellied Brent Geese are counted by members of the Danish Goose Working Group at monthly or bi-monthly intervals during the periods when birds are present, even though coverage of some sites is less complete due to counting difficulties (long distances from land to feeding areas, i.e. the Wadden Sea and Nibe & Gjøl Bredninger).

Ringing: Birds were ringed with standard metal bands in 1979, as mentioned above. A marking/resighting programme based on individually recognisable engraved darvic rings and/or colour combinations was initiated with the capture of three birds at Nissum Fjord in May 1988, and seventeen birds were caught at Agerø in May 1997 in conjunction with the satellite telemetry study (Clausen & Bustnes 1998). Further captures are planned to take place in Denmark in forthcoming years. Currently, most ringed birds in the population have been marked at Lindisfarne during 1991-97 (Clausen & Percival 1992). Intensive resighting has generated c. 4450 resights in Denmark in the same period, especially in spring when most birds use terrestrial habitats.

Other: Detailed information on distribution and habitat use of the Brent Geese were collected during the early 1980s (Madsen 1984, 1986). During 1988-93 a more detailed study on the feeding ecology, habitat availability and productivity was conducted (Clausen & Fischer 1994, Clausen 1994, Clausen et al. 1998, Clausen & Percival 1998). Since 1992, spring fattening has been studied using abdominal profile indices.

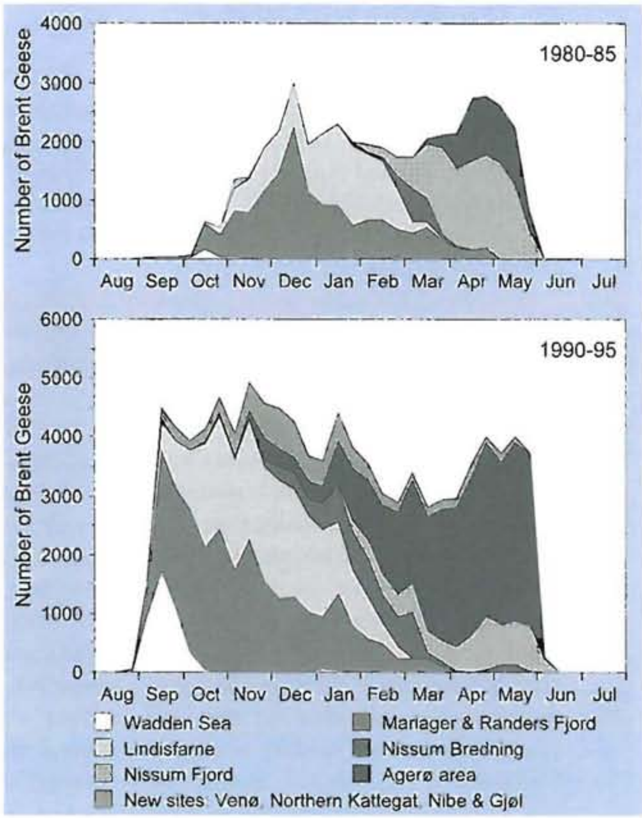

Fig. 22.7. Phenological use of wintering sites by the Svalbard Light-bellied Brent Geese during 1980-85 and 1990-95. During 1980-85, Brent Geese were presumably overlooked in the Wadden Sea.

4A.4 Protection and conservation

Hunting legislation: Brent Geese have been fully protected in Denmark since 1972 .

Site safeguard: Most of the sites and natural habitats regularly used by Light-bellied Brent Geese are protected as Ramsar sites, and all of them as Special Bird Protection Areas (SPAs) under the EU Birds Directive. In connection with a forthcoming establishment of shooting-free areas in 46 Danish coastal SPAs, a scientific appraisal of the value of the proposed reserves was made (Madsen & Pihl 1993, Madsen et al. 1998b). This appraisal among other recommendations gave highest priority to reserves proposed in areas used by the Light-bellied Brent Geese, a recommendation which has been followed by the National Forest and Nature Agency, with the outcome that four new reserves with a total shooting ban, together with adjacent areas with limited hunting activities, were established during 1996. One was situated around Agerø, two in Nissum Bredning, and one in Mariager Fjord; and the existing reserve at Nissum Fjord was enlarged in 1996 to include

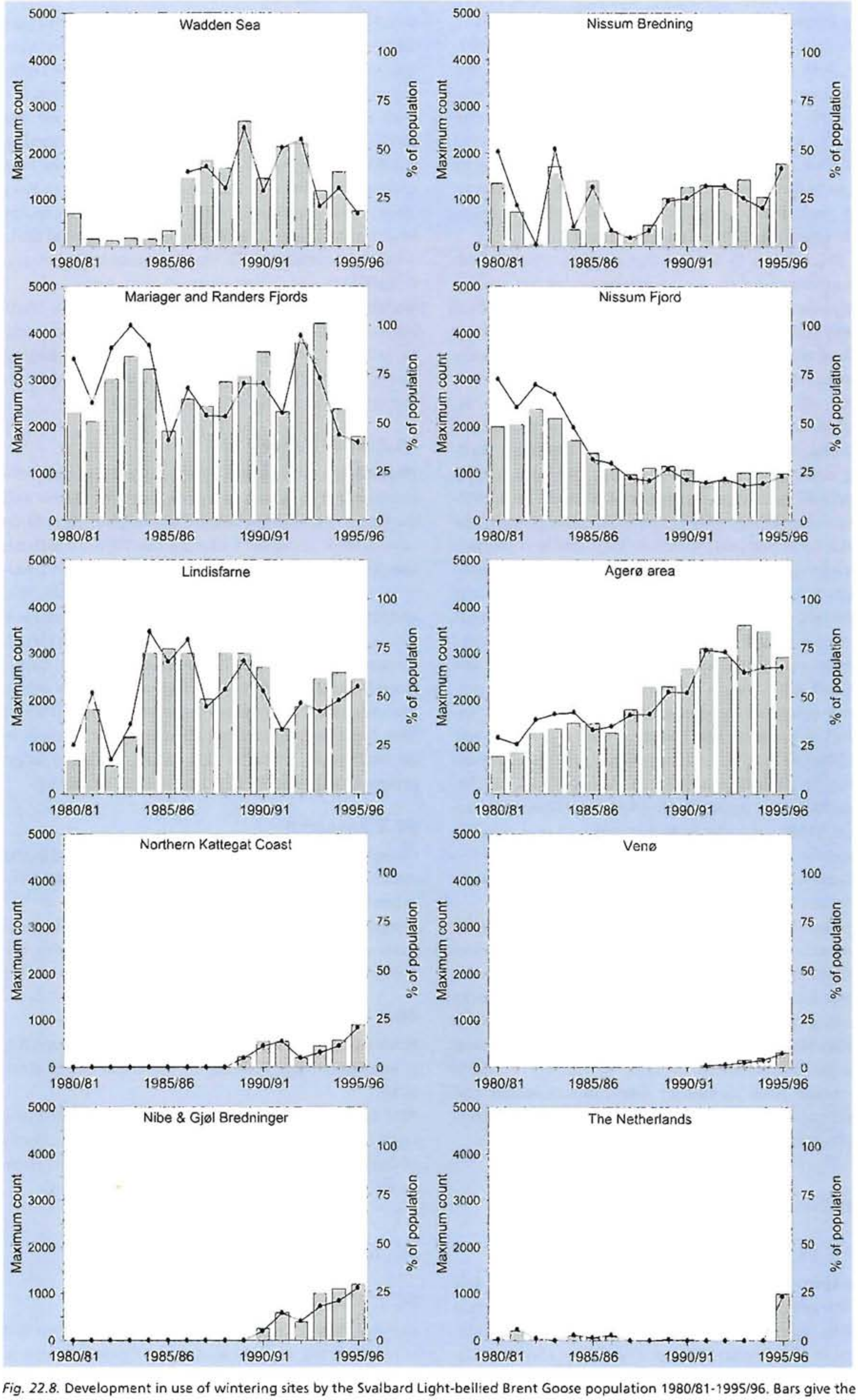

Fig. 22.8. Development in use of wintering sites by the Svalbard Light-bellied Brent Goose population 1980/81-1995/96. Bars give the maximum number of individuals and dots the proportion of the population using the site per season. During 1980-85, Brent Geese were presumably overlooked in the Wadden Sea.

the *Zostera marina* beds in the central parts of the fjord. A further three reserves were established during 1997-98 along the northern Kattegat coast, and an additional reserve is expected to be established in Randers Fjord in 1999. These, together with the existing hunting-free reserve at Gjøl Bredning and existing legislation in the Wadden Sea region, ensure effective protection of Light-bellied Brent Geese from disturbance from hunting and other activities which disturb the geese throughout the range used in Denmark.

Saltmarshes (>1 ha) are generally protected from ploughing under the Nature Protection Act, but grazing has ceased at several sites in recent years, after which many previously used saltmarsh areas have been abandoned as feeding areas by the Light-bellied Brent Geese because the saltmarsh vegetation becomes taller, eventually changing to reed-bed *Phragmites communis*, especially around Nissum Fjord. The *Zostera, Ruppia* and *Ulva* beds which the Brent Geese use as primary feeding areas from September through February, are, in principle, protected throughout Denmark, as permission to extract e.g. gravel or sand has to be given by the National Forest and Nature Agency, and it is unlikely such permission would be given in the areas used by the Light-bellied Brent Geese. Blue mussel *Mytilus edulis* fisheries, especially in the Limfjord area, may harm the outermost parts of the *Zostera* beds, used by the Brent Geese in Nissum Bredning, whereas the *Zostera* beds around Agerø and in Nibe & Gjøl Bredninger are generally protected by reserve regulations under the Nature Conservation Act. The major threat to the *Zostera* and *Ruppia* beds is, however, eutrophication. Major declines in *Zostera*, especially in Nissum Fjord, are believed to be the result of eutrophication (Clausen & Percival 1998), and this is also considered as a possible cause for recent declines of *Zostera* in the Wadden Sea (Clausen & Fischer 1994) and in Nibe & Gjøl Bredninger (Madsen 1998).

Agricultural conflict: Complaints about damage by the grazing Brent Geese have only come from farmers around Agerø, who argue that the Brents compete with cattle for saltmarsh grass. In addition, the odd flocks feeding on new sown barley fields (observed since spring 1991) cause some complaints from the farmers, and the same applies to the usage of winter cereal fields in recent years by smaller flocks during winter and spring around Randers Fjord (observed since 1993/94) and Agerø (since 1995/96).

4B. THE NETHERLANDS

4B.1 Distribution

Range: Prior to the population decline in the first half of this century, Light-bellied Brent Geese were common on the *Zostera marina* beds around the island of Wieringen in the former Zuider Zee (now enclosed IJsselmeer)(Mulder 1976). After the disappearance of *Zostera marina* in the 1930s and the construction of the IJsselmeer dam, more than forty years elapsed before larger numbers of Light-bellied Brent Geese were again observed in the Netherlands, in 1978/79, during a severe winter (Lambeck 1981a). When influxes of Light-bellied Brent Geese now occur in the Netherlands, the birds are usually found in coastal areas, which are also used by the Dark-bellied Brent Geese *Branta bernicla bernicla*, i.e. especially in the Dutch Wadden Sea area and/or the Delta area (Lambeck 1981a, van den Berg 1984, 1986, Berrevoets 1988). During the most recent (and hitherto largest) influx in 1995/96, several birds were also found inland in the Netherlands (F. Cottaar, K. Koffijberg and C. Berrevoets unpubl. data).

Habitat and feeding ecology: Similar to the Dark-bellied Brent Geese in mid-winter in the Netherlands, i.e. primarily pastures and winter cereals. Birds staging through to April-May have also been observed on saltmarshes among Dark-bellied Brent Geese.

4B.2 Abundance

Phenology: Arrival in the Netherlands is entirely dependent on the timing and severity of the winter and the freezing over of fjords in Denmark. Thus, most birds have arrived in January (during the 1978/79 influx), late December (1981/82), mid January (1984/85), early February (1986/87) and late December (1995/96), and most had left by mid-late March all years (Lambeck 1981a, van den Berg 1984, 1986, Berrevoets 1988, F. Cottaar, K. Koffijberg and C. Berrevoets unpubl. data).

Trends and numbers: During mild winters only a few individuals occur. Higher numbers (100-200 birds) have been recorded during all severe "ice" winters in Denmark since 1978/79 (Fig. 22.8), with the latest bringing exceptionally high numbers (1000 birds).

4B.3 Research

Counts: Light-bellied Brent Geese are included in the monthly goose counts organised by the SOVON Vogelondersook Nederlands.

Ringing: Several resightings of birds marked in Denmark and Lindisfarne have been reported during the last few winters in the Netherlands.

4B.4 Protection and conservation

Hunting legislation: The Brent Goose has been fully protected from shooting in the Netherlands since 1950.

Site safeguard and agricultural conflict: Since Light-bellied Brent Geese are usually seen among flocks of Dark-bellied Brent Geese problems related to these issues are covered by Ebbinge et al. (this volume).

4C. UNITED KINGDOM

4C.1 Distribution

Range: Prior to the population decline in the first half of this century, Light-bellied Brent Geese believed to originate from Svalbard were common in two areas: around Moray Firth in northern Scotland and in eastern England (from Northumberland down to the Wash and north Norfolk)(Salomonsen 1958, Owen et al. 1986). The only site regularly used in the United Kingdom (UK) since the 1960s is Lindisfarne National Nature Reserve (around Holy Island), on the north coast of Northumberland. Outside this area even observations of solitary birds are rather rare. Small groups are regularly seen along the east coast of Scotland and northern England for brief periods, especially in September and October. These birds are believed to be on their way to Lindisfarne. During the winter of 1995/96 some flocks were, however, observed at sites in the eastern parts of the UK, during a major cold-spell exodus from Denmark. The largest flock of 86 birds, two of which had been ringed at Lindisfarne in previous winters, was observed at Loch of Strathbeg in northeast Scotland.

Habitat and feeding ecology: While staging at Lindisfarne the Light-bellied Brent Geese feed mainly on intertidal *Zostera noltii, Z. angustifolia* and *Enteromorpha* spp. (Percival et al. 1996, Percival & Evans 1997). Saltmarshes are used from mid winter onwards. In recent winters significant numbers have fed on winter cereal fields during January and February (peak of 1800 in January 1996, Percival & Anderson 1998). Smaller numbers have also started feeding on pasture fields in 1995/96

4C.2 Abundance

Phenology: Historically the birds used Lindisfarne during the winter period from November to March (e.g. Salomonsen 1958, Madsen 1984)(Fig. 22.7). Since the mid 1980s birds have arrived earlier, and the first flocks now arrive in September or even late August (Clausen et al. 1998). Likewise the majority of the birds depart slightly earlier (Fig. 22.7).

Trends and numbers: Lindisfarne was previously primarily used as a resort for the Light-bellied Brent Geese when severe winters caused the fjords to freeze in Denmark. In these years, most of the population gathered at Lindisfarne, while in mild winters only a few hundred birds visited the area (Madsen 1984, Owen et al. 1986). Since the mid 1980s, Lindisfarne has regularly been used by 50-70% of the population, despite the fact that there has been only one winter (1995/96) since 1987/88 severe enough to cause widespread ice coverage in Danish fjords. Hence Lindisfarne may now be considered of almost equal importance to Mariager & Randers Fjords as an autumn and early winter staging area.

4C.3 Research

Census: Since 1972 weekly counts have been made by the warden at Lindisfarne National Nature Reserve. Additional detailed counts have been made by Steve Percival and coworkers from the University of Sunderland since 1989.

Ringing: A marking/resighting programme initiated in Denmark/Svalbard in 1988/89 has received major input from captures at Lindisfarne, with 331 Light-bellied Brent Geese being caught and c. 2600 resightings being collected at Lindisfarne during 1991-97. Captures are planned to continue in forthcoming years.

Other: Detailed studies on the distribution, habitat utilisation and feeding ecology of Brent Geese, as well as management of saltmarshes, have been carried out since 1989 (Percival et al. 1996, Percival & Evans 1997, G.Q.A. Anderson unpubl. data). A follow-up project on the effects of a newly established shooting-free reserve, including parts of the *Zostera* beds at Lindisfarne National Nature Reserve, is being made during 1996-99.

4C.4 Protection and conservation

Hunting legislation: The Brent Goose has been fully protected from shooting under the Wildlife Act since 1954. Small numbers have been shot illegally at Lindisfarne in recent years.

Site safeguard: Lindisfarne is a National Nature Reserve. Part of the area is a Ramsar site and a SPA under the EU Birds Directive. The National Nature Reserve includes two shooting-free areas: Budle Bay and the Ross Back Sands at the south end of the reserve and Goswick sands to the north (Townshend & O'Connor 1993), but these are seldom used by the Brents. Neither area supports any significant food resource (Clausen & Percival 1998, Percival et al. 1996, Percival & Evans 1997). The parts of the reserve used by wildfowlers (hunting mainly Wigeon *Anas penelope*) overlap those used by the Brent Geese (Percival et al. 1996, Percival & Evans 1997). As the Brent Geese now arrive earlier, at the same time as the Wigeon, increased hunting disturbance has resulted. To safeguard the Brent Geese from hunting disturbance, a new shooting-free area was established in the main Brent Goose feeding area in 1997. A major *Zostera* bed at Holy Island Sands disappeared during 1974-1989, probably as a result of a change in sediment of the Sands from a muddy to sandy substrate after establishment of the Holy Island Causeway (Clausen & Percival 1998). The remaining *Zostera* beds appear to be stable in size (600 ha, 1989-96) and a new *Zostera* bed is developing in Budle Bay. There is no known evidence of eutrophication impacts on the *Zostera* stands in the area, but this has not been thoroughly investigated.

Agricultural conflict: To date only a small number of farmers (five) have been affected by Brent Geese feeding on winter cereals and pasture. The problem has been very localised with a high density of birds using the same few fields consistently. Complaints have been made in the case of winter cereals and the geese have been regularly scared off these fields. Feeding on fields has occurred from January to March when food supplies of *Zostera* and *Enteromorpha* spp. on the mudflats are virtually depleted. In the winters of 1995/96 and 1996/97, geese moved directly from the mudflats to the fields and very little saltmarsh feeding was observed until March (Percival & Anderson 1998). Current scaring tactics seem liable to worsen the problem by scattering the birds across a wider area of farmland if undisturbed areas with an adequate food supply are not provided (Vickery & Summers 1992). Scaring has been observed to cause the geese to move to previously unused fields (G. Anderson unpubl. data). There is a large area of apparently suitable winter cereal and pasture on the Northumberland coastal plain close to Lindisfarne and there is clearly potential for further conflict over a wider area. This is especially likely in years when the majority of the population is present at Lindisfarne (as in the most recent winter of 1996/97)(Percival & Anderson 1998).

Suggested solutions to the current and apparently growing problem have been to manage specific areas of farmland adjacent to the mudflats as alternative feeding areas for the Brent Geese (Owen 1990), and the creation of more saltmarsh through the re-flooding of previously drained land, now unimproved pasture. Either strategy is feasible at Lindisfarne.

5. DISCUSSION

Population status: The East-Atlantic fly-way population of Light-bellied Brent Geese is among the smallest goose populations in the world, and considered as vulnerable (Madsen et al. 1996b). Despite the recent recovery from 1600-2000 individuals in the late 1960s to 5000-6000 at present, a coincidence of a few breeding failures in combination with enhanced over-winter mortality of juveniles in cold winters could easily bring the population down to a low level, as pointed out by Clausen et al. (1998). Hence safeguarding of the population's breeding, moulting, staging and wintering areas should be given highest priority.

Survey of the main breeding area of Tusenøyane was carried out in 1985, 1989 and 1995, and the comparison between the number of breeding pairs there with the number of successful breeding pairs in the population as a whole clearly reveals that the majority of actual birds which breed come from there (Table 22.1). Outside Tusenøyane, Moffen and Kilen constitute the only important breeding areas. Based on the 1985 surveys, virtually all successful breeding pairs, estimated at 476-600 pairs (Table 22.1), were found on either Tusenøyane (435-600 pairs; Persen 1986) or Kilen (99 pairs; Hjort et al. 1987, see section 2.1), and in 1989 and 1995 the vast majority were found in Tusenøyane (Table 22.1). The recent survey of Franz Josef Land found only very few breeding pairs.

In contrast to this fairly well-established knowledge of the breeding concentrations, very little is known about the moulting concentrations. Summing the main concentrations shown in Fig. 22.3 gives only slightly over 1000 birds, which would indicate that some major moult sites have been overlooked, or more than 3000 non-breeding birds moult in small flocks scattered over Svalbard and Franz Josef Land. The available records from Kilen suggest another 300 birds to moult there, while no direct evidence of larger moult concentration have been compiled in north-east Greenland outside Kilen (Hjort 1995) or in Franz Josef Land.

The evidence strongly suggests that Light-bellied Brent Geese have unknown staging area(s) en route between Denmark and the breeding sites on Svalbard, at least on spring migration. The recent satellite telemetry study suggests they may be situated on the southern parts of Svalbard (Clausen & Bustnes 1998), and historical evidence also points to Bjørnøya as a potential stopover area at this time of the year (Mehlum 1998).

The major cause behind the changes in distribution and phenological site-use of the Svalbard Light-bellied Brent Goose population in recent years appears to be changes in availability of *Zostera* beds in Denmark and Lindisfarne, as well as depletion of the *Zostera* and *Ruppia* food resources during the course of the winter (evidence from Mariager Fjord and Lindisfarne, indirect evidence from the Wadden Sea). Because of a still increasing utilisation due to the increasing population, the depletion is believed to take place earlier in the season than it did in the early 1980s (Clausen & Percival 1998). This has prompted the geese to search for new areas. The new late autumn/mid winter sites of the northern Kattegat coast, Nibe & Gjøl Bredninger, Agerø and Nissum Bredning all support quite substantial beds of *Zostera marina*, which is the main habitat used by the birds when visiting these areas in this period (Clausen & Percival 1998). Hence at present there seems to be enough suitable natural habitat for Light-bellied Brent Geese in the areas now used from autumn throughout winter to spring in Denmark (Clausen & Percival 1998). Exodus from Denmark in severe winters may, however, give the geese problems with finding suitable feeding areas at the traditional resort, Lindisfarne. Recent studies have shown that the intertidal stocks of *Zostera* are depleted by grazing Brent Geese and Wigeon, as well as by tidal action and senescence of the *Zostera*, by early February (Percival et al. 1996, Percival & Evans 1997), and the extent of suitable saltmarsh at the site is limited (approximately 60 ha, G.Q.A. Anderson unpubl. data). As seen in the last ice winter of 1995/96 a large proportion of the population took to feeding on arable land instead of the traditional intertidal areas, and other birds went to sites in the Netherlands and Scotland, where they also used pastures and arable land.

Conservation issues: In Denmark and the UK, hunting organisations have expressed a desire to have shooting of Dark-bellied Brent Geese re-opened. The National Environmental Research Institute, Denmark, has recommended that if hunting should be discussed, it should not be permitted in areas regularly used by Light-bellied Brent Geese in Denmark, i.e. the Wadden Sea and the northern parts of Jutland (Madsen et al. 1996a). The same should apply at Lindisfarne.

On the breeding grounds, a high protective status has been given to all areas used by Light-bellied Brent Geese on Svalbard and in Greenland. In contrast, no protection exists on Franz Josef Land, and it may be an important issue in conservation management of the population, considering the increasing tourism around Svalbard and Franz Josef Land archipelagos (largely wildlife tour boats). The protectional zoning proposed by Uspenski et al. (1987) would be an important improvement in the conservation of Franz Josef Land.

At present, the known wintering areas of the Light-bellied Brent Goose are considered to be well protected, especially with the recent establishment of shooting-free reserves throughout Denmark and at Lindisfarne, which implies that, in the near future, Light-bellied Brent Geese should have not only safe roosting places, but also undisturbed feeding areas throughout their wintering range, even during days when hunting takes place. Lindisfarne, and seven of the eight sites used in Denmark, are also protected under the Ramsar Convention, and Lindisfarne and all Danish sites as SPAs under the EU Birds Directive.

However, it should be pointed out that several management problems still exist within most of the sites used by the geese during winter. Especially the saltmarshes around Mariager Fjord, Nissum Fjord and Lindisfarne deserve attention in terms of grazing management, which could increase the value of the sites used by the geese (Clausen & Percival 1998, G.Q.A. Anderson unpubl. data). Site management plans based on careful ecological research (which has been carried out in most areas) should be a priority in the future.

Agricultural conflict: Until recently, Light-bellied Brent Geese only used what may be regarded as their natural habitats, i.e. subtidal and intertidal seagrass and algae beds, and saltmarshes (especially in spring); and farmers rarely complained about damage. However, with the increase in numbers around Agerø in recent years, farmers have started to complain about the use of the saltmarshes, in some years with good reason. Brent Geese in the major feeding area in northwestern Agerø took 20-97 % of the net above-ground primary production of *Puccinellia maritima* during April and May (Clausen 1998), and hence, from the farmers point of view, delay the time when young cattle can be put onto the saltmarshes (this usually occurs in early May in Denmark). In addition, the recent use of winter and spring cereals around Nissum Fjord, Agerø, Lindisfarne and Randers Fjord has begun to cause problems.

Future research needs: The main breeding areas, i.e. Tusenøyane, Moffen and Kilen, should be monitored regularly, especially to follow future trends in Polar Bear predation rates, and (on Svalbard) competition for breeding sites between Light-bellied Brent Geese and the growing Barnacle Goose population (Madsen et al. 1989). A survey of the breeding population on Tusenøyane has not been made in a successful breeding year since 1985. In planning future surveys of Tusenøyane, the recently described correlation between ice conditions and Polar Bear predation rates on the breeding output (Madsen et al. 1998a) needs to be taken into account. Hence in years with ice surrounding Tusenøyane in mid-late June one can expect high Polar Bear predation rates and goose breeding failures. In such a year funding for surveys are better directed towards expected moulting areas in north Svalbard, as most birds apparently leave Tusenøyane to moult elsewhere in failure years.

Future survey priorities in the Kilen area are first to update the population estimate for the site (both breeding and moulting concentrations). Secondly, a comparative study of predation rates at Kilen compared to Tusenøyane, needs to be made. Hjort et al. (1987) pointed out that no Arctic Foxes were observed in the area, and that they only found fox tracks once, a very unusual situation according to their previous experience on earlier visits to North Greenland. Hence Kilen breeders may be very little influenced by predation, also because most Polar Bears are expected to have left this area when the Brent Geese start breeding, due to the presence of an open water polynia in the Greenland Sea adjacent to Kilen (see Born et al. 1997).

Detailed survey of less well surveyed parts of Svalbard (North Nordaustlandet in particular, but also Woodfjorden and Wijdefjorden on North Spitsbergen) and Franz Josef Land should be given high priority, especially to obtain more precise coverage of the moulting sites used by the population. Most surveys in Franz Josef Land during the 1990s have been made rather late in August, and many birds could have left the archipelago after termination of flight-feather moult.

Despite the fact that none of the birds studied by satellite telemetry stopped for long to feed in northern Norway or on Bjørnøya in spring 1997 (Clausen & Bustnes 1998), observational evidence still suggests this to be an option used by some birds in some years. Likewise it is still uncertain to what extent birds stopover on return migration. These questions need to be studied further, and this could be done in combination with a more detailed study of the flight energetics of birds from the population using satellite telemetry. The birds that were followed to Kilen made an almost non-stop flight of 3500 km (Clausen & Bustnes 1998), adding approximately 1000 km to the distance travelled by Tusenøyane breeders. Hence the option of breeding in a potentially low predation area in Northeast Greenland may be counter-balanced by having to fly considerably further, i.e. using more reserves on spring migration.

Svalbard Light-bellied Brent Geese have changed their phenology, site and habitat use in the wintering areas dramatically during the last 15 years, and it is important that monitoring of the wintering sites and adjacent areas is continued, to document further changes. The marking/resighting programme should be continued, aimed at improving the understanding of mortality rates of different age classes in the population, and to provide data for a more thorough analysis of the viability of this small population.

International conservation: No steps have been taken so far, but an internationally co-ordinated flyway management plan under the Bonn Convention is planned for the foreseable future.

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23 Red-breasted Goose
Branta ruficollis

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1. POPULATION REVIEW

1.1 Range

The Red-breasted Goose breeds on the Russian arctic tundra of the Taimyr, Gydan and Yamal Peninsulas, with 70% of the breeding population nesting on the Taimyr (Kostin 1985). In autumn it migrates south and west through Russia and Kazakhstan, to winter predominantly on the north and west Black Sea coasts of the Ukraine, Romania and Bulgaria. There are five known staging areas in Russia, Kazakhstan and the Ukraine. On the wintering grounds, the species is concentrated on agricultural land for feeding, and three to four key sites on coastal lakes for roosting. It is this restricted range during winter that qualifies the species as *vulnerable* (criteria B1 and D2) under the latest IUCN criteria for globally threatened species (IUCN 1995). The restricted wintering range also provides the potential for reliable population estimates.

During recent mid winter censuses, 80-90% of the world population of Red-breasted Geese were recorded in Bulgaria and Romania in January (Wetlands International 1994-1996; B. Ivanov, P. Iankov & G. Dandliker pers. comm.). Smaller, though significant, numbers (500-6000) winter in the Ukraine and possibly Azerbaijan, while some may also visit Greece in severe winters (Wetlands International 1996, D. Vangeluwe pers. comm.). Small numbers (5-90) are regularly observed in the Netherlands and Hungary (Madsen 1994, S. Faragó pers. obs. 1996), and occasionally in Turkey, Iraq and Iran (Wetlands International 1996, Hunter & Black 1996). The species is accidental in Britain, Belgium, Norway, Sweden, Denmark, Finland, Germany, France, Poland, Czech Republic, Slovakia, Austria, Italy, Spain, Albania, Serbia, Israel, Cyprus, Egypt and southeast China (Cramp & Simmons 1977).

1.2 Delineation of flyways

In the summer of 1996, approximately 150 adults and 50 goslings were ringed in the Pura River area of the Taimyr Peninsula as part of a breeding biology study (Quinn et al. 1996a). Prior to this, little ringing of Red-breasted Geese had been carried out (Y. Schadilov pers. comm.). Flyways can be extrapolated from direct observations of flocks on the staging grounds and in flight (Fig. 23.1). It is suggested that the geese migrate along a narrow corridor no more than 100-150 km wide (Red Data Book of the Kazakh SSR), across the Nadym and Pura basins, to the first staging site on the Ob flood plains on the Arctic Circle (V. Krivenko pers. comm.). They continue south on the eastern side of the Ural Mountains to a second staging area on the Middle Ob near Chanty-Mansijsk, Russia. A small number have been known to stage in the region between Surgut and the River Vakh. From the Middle Ob, they move southwest across the south of the Western Siberian Plain, over the town of Kustanai to the third major staging

area on the Tobol-Ishim forest-steppe and the watersheds of the Ubagan, Ulkayak and Irgizin rivers in the Kazakh uplands (Krivenko 1983). Passing over the towns of Orsk and Aktyubinsk, the geese then move across the north of the Caspian Sea to stage in the Manych Valley, Russia. From there, they migrate over the northern coast of the Black Sea to the fifth major staging area between the Dnepr and Dnestr deltas, Ukraine. Here some remain to winter, but most continue on to the main wintering grounds in Bulgaria and Romania (Hunter in press, Hunter & Black 1996).

1.3 Population trends

Records are scarce prior to 1954, but numbers may have been larger than, or similar to, those of today; in 1899 "many tens of thousands of Red-breasted Geese were seen at their wintering sites" (Krivenko 1983). Between 1956-1967 the population was estimated at 50,000 to 60,000. The best coverage during that era was achieved in the winters of 1967 and 1968 when totals of around 49,000 were divided equally between the Black Sea and Caspian Sea regions (Table 23.1). Between 1970 and 1990 count totals did not exceed 30,000 geese and ornithologists suggested that the population might have crashed due to the birds being forced from their traditional, but degraded wintering area on the Caspian Sea, and/or the effects of DDT on populations of Peregrine Falcons *Falco peregrinus* which are thought to protect nesting geese from Arctic Foxes *Alopex lagopus* (see below). The wintering grounds on the Caspian Sea were apparently abandoned in 1971, as the last large count in that area was in 1970 (Table 23.1). Peregrines in Britain and Europe were most severely affected in the 1950s and 1960s (Ratcliffe 1993).

Since 1991, a series of coordinated counts was initiated by ornithologists in Romania and Bulgaria during the mid winter Wetlands International international waterfowl census (IWC) week, which is usually in early January (Vangeluwe & Stassin 1991, Vangeluwe & Snethlage 1992). Counts from other wintering areas, especially the Ukraine, were also included in the final IWC tally. Coordinated counts were required since movement between countries was variable between and within years. The timing of movement, from the northernmost areas to the south, may be influenced by depletion of food for geese and by increasingly colder temperatures as winter progresses.

Counts during 1991-1995, excluding the 1994 count (which was incomplete due to poor weather conditions and visibility during the census), ranged between 43,180 and 75,879 (Table 23.2), with a four-year mean of 62,144. The variation in counts between years is quite large, indicating that the population may be prone to fluctuations of up to 22.4% over two-year periods. We suspect that such fluctuations are not due to actual variation in recruitment and mortality (although this idea remains to be tested when appropriate data are available). It is more likely that the variation is due to

Table 23.1. Maximum counts or estimates (where count data are not available) of wintering Red-breasted Geese during 1899-1996. Note: winter 1953/54 is listed as 1954, winter 1954/55 as 1955, and so on.

Year	Romania	Bulgaria	Ukraine	Greece	Hungary	Caspian Sea	Azerbaijan/ Miscellaneous*	Total wintering
1899						huge flocks[4]		
1930	small flocks[1]	solitary birds and small flocks[2]						
1936	14[3]							
1939		15-20[5]				dozens to		
-> 1950		rare[5]				thousands[4]		
1954				300[6]				300
1955								
1956						60,000[7]		60,000
1957						40,000[8]		40,000
1958						2400[9]		2400
1959								
1960						11,000[9]		11,000
1961						4200[10]		4200
1962						8000[9]		8000
1963				40[11]		4800[10]		4840
1964				45[11]		4500[10]		4545
1965						3300[10]		3300
1966								
1967	25,000[12]					23,800[14]		48,800
1968	25,000[12,13]			12[11]		24,000[15]		49,012
1969	25,000[13]			54[11]				25,054
1970	4080[16]	1000[11]		12[11]		25,000[15]		30,092
1971	9300[1]			200[17]				9500
1972	6000[17]			4[19]	7[20]			6011
1973					14[20]	17[21]		31
1974	3200[22]			7[11]	41[20]			3248
1975	6000[23]				10[20]	50[14]		6060
1976	5500[23]	1500[19]		2[11]				7002
1977	1000[24]	1274[25]			1[20]			2275
1978	4250[26]	1580[5]			86[27]			5916
1979	200[22]	15,071[25]		<50[18]	43[20]	65[14]		15,429
1980		16,566[25]			60[20]	23[14]		16,649
1981		2306[25]				31[14]		2337
1982	1000[28]	12,243[29]				45[14]		13,288
1983	6000[30]	9948[29]						15,948
1984	6000[30]	6890[29]			47[31]			12,937
1985	6000[30]	14,047[29]		2000[11]	2[32]			22,049
1986	6000[30]				14[32]		4[33]	6018
1987	6000[30]	15,163[34]			3[32]		1[33]	21,167
1988	2400[35]	3186[34]	100[36]		12[32]		2[33]	5700
1989	11,630[35]	13,246[34]	100[36]	116[21]	8[32]	500[37]	7[33]	25,607
1990	4310[29]	10,947[34]	86[21]		2[32]	1[21]	1[33]	15,347
1991	36,335[38]	5800[34]	1040[36]		2[32]		3[33]	43,180
1992	26,913[39]	42,816[39]	900[36]		1[21]		11[33]	70,641
1993	14,650[40]	59,279[34]	1950[33c]				2[33]	75,881
1994	11,266[33a]	4310[34]	3038[33c]	9[41]			8[33]	18,631
1995	12,540[33a]	40,557[33b]	5766[33c]	6[33]			5[33]	58,874
1996	10,686[33a]	19,925[34]	1320[36]					31,931

* Netherlands, France, Spain, Sweden, Turkey

1. Anon; 2. Anon 1995; 3. Scott 1939; 4. Verestchagin, via M. Patrikeev pers. comm.; 5. Ivanov & Pomakov 1983; 6. Coombes in Bannerman 1957; 7. Cramp & Simmons 1977; 8. Uspenski & Kishko 1967; 9. Vinogradov & Tcherniavskaya, via M. Patrikeev pers. comm.; 10. Vinogradov via M. Patrikeev pers. comm.; 11. Handrinos 1991; 12. Ciochia & Hafner 1969; 13. Johnson & Hafner 1970; 14. Vinogradov, Morozkin, Babaev - via M. Patrikeev pers. comm.; 15. Krivenko 1983; 16. Scott 1970; 17. Dijksen et al. 1973; 18. Scott 1980; 19. Anon 1978; 20. Sterbetz 1982; 21. Wetlands International database, Wageningen, the Netherlands; 22. Dijksen & Smith 1974; 23. Puscariu 1983; 24. Puscariu 1977; 25. Michev et al. 1981; 26. Lebret 1978; 27. Sterbetz 1980; 28. O. Thorup & T. Bregnballe, unpublished report; 29. Michev, T. et al. in: Cracknell 1990; 30. Madge & Burn 1988; 31. Faragó et al. 1991; 32. S. Faragó pers. comm.; 33. Wetlands International Goose Research Group database, via a D. Munteanu, b T. Michev, c T. Ardamatskaya; 34. T. Michev; 35. Munteanu et al. 1989; 36. I. Rusev & A. Korzyukov; 37. Vinokurov 1990; 38. Vangeluwe & Stassin 1991; 39. Vangeluwe & Snethlage 1992; 40. Black & Madsen 1993; 41. G. Handrinos pers. comm.

the counters' annual success in finding all the birds in the large census area.

To summarise the data in Table 23.1, for years when count coverage included the main wintering areas: the maximum population estimate between 1957-70 was 60,000 (mean 45,641, n=5, SD 11,089), between 1976-1990 it was 25,607 (mean 12,950, n=12, SD 7573), and between 1991-1995 it was 75,879 (mean 62,144, n=4, SD 14,505). In review, in the 1950s, when some of the geese wintered in the Caspian region, the population numbered about 50,000-60,000. For a period after the mid 1970s, when the population abandoned the Caspian wintering grounds and moved to the Black Sea coast, numbers were in the region of 25,600. Currently, numbers are much higher, with a maximum count of 75,879 in 1993.

The precise phase of the recent population increase is not known, as the improvement in census effort has only recently occurred. The population may have responded to the various protective legislation implemented in the 1970s and 1980s, and to the creation of vast tracts of cereal crops in the Romanian and Bulgarian wintering grounds in the 1960s and 1970s. Trends within specific wintering states will be discussed in section 4 (below).

1.4 Breeding success

From studies conducted in the Pyasina basin on the Taimyr Peninsula, the average percentage of local Red-breasted Geese breeding over the period 1977 to 1983 was 24.4%, though this varied from 7% to 54% (Kostin & Mooij 1995). Breeding success fluctuated from year to year and apparently depended on climate, predation and population levels of birds of prey which are thought to impart protection to nesting geese from predators. A correlation between the presence of nests of birds of prey and the average number of nests of Red-breasted Geese has been found (Kostin & Mooij 1995). Juvenile mortality at the embryonic and early post-embryonic stage averaged 15.4%, and varied between 5% and 32% (calculated as the difference between the average clutch size and the average brood size). The average number of goslings per breeding pair after leaving the colony was 4.5 (Kostin 1985, Kostin & Mooij 1995) (see section 2 below).

Severe climatic conditions can inhibit all recruitment in arctic geese (Owen 1980). During counts in Bulgaria and Romania between 1990 and 1995, annual recruitment rates, based on the proportion of young to adults, was determined to be between 0% and 6% (Black & Madsen 1993).

1.5 Mortality

Red-breasted Goose mortality rates have not been calculated to date.

Predation: The Arctic Fox is thought to be the main predator of the Red-breasted Goose. Nest predation can vary from 7% to 59%, depending on the cyclical variation of the main prey of the Arctic Fox, the Siberian and Collared Lemmings (*Lemmus sibericus* and *Dicrostonyx groenlandicus*, respectively), and the proximity of the goose nests to those of Peregrine Falcons, Rough-legged Buzzards *Buteo lagopus*, and Herring Gulls *Larus argentatus* (Kostin & Mooij 1995). The area "protected" by the birds of prey and gulls seems to be limited to the immediate vicinity of the nests of these birds, and so once the goslings leave the nest they also become vulnerable to predation from these species (J. Quinn pers. comm., British Broadcasting Company archives 1996). On the wintering grounds, the White-tailed Eagle *Haliaeetus albicilla* and Racoon-dog *Nyctereutes procyonoides* have been observed attacking the geese.

Hunting: Though the Red-breasted Goose is protected in most countries, deliberate and accidental death caused by illegal hunting occurs throughout the species' range. The number of geese shot is not extensively monitored in any of the range-states and, coupled with the lack of regular productivity estimates and overall mortality estimates, it is difficult to assess the impact that illegal hunting may have (Hunter & Black 1996).

Poisoning: In Romania, there have been some cases of wintering geese being intentionally and illegally poisoned, and the carcasses sold as food. The use of rodenticide on the wintering grounds has been known to cause the deaths of many geese including Red-breasted Geese, especially in the winter of 1988/89 (B. Ivanov, P. Iankov & G. Dandliker pers. comm.). The impact of poisoning on the population is unknown, but likely to be small.

Climate: Severe conditions on the wintering grounds have been known to cause deaths on ice-covered roost sites, though the impact on the population is unknown.

2. BREEDING GROUNDS AND BREEDING ECOLOGY

2.1 Distribution

Range: Red-breasted Geese breed on the subarctic tundra of the Taimyr, Gydan and Yamal Peninsulas in northern Russia. While the range on the Gydan and Ya-

Table 23.2. Recent comprehensive mid winter counts of Red-breasted Geese in their main wintering quarters.

(January)	Bulgaria	Romania	Ukraine	Total
1991	5800	36,335	1040	43,180
1992	42,816	26,913	900	70,629
1993	59,279	14,650	1950	75,879
1994	4310[1]	11,266	3038	18,614[1]
1995	40,557	12,540	5766	58,863

[1] Poor count year due to weather and poor visibility

mal Peninsulas is thought to be shrinking, the range on the Taimyr, where 70% of the breeding population nest (Kostin 1985), is thought to be expanding (E. Syroechkovski Jr. pers. comm.). The main breeding area is the Pura-Pyasina river catchment in western Taimyr (centre 72° N 88° E). For detailed information on breeding sites see Krivenko (1983), Vinokurov (1990), Kostin & Mooij (1995), Quinn et al. (1996a, b) and Hunter & Black (1996). Small numbers may be breeding on the tundra west of the Ural Mountains (Vinokurov 1990), but this is not likely to be a significant proportion of the breeding population.

Habitat and feeding ecology: The species usually nests in colonies on steep river banks and precipices, low hills, rock outcrops, mud/clay ridges and outcrops, and rocky and sandy islands (Kretschmar & Leonovich 1967, Kostin 1985, Quinn et al. 1996a, b). Cover is usually thin and includes Dwarf Birch *Betula* spp., Willow *Salix* spp. or dead grass (Cramp & Simmons 1977). Grass leaves and the shoots of Cotton Grass *Eriophorum angustifolium* and *E. scheuchzeri* make up the bulk of the diet (Uspenski 1965, Zharkova & Borzhonov 1972), while *Carex* spp. and *Equisetum* spp. have also been found to be important (Quinn et al. 1996a).

Fig. 23.1. Flyway and known staging areas for Red-breasted Geese.

Association with other nesting birds: It has long been recognised that nesting Peregrine Falcons, Rough-legged Buzzards and Herring Gulls probably provide nesting Red-breasted Geese with protection from Arctic Foxes (Popham 1897, Kostin 1985). Recent surveys indicate that Snowy Owls *Nyctea scandiaca* may provide similar protection, as may Arctic Terns *Sterna paradisaea* from raiding Skuas *Stercorarius* spp. and gulls (Quinn et al. 1996a). Several suggestions explaining why the goose's nest is not attacked by the birds of prey and gulls have been made, one being that communal nesting is advantageous to both species for detecting potential predators/competitors (Kostin 1985, Ratcliffe 1993).

2.2 Moult migration and moulting areas

Red-breasted Geese moult on or near the breeding grounds in flocks of 11 to 1500 (mean 314, n=14; Quinn et al. 1996a), and sometimes with White-fronted Geese *Anser albifrons* and Bean Geese *Anser fabalis*. It has been suggested that they moult in association with birds of prey for protection during the flightless stage (Naumov 1931), however, no relationship has been found between the distribution of moulting geese and the distribution of birds of prey (Y. Kokorev, I.O. Kostin, J. Mooij & V. Zirianov pers. comm.). For breeders, the flightless stage occurs between mid July and late August, whilst non-breeders moult two weeks earlier (Uspenski 1965).

2.3 Research

Over the past ten years, surveys have discovered several new sites beyond the previously known breeding range (E. Syroechkovski Jr. pers. comm.).

A study of the breeding biology of the Red-breasted Goose and the implications for its conservation was carried out during 1977-1983 (Kostin 1985). A re-assessment of the data suggested that climate has a major influence on hatching date, the percentage of breeding birds and the number of nests per colony (Kostin & Mooij 1995). More recently, a study of the breeding and feeding ecology of the goose and associated Peregrine Falcons on the Taimyr was initiated in 1995. International teams of British, Russian, Dutch and American biologists returned to the study area on the Pura River in 1996 and 1997 (Quinn et al. 1996a, b).

2.4 Protection and conservation

Hunting legislation: Hunting and exportation of Red-breasted Geese are illegal in Russia. However, since the changes in the country's administration, reserves and the enforcement of hunting legislation are now controlled by regional authorities. Consequently, there is less communication with a central administration, and less monitoring and regulation of activities in remote areas (I.O. Kostin pers. comm.). It is feared that higher proportions of illegal hunting, and mining/oil exploration in the breeding grounds, may go ahead unreported.

Site safeguard: Large areas of the Taimyr Peninsula have been given reserve status, however, only about 20% of the known breeding sites lie within these reserves. The percentage of breeding pairs this represents, is unknown (Hunter & Black 1996). In 1978, the largely unprotected Pura-Pyasina watershed in the Taimyr held the highest concentration of breeding Red-breasted Geese (Kostin 1985). Ramsar status was proposed for part of this area, but was not ratified.

In November 1994, the Working Group on Geese of eastern Europe and northern Asia was established with one of the aims to support and develop studies on Red-breasted and Lesser White-fronted Geese *Anser erythropus* in Russia, and to plan conservation measures to protect the most important areas for these species.

3. STAGING AREAS

3A. KAZAKHSTAN

3A.1 Distribution

Range: There is reported to be an important staging area for Red-breasted Geese on the Tobol-Ishim forest-steppe and the watersheds of the Ubagan, Ulkayak and Irgizin rivers in the Kazakh uplands (52° N 65° E, Fig. 23.1). The current status of this area as a staging site is not well described (Zhatkanbayev pers. comm.), but recent searches for Lesser White-fronted Geese in the Kustanay region have provided some information about Red-breasted Geese as well (Tolvanen & Pynnönen 1998, Markkola et al. 1998).

Habitat and feeding ecology: Little is known though grass shoots may be supplemented with tubers and rhizomes on steppe habitat during migration (Dement'ev & Gladkov 1952).

3A.2 Abundance

Phenology: Red-breasted Geese occur in the Kazakh uplands during the first 20 days of May. During the autumn migration, birds begin to appear in the first half of September, with mass migration occurring in the first half of October (Krivenko 1996).

Trends and numbers: Lack of data prevents description of trends. A maximum of 3000 individuals was recorded during spring in the period 1972-1977, and a maximum of 15,000 in autumn (Krivenko 1983). During May 1997, it was estimated that 5500-8000 Red-breasted Geese used the Kustanay region (extrapolated from the proportion of Red-breasted Geese in the larger flocks of White-fronted Geese)(Markkola et al. 1998). During October 1996, 88,000 Red-breasted Geese were estimated to stage in the region (Tolvanen & Pynnönen 1998), a number exceeding the current population estimate.

3A.3 Research

None known.

3A.4 Protection and conservation

Hunting legislation: The Red-breasted Goose is protected in Kazakhstan.

Site safeguard: None known.

Agricultural conflict: None known.

3B. RUSSIAN FEDERATION

3B.1 Distribution

Range: There appear to be three major staging areas in Russia (Hunter & Black 1996, Fig. 23.1). For the autumn migration, the first staging area is on the Ob floodplains, north of Chanty-Mansijsk on the Arctic Circle (66 N 67° E; V. Krivenko pers. comm.), the second on the Middle Ob near Chanty-Mansijsk (62° N 68° E), and the third on Russian territory at Lake Manych-Gudilo (47° N 43° E). Lake Manych-Gudilo is actually the fourth major staging site on the entire flyway, the third being in Kazakhstan (see above). A small number have also been known to stage in the region between Surgut and the River Vakh (61° N 75 E).

Habitat and feeding ecology: There is little information on habitat use in staging areas in Russia, though it is thought that grass shoots may be supplemented with tubers and rhizomes on steppe habitat (Dement'ev & Gladkov 1952).

3B.2 Abundance

Phenology: Spring passage through the Lake Manych-Gudilo area begins in late February/early March with mass movements occurring in late March/early April. Migration through the Ob floodplains (North Duvobje) begins between 1 and 20 May, with mass migration occurring between 11 and 31 May (Krivenko 1996). The exact timing of spring passage through the Middle Ob is not documented. However, based on known staging dates in Kazakhstan (early May) and the Ob floodplains, passage probably occurs around mid May.

During the autumn migration, Red-breasted Geese pass through the Ob floodplains (Ustje Obi) between mid August and mid October (Krivenko 1996).

Trends and numbers: There is little information on numbers at staging areas. A maximum of 10,000 Red-breasted Geese was recorded at the staging site on the Ob floodplains in 1993. At Lake Manych-Gudilo, 8000 individuals are currently known to pass through during spring and 8000-20,000 during autumn (Krivenko 1996). A maximum of 25,000 was recorded in the Lake Manych-Gudilo area in autumn 1976 (Krivenko 1983).

3B.3 Research

As far as is known, no research has been conducted on Red-breasted Goose staging sites in Russia.

3B.4 Protection and conservation

Hunting legislation: The Red-breasted Goose is listed in the Red Data Book of the USSR and is protected throughout Russia. Coupled with an export ban declared in 1970, any form of hunting is illegal in staging areas within Russia.

Site safeguard: On 13 September 1994, Russia ratified the Ramsar Convention. The Ob floodplains within the Upper Duvobje area and Lake Manych-Gudilo were subsequently designated as Ramsar sites.

Agricultural conflict: None known.

4. WINTERING AREAS

4A. BULGARIA

4A.1 Distribution

Range: The most important sites for wintering Red-breasted Geese are Lakes Shabla and Durankulak (43°30' N 28°30' E) on the Black Sea coast in the far northeast of the country (Fig. 23.2), and the adjacent southern end of the Dobrodja plateau (Michev et al. 1991, Munteanu et al. 1991, P. Iankov pers. comm.).

Habitat and feeding ecology: The geese feed predominantly on agricultural land on the Dobrodja plateau, the diet consisting of the green parts of winter wheat, barley, maize, some pasture grasses, grass shoots on ploughed land and spilt grain (Sutherland & Crockford 1993). The Red-breasted Goose almost always feeds with other, larger species of geese such as the White-fronted Goose. Throughout the day, the birds fly to coastal and freshwater lakes to drink. Some of these lakes, in particular Shabla and Durankulak, are used as night-roosts and can be up to 40 km from the main feeding areas. At roost sites, the birds will utilise the middle of the lakes, or remoter shallow areas, and muddy and sandy beaches with low aquatic vegetation. When the lakes freeze the birds roost on the ice and/or the sea if it is calm (B. Ivanov, P. Iankov & G. Dandliker pers. comm.).

4A.2 Abundance

Phenology: Red-breasted Geese first start to arrive on the wintering grounds in small numbers in October, with mass migration occurring in November, and are usually seen with White-fronted Geese (D. Vangeluwe pers. comm.). The geese depart for the breeding grounds in March.

Trends and numbers: In recent winters, 80-90% of the world population of Red-breasted Geese were observed in Bulgaria during January counts (B. Ivanov, P. Iankov & G. Dandliker pers. comm.), 90% of which were recorded on Lakes Shabla and Durankulak alone (Wilson & Moser 1994).

Only in the last 20-30 years have Lakes Shabla and Durankulak become the most important sites for wintering Red-breasted Geese. Prior to the late 1960s, the main wintering site for the species was the Azerbaijan coast of the Caspian Sea, with only small flocks or single birds ever being recorded on the northwestern Black Sea (Fig. 23.3, Hunter & Black 1996). Under the communist regime during the 1950s, areas of private land in Bulgaria and Romania were joined to form large tracts of winter cereals making them suitable feeding areas for tens of thousands of geese. It is thought that this increase in food resource coupled with the protection of Lake Shabla in the 1970s as a government hunting estate, provided suitable alternative wintering sites at the time when the traditional sites in Azerbaijan were becoming degraded. Since the 1970s, and with the advent of comprehensive mid winter counts in the 1990s, numbers in Bulgaria have increased from 1000 in 1970 to over 59,000 in 1993. This is more likely to be the result of redistribution, improved count coverage and increased conservation effort, than of a true increase in population size.

4A.3 Research

Annual mid winter counts of waterfowl at all important wetland sites in Bulgaria have been conducted since 1977 (with the exception of 1986). Extensive monitoring coordinated with counts in Romania and the Ukraine, was initiated in winter 1990/91, and in January 1993, ornithologists from the UK and Denmark joined Romanian and Bulgarian teams to conduct surveys and for discussions on Red-breasted Goose conservation (Black & Madsen 1993). Studies of the ecology and conservation of the species on the Dobrodja plateau (Bulgaria and Romania), provided an insight into diurnal movements and habitat preferences (Vangeluwe & Snethlage 1992). A PhD project on habitat choice and distribution was initiated in 1995.

4A.4 Protection and conservation

Hunting legislation: Listed as *endangered* in the Red Data Book of Bulgaria, and protected under the Law for the Conservation of Nature (1967) whereby a penalty is imposed for damage to a protected species (Michev et al. 1991, B. Ivanov, P. Iankov & G. Dandliker pers. comm.). The hunting season opens for other species of geese on 1 September and closes on 31 January; with hunting days on Saturday, Sunday and Wednesday (Wilson & Moser 1994, B. Ivanov pers. comm.).

The Committee on Forests is responsible for enforcing hunting laws, however violations are increasing as a result of poor enforcement. Increasing activity by hunters from outside Bulgaria is also causing concern and legislation to control tourist hunting is in preparation.

Site safeguard: Lake Durankulak is a Ramsar site and Lake Shabla is protected by Bulgarian law (B. Ivanov pers. comm.). There used to be a 500 m buffer zone around Lake Shabla in which shooting was prohibited (Ivanov & Pomakov 1981), however, privatisation of the land has changed the borders of the protected zone. In 1992/93 the perimeter fence was destroyed and the land cultivated right up to the lake-side (B. Ivanov, P. Iankov & G. Dandliker pers. comm., D. Vangeluwe pers. comm.). Shooting within the protected zone, and from the lake itself, now occurs regularly (Wilson & Moser 1994, Black & Madsen 1993, D. Vangeluwe pers. comm., P. Iankov pers. comm.).

Special programmes are underway to protect the Red-breasted Goose and eight other species in Bulgaria, and are supported by BirdLife International and Wetlands International (Wilson & Moser 1994). A joint project of the Ministry of the Environment and the Swiss Association for the Protection of Birds on the coastal wetlands of the Black Sea includes the preparation and implementation of a management plan for Lakes Shabla and Durankulak. The Red-breasted Goose will be the main focus of these management plans. The project started in 1994 and is funded by the Swiss Government. A privately run conservation organisation, Le Balkan, rents 160 hectares of private and municipal land for wintering geese.

Agricultural conflict: The changes in agricultural policy and practices occurring in Romania, and their implications for the geese, may also apply to wintering sites in Bulgaria. Though preliminary enquiries suggest that only one third of arable land in south Dobrodja may be privatised as a result of the changes in agricultural policy (B. Ivanov, P. Iankov & G. Dandliker pers. comm.), the threat lies in whether privatisation will lead to: (a) unforeseen land use change, such as large-scale conversion to cash crops, development or increased hunting; and/or (b) intensification of existing arable land, which in turn may lead to conflict between the geese and the landowners, as happens in western Europe (Owen 1990).

Other: Education materials such as posters depicting the Red-breasted Goose have been prepared.

4B. ROMANIA

4B.1 Distribution

Range: The lagoon/steppe areas of the Danube Delta (Delta Dunarii), including the Razelm-Sinoie complex of lakes (45 °N 29 °E) on the Black Sea coast, and adjacent Dobrodja plateau are the most important sites in Romania for the Red-breasted Goose (Fig. 23.2, Madsen 1994, Hunter & Black 1996).

Habitat and feeding ecology: The geese roost on the Razelm-Sinoie complex and fly to agricultural land on the Dobrodja plateau to feed. See section 4A.1 for habitat and feeding ecology.

4B.2 Abundance

Phenology: Red-breasted Geese first arrive on the wintering grounds in Romania in October, with mass migration occurring in November (D. Vangeluwe pers. comm.). They depart for the breeding grounds in March.

Trends and numbers: A maximum total of 36,335 Red-breasted Geese was counted in Romania in the winter of 1990/91 (Vangeluwe & Stassin 1991), with 33,830 counted feeding on the Dobrodja plateau (Sutherland & Crockford 1993). Geese using sites in Romania may move further south to Bulgaria as their food is depleted and as temperatures decline.

Available data suggest that geese formerly wintering in Azerbaijan, first shifted to the Danube Delta in Romania before also wintering on Lakes Shabla and Durankulak in Bulgaria. The first records of large numbers of Red-breasted Geese wintering in the Danube Delta area were in 1967-1969, when an estimated 25,000 individuals were observed (Fig. 23.3, Table 23.1). Though relatively large numbers continued to be recorded, these high counts were not matched again until 1991. Similar to Bulgaria, the increase in numbers in the 1990s, in comparison to earlier decades, is more likely to be due to improved monitoring, than to an increase in population size. Mid winter counts since 1991 suggest that numbers wintering in Romania have been decreasing (Table 23.2). This may be due to climatic trends; warmer weather allowing the birds to remain further north for longer, colder weather pushing the birds south, or it may be due to restricted coverage during censusing.

4B.3 Research

Annual mid winter counts of Red-breasted Geese in Romania have been conducted since 1988, as part of Wetlands International's international waterfowl census programme. Since 1990/91 these have been coordinated with similar counts in Bulgaria and the Ukraine, thus achieving comprehensive mid winter data (D. Vangeluwe pers. comm.). Feeding distribution studies on the Dobrodja plateau, showed that the geese preferred to feed on winter wheat at lower altitudes, on flatter ground, further away from human habitation and closer to roost sites than was typical of the area (Sutherland & Crockford 1993). Additional studies on the ecology and conservation of the goose were carried out in 1992 (Vangeluwe & Snethlage 1992). In January 1993, ornithologists from the UK and Denmark joined Romanian and Bulgarian teams to conduct coordinated surveys and for discussions on Red-breasted Goose conservation (Black & Madsen 1993). A programme of mapping the distribution and habitat used by the geese was initiated by a volunteer network in 1996.

4B.4 Protection and conservation

Hunting legislation: Only since 1996 has the Red-breasted Goose been completely protected from hunt-

Fig. 23.2. Main wintering range of the Red-breasted Goose. Key roost sites are indicated by arrows.

ing in Romania. Under a new law for game and game protection, published in the 'Monitorul Oficial al României', No.235/27, September 1996, and enforced since 27 October 1996, the Red-breasted Goose is listed with several other species whose hunting is prohibited. For huntable species, the hunting season has been shortened from 15 August-31 March to 10 September-1 March, and in the Danube Delta Biosphere Reserve the 1996/97 hunting season began later on 10 October 1996.

Site safeguard: The Danube Delta has been designated as a Biosphere Reserve, a World Heritage Site and a Ramsar Site. The Global Environmental Facility (GEF) is funding a comprehensive project to implement obligations arising from these designations. The law for the Danube Delta Biosphere Reserve strictly controls all forms of utilisation of wildlife, by a process of permitting, administered and enforced by the reserve administration (Wilson & Moser 1994). The geese are not protected at the main feeding sites on the Dobrodja plateau.

Agricultural conflict: Due to recent political changes, land in Romania has been divided and privatised or abandoned (Crockford 1991, Black & Madsen 1993). Privatisation may lead to changes from the cereals favoured by the geese, to cash crops such as maize, vineyards and vegetables, which Red-breasted Geese do not utilise or are of low importance. A similar change in land use on the Caspian Sea coasts was the likely cause of the massive redistribution of Red-breasted Geese to the Black Sea coast and the apparent decline in numbers in the 1970s. It is possible, therefore, that agricultural changes in Romania (and also Bulgaria and the Ukraine) may result in another redistribution event, which may in turn lead to another population decline.

Other: Educational materials including posters depicting the Red-breasted Goose have been prepared and distributed in the Dobrodja area.

4C. UKRAINE - STAGING AND WINTERING

4C.1 Distribution

Range: The Danube Delta (45°30' N 29° E) and the area between and including the deltas of the Dnepr (46° N 32° 30' E) and Dnestr (47° N 31° E) hold the highest concentrations of Red-breasted Geese in the Ukraine during migration (Ardamatskaya 1994, Figs. 23.1 & 23.2). The geese winter on the northwestern coast of the Black Sea from the Danube Delta to the Crimean Peninsula, including the Yagorlystski and Tendra Bays (Madsen 1994). The most important area for the geese in winter is between the Danube and the Dnestr Rivers (Fig. 23.2, Rusev et al. 1996). During the winter, the geese migrate between the Ukraine and Bulgaria/Romania depending on weather conditions; moving south to Bulgaria/Romania in sudden cold spells, and north during mild periods (D. Vangeluwe pers. comm.).

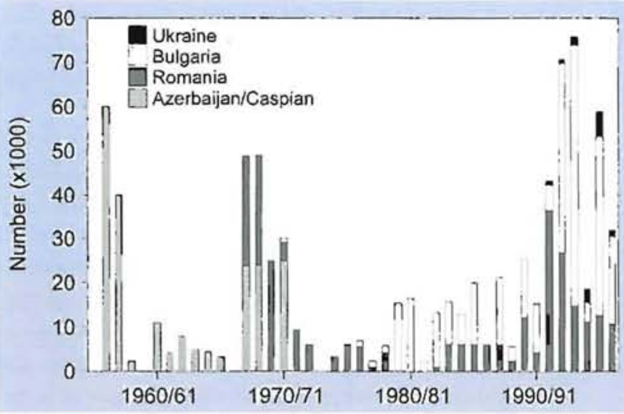

Fig. 23.3. Maximum counts and estimates (where count data are not available) of Red-breasted Geese on the main wintering grounds.

Habitat and feeding ecology: During the autumn migration Red-breasted Geese feed on winter wheat and spilt grain in harvested fields of maize, sunflowers and millet. In the Danube Delta the geese also feed in rice fields. In the spring only winter wheat is utilised. During winter, winter wheat is the main food item, though the geese sometimes also feed on spilt maize after harvest. They are also occasionally seen feeding on the floodplains of the Danube and Dnestr deltas, and on natural habitat in the protected zones of the Black Sea coastal wetlands. The Red-breasted Geese usually feed with mixed flocks of White-fronted, Lesser White-fronted and Greylag Geese. The density of the geese within these flocks appears to depend upon the height of the wheat plants i.e. the taller the plants the greater the concentration of geese. Preferred feeding sites are usually within 5-8 km of coastal lakes which are used as night roosts during migration and winter, however, the best feeding areas may be 50 km away from these roosts. When the lakes froze in winter 1995/96, the birds roosted on the ice and on the coast.

4C.2 Abundance

Phenology: Spring migration through the Azov-Black Sea basin begins in early March, with mass migration occurring during March-early April. In autumn, birds begin to pass through the region during the first ten days of September, with mass migration occurring in October-early November. The Red-breasted Geese are usually seen mixed with migrating White-fronted Geese. The distinction between birds on migration and those staying to winter in the Ukraine is not clear. However, birds arriving during late November to early December are assumed to winter in the Ukraine, and birds seen from early March onwards are assumed to be on migration to the breeding grounds.

Trends and numbers: Little data have been collected for Red-breasted Geese staging in the Ukraine. A maximum of 600 birds was observed staging near the Burnas Liman in October 1994, though it is thought that 8000 to 12,000 Red-breasted Geese regularly stage in the country. Numbers of Red-breasted Geese wintering in the Ukraine are likely to have increased during the 1970s as the geese shifted from the Caspian to the Black Sea. In the period up to 1989, wintering numbers were thought to be about 100, but since then counts have increased from 86 in 1990 to a maximum of 5766 in 1995 (Table 23.1). The lower numbers recorded in winter 1996 were probably due to the very cold weather that year when birds were likely to have moved further south. The increase in Red-breasted Goose numbers over the past 5-10 years is likely to be the result of better coverage during mid winter counts.

4C.3 Research

No specific research on the Red-breasted Goose has been conducted on the staging areas in the Ukraine. Winter counts of birds in the Black Sea coastal zone of the Ukraine were initiated by members of the Natural Heritage Fund more than 20 years ago. More intensive coverage, using helicopters and boats, began in 1991 in order to determine which areas would be suitable as Natural Reserves and to assess the threats to the habitat and birds (Rusev 1993, 1995, unpubl.). Regular counts of wintering geese, including Red-breasted Geese, have been conducted since 1989/90 as part of Wetlands International's international waterfowl census programme.

4C.4 Protection and conservation

Hunting legislation: The Red-breasted Goose is listed under Category II of the Red Data Book of the Ukraine, and as such, any hunting of the species is illegal. However, illegal shooting is widespread in staging and wintering areas. The hunting season for legal quarry is on Saturdays, Sundays and Wednesdays from the second Saturday of August until the end of November or mid December. The season can be prolonged, however, by the hare-hunting season which occurs from December to January.

Hunters and farmers have used the apparent increase in numbers on the wintering grounds to successfully lobby for an increase in the duration of the hunting season and an increase in shooting quotas from one to three geese per hunter per day. Though protected by law, 150-200 Red-breasted Geese are shot annually during the hunting of White-fronted Geese (Koshelev et al. 1991). The absence of effective legislation is allowing foreign visitors to hunt on the main wintering site between the Danube and Dnestr rivers. There is concern that this will cause a decline in the birds using that area. Hunting activity requires greater control through the enforcement of tougher legislation and more restrictive quotas.

Site safeguard: Some of the wetlands used by the geese during migration and winter are protected by the "Nature Reserve Fund" law of the Ukraine. Geese using the Ukrainian parts of the Black Sea Biosphere Reserve and Dnestrovskiye Plavni are strictly protected and managed (Wilson & Moser 1994). The Ukrainian Government ratified the Ramsar Convention on 29 November 1994, and under the Order on "Measures for the Conservation of Wetlands of International Significance" (23 November 1995), 17 wetlands totalling 600,000 ha in the Azov-Black Sea region were given international status. Eight other areas have been identified for future protected status, however, the ecological value of some of these is declining.

Agricultural conflict: Staging and wintering geese are reported to damage winter wheat crops in the Ukraine. Farmers, hunters and foresters, who may not distinguish between the different species of geese, are lobbying the Government to adopt legislation which will allow shooting during the hunting season and scaring during the closed season. Such legislation could be harmful to staging Red-breasted Geese which need these reserves of food for migration and possibly also for breeding.

According to the newly adopted Constitution of the Ukraine (28 June 1996), agricultural land will be privatised. This is likely to lead to changes in land use, the types of crops grown and additional conflict between farmers and geese (see section 4B.4).

The use of rodenticides to control populations of Common Voles *Microtus arvalis* in peak years (e.g. 1989) has been known to harm geese.

Other: Since 1992, the Natural Heritage Fund, a regional, non-governmental organisation working for wildlife conservation on the Black Sea coast, has been distributing booklets on the conservation of the Red-breasted Goose and its habitats, amongst hunters and local people. Public awareness has also been raised through newspaper and radio.

4D. AZERBAIJAN, GREECE, HUNGARY AND THE NETHERLANDS

In order to present a complete review of the status of Red-breasted Geese wintering in the Western Palaearctic, it is worth briefly mentioning the small, but regular, flocks which have been known to visit Azerbaijan, Greece, Hungary and the Netherlands in the recent past.

Azerbaijan: The last record of large numbers of Red-breasted Geese in the former main wintering ground for the species was 25,000 in 1970. Since then up to only 500 individuals have been documented, the most recent record being one in 1990. Some suggest that around 500 birds continue to winter regularly in Azerbaijan (D. Vangeluwe pers. comm.), but the general consensus is that they no longer exist in any significant numbers, and have not done so for the last 20-25 years (M. Patrikeev pers. comm., Hunter & Black 1996). In January and February 1996, surveys of the Kizil Agach area, a former key site for wintering Red-breasted Geese, recorded none (D. Paynter pers. comm.).

Greece: The northeast coast of the Aegean Sea (40° 45' N 26° E), is the only area in Greece to regularly hold small flocks of wintering Red-breasted Geese, with counts ranging from 0-116 since 1963. In relatively cold periods, larger numbers move in from Romania and Bulgaria (D. Vangeluwe pers. comm.). A maximum of 2000 Red-breasted Geese was recorded in the Evros Delta in the severe winter of 1984/85 (Handrinos 1991).

Hungary: Available data indicate that over the period 1972-1992, flocks of 1-90 birds visited sites in Hungary in most years. Data are not available for winters since 1992, but it is thought that numbers are similar to those observed in the 1980s (S. Faragó pers. obs.).

The Netherlands: Winter counts since 1986, show that flocks of one to six Red-breasted Geese regularly turn up in the Netherlands.

5. DISCUSSION

Population status: According to IUCN (IUCN 1995, Mace & Collar 1995) and BirdLife International classification criteria (Tucker & Heath 1994) the Red-breasted Goose population, which numbers between 43,180 and 75,879 (mean 62,138), should be treated as *vulnerable* for four reasons:

1) the population is below 100,000 individuals, a significant threshold level for waterbird species as stated in the African Eurasian Waterbird Agreement,
2) the majority of the population may concentrate in small areas; recently as much as 90% on just one Bulgarian lake in winter,
3) the entire wintering population is apparently prone to redistribution in response to changes in agricultural practices; as was the case in the 1970s when the birds shifted from the Caspian region to the western Black Sea region,
4) the population may be prone to sudden sizeable declines.

Conservation issues: Red-breasted Geese winter in dense flocks in limited areas, implying that they are specialised in their habitat requirements, perhaps more so than most other Western Palearctic geese. Coupled with the fact that in certain years the species is prone to very low or no recruitment and that the population may be prone to sizeable fluctuations, changes in agricultural practices within the wintering and staging range could pose a serious threat. In order to assess the precise conservation needs of the species, a better understanding of the species' population dynamics and ecological requirements is required (see below).

The Red-breasted Goose would benefit from greater protection from increasing illegal hunting and disturbance. Recent influxes of tourist hunters from other European countries are exacerbating shooting and disturbance problems at feeding and roost sites. Programmes to monitor and control hunting disturbance may be useful throughout the species' wintering range. At Lake Shabla in particular, the protected zone around the lake could be re-established and greater efforts to control hunting should be made.

Existing reserve areas on the Taimyr Peninsula could be extended to include the most important Red-breasted Goose breeding areas.

Agricultural conflict: Red-breasted Geese favour, and may depend upon, large areas of winter wheat and barley on the wintering and staging grounds on the north and western coasts of the Black Sea. Since reforms in agricultural policy in Bulgaria, Romania and the Ukraine, maize, wine, fruit and vegetable production has increased and intensive arable farming may follow, as these range states compete with other European countries. Consideration should be given to the Red-breasted Goose when new agricultural policies are drafted. It may be necessary to initiate a system of compensation to farmers and other landowners for the sometimes considerable damage caused to crops by Red-breasted and White-fronted Geese, in order to alleviate the pressure on the local authorities to allow shooting and/or scaring of wintering geese. Farmers could be encouraged to continue to grow wheat and barley, rather than switch to cash crops, or alternatively, the areas most used by the geese could be given protected status and the agricultural land managed sympathetically (see Owen 1990).

Future research needs: In order to fully understand Red-breasted Goose population dynamics and ecological requirements, several programmes of research are required:

1) Given the potential for large fluctuations in population size, it is crucial that coordinated mid winter counts in Bulgaria, Romania and the Ukraine are continued for at least the next five years in order to determine the true status of the current population. It would be useful to increase the frequency of these counts up to twice per month in the peak season, though financial restrictions make this unlikely for the foreseeable future. Age ratio and brood size assessment should be included in the counts to give an indication of recruitment, survival rates and age structure. Distribution and numbers of breeding Red-breasted Geese, and threats to the breeding population, should also be monitored.
2) Red-breasted Goose habitat in Bulgaria, Romania and the Ukraine should be monitored and, if changes and/or conflicts with landowners are seen to be affecting the suitability of the land for the geese, actions to prevent displacement of the species should be taken.
3) The most important staging areas should be identified; distribution of geese within these areas, habitat use and threats should be determined. Marking birds with rings or satellite transmitters may help to determine exact migration routes and the most important staging areas. Studies of the role of spring fattening are required to determine from which staging habitats the geese are obtaining adequate resources for nesting.
4) Studies of feeding ecology and habitat use on the wintering grounds are necessary to ensure that any habitat protection and enhancement projects optimise the species' chances of survival and reproduction.
5) Further studies on the feeding ecology of breeding

birds are required to determine constraints on nesting success imposed by the phenology, availability and value of the food resources and the potential dependence on protection from birds of prey, especially Peregrine Falcons.

International conservation: As a globally threatened species, the Red-breasted Goose has been the focus of several international conservation efforts. It is listed in the Red Data Books for most countries within its range, and under numerous conventions for the conservation of species: European Union (EU) Wild Birds Directive - Annex 1; CITES - Appendix II; Bonn Convention - Appendix 2 (under review); Bern Convention - *strictly protected*; ICBP World Check-list of Threatened Birds (Collar & Andrew 1988); IUCN - *vulnerable* (IUCN 1995).

Two international Red-breasted Goose action plans have been compiled; one to identify actions to prevent avoidable mortality in the EU, focussing on conservation in Greece (Hunter & Black 1994), and the other to identify conservation actions throughout Europe as part of BirdLife International's action plans for globally threatened birds in Europe (Hunter & Black 1996). In preparation for the BirdLife International action plan, an international Red-breasted Goose workshop was held in Strasbourg in December 1994 for discussions on the status and conservation of the species. During the workshop it was agreed that a Red-breasted Goose Working Group, consisting of experts from each range country, should be established.

A joint project of the Bulgarian Ministry of the Environment and the Swiss Association for the Protection of Birds to prepare and implement a management plan for Lakes Shabla and Durankulak began in 1994 and will run for at least three years. The Red-breasted Goose will be the main focus of these management plans. In 1995, 1996 and 1997, British, Dutch, Russian and American scientists formed expeditions to the Taimyr to study the breeding biology of the Red-breasted Goose and associated Peregrine Falcons.

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