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Moult Migration and Wing-feather Moult of Seaducks in Denmark

by
ANDERS HOLM JOENSEN

Med et dansk resumé: Havændernes fældningstræk og svingfjerfældning i Danmark.

Резюме на русском языке
Миграции на линьку и линька маховых перьев морских уток в Дании

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Author's address:
Mag. scient. A. Holm Joensen
Game Biology Station, Kalø
8410 Rønde, Denmark

Introduction

The presence in summer of moulting diving ducks in Danish waters has previously been treated by SALOMONSEN (1967, 1968, 1972) who described the moult migration and moulting areas of *Somateria mollissima, Melanitta nigra* and *Melanitta fusca*. In the second report the presence of moulting *Bucephala clangula* was also mentioned. In 1963 a survey of the moulting areas of *M. nigra* off the west coast of Jutland was conducted (JOENSEN 1965).

Since 1966 the Game Biology Station has carried out studies on waterfowl populations in the whole of Denmark throughout the year (see JOENSEN 1968), and part of this was a survey of moulting seaducks in Danish waters in the summers of 1966–1972. The aim of this study was first and foremost to locate and estimate the size of the moulting seaduck populations, because there was an obvious lack of detail in the existing knowledge. Secondly, the objective was to collect as much information as possible concerning the moult migration and the time of moult of the different age- and sex-categories.

Most information was collected in aerial surveys over Danish waters during May–September. Additional data were obtained through observations from coasts and boats, examination of museum specimens, and studies of birds killed by sportsmen in the early part of the shooting season (1. Oct.–29. Feb.).

The present paper summarizes the results of the studies of 1966–1972 concerning five diving duck species, which during the summer moult are almost entirely confined to salt-water areas: *Somateria mollissima, Melanitta fusca, Melanitta nigra, Aythya marila* and *Mergus serrator*. For each species information concerning the distribution and numbers throughout the period May–September is given, with particular emphasis on distribution and numbers during the flightless period. In addition the existing knowledge on moult migration has been summarized, and the age- and sex-composition of the moulting populations and the timing of the wing-feather moult has also been described. The report does not however include an analysis of other aspects of the plumage moult during the summer months.

The occurrence of *B. clangula*, which moults both in salt-, brackish- and freshwater areas is described in a special report (JEPSEN & JOENSEN 1973) and JEPSEN (1973) has given an account of the moult biology of this species. *Aythya fuligula* and *Aythya ferina* also moult in Denmark, mostly however in small numbers and almost exclusively in fresh water. Since the present study primarily concerns seaducks, the data obtained on the two last mentioned species is insufficient for their inclusion in the present report.

The studies in 1966–1972 gave no indication of moulting in Danish waters of *Clangula hyemalis* and *Mergus merganser*, both numerous winter visitors. During aerial surveys all species of waterbirds were recorded, and some moulting areas of *Alca torda* and *Gavia* sp. were found. Since these species are very difficult to observe from an aircraft the data are, however, insufficient for a thorough description of their occurrence.

The author is indebted to many people who supplied information and helped in various ways in the study. First of all to EBBE BØGEBJERG HANSEN, who since 1969 has been attached to the waterfowl

population survey at the Game Biology Station. The author would like to thank the Royal Danish Air Force and the Army Air Corps for supplying aircraft and pilots, and the pilots engaged in the survey. The game dealer firms of MØLLER & MELGAARD, Copenhagen, ANDERSEN & SCHRØDER, Copenhagen, BARTELS EFTF., Århus and CENTRUMFISK, Svendborg, are thanked for their invaluable assistance in letting the Game Biology Station examine birds bagged by and received from sportsmen. Thanks are also due to many sportsmen and ornithologists, who gave information on moult migration and moulting areas, particularly to JØRGEN RABØL, who supplied much unpublished material concerning the migration in Denmark, particularly of *S. mollissima*. Dr. ROBERT RUSSEL gave valuable criticism of the English manuscript.

Material

AERIAL SURVEYS

Most of the information for the present study was collected by aerial surveys with small single-engined aircraft. In the summers of 1966–1972 (May–September) a total of 56 flights were conducted, comprising more than 200 flying hours. More than 4/5 of the flying time was used for surveys, while the remainder was used in travelling between airfields and coasts. Appendix 1 gives information on each flight (date, weather conditions, areas surveyed, the degree of coverage and the

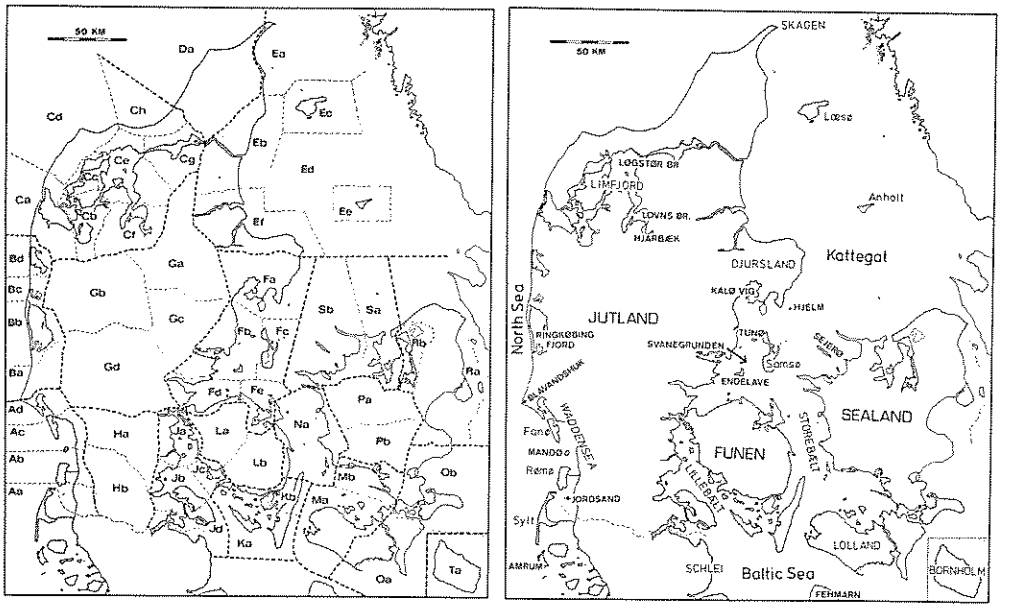

Fig. 1. Left: Map of Denmark showing division into districts and sub-districts used in aerial surveys of waterfowl (see Table 1 and Appendix 1). Right: Map showing the location of areas mentioned in the text.

Fig. 1. Venstre: Kort over Danmark visende opdelingen i distrikter og underdistrikter benyttet ved andefugletællinger (se Tabel 1 og Appendix 1). Højre: Kort visende områder omtalt i teksten.

survey- and total flying time). The map (Fig. 1) shows the division of Denmark and its surrounding waters into districts and sub-districts used in the waterfowl surveys. Table 1 gives a summary of the geographical, monthly and yearly distribution of flights and flying hours (May–September).

The use of aircraft is the only method by which waterfowl populations in Denmark and adjacent waters can be satisfactorily mapped and assessed. This is especially true for the marine diving ducks, which are mainly confined to waters so far away from the coasts, that coastal counts are unable to include them. The methods applied during aerial surveys of waterfowl in Denmark during winter have been described by JOENSEN (1968).

Influence of weather

The methods of surveying diving ducks from aircraft during winter and summer are principally the same, but when the birds are flightless they are particularly difficult to observe. In all cases the figures obtained represent minimum numbers for birds present in the areas covered, and in many cases during surveys of moulting seaducks only a small proportion of the birds have in fact been registered. This is partly due to their dark and well-camouflaged summer plumages, but more important is their habit of diving on the approach of an aircraft. Outwith the flightless period this reaction is only rarely seen. Once moulting birds have started diving, they often do so repeatedly as long as the aircraft is in the vicinity. At any time only a small proportion of the birds are above the surface, and it is virtually impossible to estimate the number of ducks present in the area. In order to avoid scaring them, the birds have to be observed and their numbers estimated from

District *Distrikt*	No. years with survey (no. surveys). – *Antal år med tælling (antal tællinger).*					Total *I alt*
	May	June	July	Aug.	Sept.	
A	4	–	3(4)	2	2	11(12)
B	4	–	3	2	4	13
C	4(5)	2	4(5)	3	1	14(16)
D	–	–	–	1	–	1
E	5	–	2	3	2	12
F	4	1	4	3	1	13
J	1	1	1	–	–	3
K	2	1	1	–	–	4
M	2	1	1	2	–	6
N	1	1	3	–	–	5
O	1	1	1	1	–	4
R	–	–	–	–	–	–
S	2	1	3	1	–	7
T	–	–	–	–	–	–

Year *År*	No. flights/flying hours *Antal flyvninger/flyvetimer*					Total *I alt*
	May	June	July	Aug.	Sept.	
1966	–	–	–	–	1/3	1/3
1967	3/9	–	–	4/13	–	7/22
1968	4/13	–	1/3	3/8	–	8/24
1969	3/8	4/14	4/17	1/4	2/8	14/51
1970	4/18	–	4/15	3/14	4/15	15/62
1971	4/16	–	3/19	1/6	–	8/41
1972	1/1	–	–	1/3	1/1	3/5
Total	19/65	4/14	12/54	13/48	8/27	56/208

Table 1. Summary of data concerning aerial surveys 1966–1972 (May–September). Upper section: The number of years in which each district or part of a district was surveyed (in cases of more than one survey in a month, the number of surveys is given in brackets). Lower section: The number of flights and number of flying hours in certain months of each year. See also Fig. 1 and Appendix 1.

Tabel 1. Oplysninger om flytællinger i 1966–72 (maj–september). Øverst: Antal flyvninger pr. måned i hvert distrikt. Nederst: Antal flyvninger pr. måned i hvert år. Se Fig. 1 og Appendix 1.

much greater distances and heights than during other seasons of the year. Therefore satisfactory observations can only be made during perfect weather conditions. In fact this requirement is only fulfilled when there is good visibility and a flat calm sea surface, and such weather conditions very seldom occur in the waters around Denmark. Even a little rippling of the surface will cause a notable proportion of the birds to be overlooked.

In Appendix 1 the observation conditions during each survey have been described with a code of roman numerals I, II and III, referring to the feasibility of observing diving ducks during the moulting season. »I« means rather poor conditions, either visibilities below 2–3 km. or wind velocity at sea level of more than 10–15 knots causing high waves on the surface. »II« means quite good but not perfect weather conditions, and »III« means perfect weather conditions with excellent visibility (more than 10 km.) and flat calm sea surface in most of the areas surveyed. During July and August nearly all aerial surveys were started when weather conditions were perfect (III) or this situation had been forecasted. The fact that of 26 aerial surveys only 10 were actually carried out under excellent conditions (III), 8 under good to excellent conditions (II–III), 5 under good conditions (II) and 3 under poor to good conditions (I–II) illustrates the difficulties connected with aerial counts in Denmark.

The proportion of birds recorded under the different observation conditions varies from species to species. When the sea is calm and the visibility good (III), even small assemblies of birds of all species can be seen at distances of 2–3 km., and large flocks with thousands of birds have on several occasions been spotted at distances of more than 10 km. During good conditions (II), medium and large flocks of *S. mollissima* within 2–3 km. of the flying route will normally be recorded, but small flocks will to a great extent be overlooked within this range, as will large flocks further away. For all other species, even rather large flocks are often overlooked at close range during the conditions of II.

The consequence of the varying weather conditions is that although a relatively large number of surveys have been conducted in all important moulting areas, in most areas conditions enabling an accurate count of the birds have only been experienced once or twice during the seven years of the investigation. In some areas in fact the very best conditions never occurred. This causes difficulties when estimating the total number of birds present in Danish waters, because it has not been possible for any of the species to get accurate figures from all important moulting areas in the same year. The totals for the whole country have been reached by adding the »best« figures obtained in each of the main geographical sectors. This procedure is based on the assumption that within each of the larger sections of our waters the number of moulting seaducks is rather stable from year to year, and that no major shifts take place from one area to another. Several observations indicate that this is true (*S. mollissima* in the Waddensea and several places in the S. Kattegat, and *M. fusca* in the Limfjord). However other observations indicate that some changes may occur (e.g. *M. nigra*, see page 24). This possible error has to be borne in mind when considering the reliability of estimates for the total populations.

Geographical distribution of aerial surveys and degree of coverage.

Table 1 gives information on the number of flights in each of the main districts

within Danish waters (see also Fig. 1). Most surveys covered areas which from previous reports were known to be important moulting areas, such as the Waddensea and waters to the west (A), the fiords and coasts of W. Jutland (B), the Limfjord (C), and parts of the Kattegat (E, F, S). The number of flights in other waters is much smaller, particularly in the southeastern part of the country, and some districts (R, T) were not surveyed at all from the air. With the amount of flying time available, first priority had naturally to be given to areas known to be of great importance. However at the same time the material is biased. Moulting seaducks have probably been overlooked in all waters (see above), but although it is known that the Lillebælt (J), the South Funen archipelago (K), the Storebælt (N), the waters S. and E. of Sealand (M, O, R) are of relatively little importance, a greater proportion of moulting birds have been left unrecorded here than in other waters.

The method of conducting aerial surveys, and of observing, estimating and recording flock size has been described for winter censuses by JOENSEN (1968). The same principles for coverage were used during summer surveys, i.e. mostly coastal and other shallow waters were covered, and mainly those known to be important haunts at other times of the year. In several important moulting areas the network of flying routes was so dense, that nearly one hundred percent coverage was performed on most flights (the Waddensea, the fiords of W. Jutland, the Limfjord, waters within 5–10 km. of Læsø in the N. Kattegat, waters N. of Djursland, and most parts of the S. Kattegat between Jutland, Sealand and Funen. Some waters are however so extensive that only relatively small proportions of the area could be covered in the flying time available (see Fig. 2). This is particularly true for the North Sea (areas more than 2–3 km. from the coast), and large parts of the Northern and Central Kattegat. The area first mentioned is known to have large numbers of moulting *M. nigra* (JOENSEN 1965), and a few successful transect flights in the second area indicate that substantial numbers of *S. mollissima*, and possibly also *M. nigra* and *M. fusca* can moult here. The lack of data from such areas is evident and of importance when considering the total figures obtained.

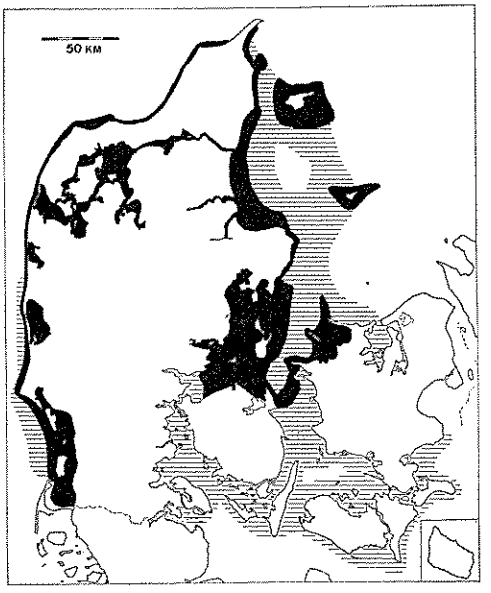

Fig. 2. Degree of coverage in aerial surveys May–September 1966–72. Black: areas covered regularly. Hatching: areas covered only a few times and more superficially. White: areas where no aerial surveys were made in connection with this study.
Fig. 2. Dækningsgraden af flytællinger maj–september 1966–72. Sort: områder dækket regelmæssigt. Skraveret: områder dækket få gange og mere overfladisk. Hvid: områder som ikke blev undersøgt med fly i forbindelse med denne undersøgelse.

OBSERVATIONS FROM COASTS AND BOATS

In addition to aerial surveys many observations were made from coasts, mainly by the staff of the Game Biology Station, although many ornithologists and sportsmen also supplied information. This material contains a lot of data, particularly on the roosting areas and movements of seaducks in the pre-moult and post-moult periods, the age- and sex-composition of the flocks, and on the time of the moult (finding of feathers on the shores). In addition a number of moulting areas along shores, mainly in areas not thoroughly surveyed from the air, were also discovered. However coastal observations added little to our knowledge on the distribution and numbers present in the most important moulting areas, which are generally too far away from the coasts.

In 1970, 1971 and 1972 several motorboat trips were made to various moulting areas. Thus in the Waddensea, the Ringkøbing Fjord, the Limfjord and particularly in the Central and Southern Kattegat, important supplementary information was collected concerning the time of moult and composition of the flocks, as well as on the habitats used. On several occasions the result of aerial surveys were compared with simultaneous counts from the boat and it was consistently found that in the moulting period it is virtually impossible to estimate numbers from a boat. The tendency for the birds to dive and scatter rapidly when disturbed by a boat will always cause a considerable degree of underestimation, and in several important areas the boat team observed less than one-quarter of the birds seen from the air.

STUDIES OF SPECIMENS COLLECTED AND BIRDS KILLED BY SPORTSMEN

During the summer of 1970–71 a small number (abt. 90) of specimens was collected in various moulting areas by special permission from the Ministry of Agriculture (specimens now in the collection of the Game Biology Station). Together with a small number (abt. 50) of summer skins (mostly from the beginning of this century) in the collection of the Zoological Museum, Copenhagen, these have been examined; see Table 2 and Appendix 2. Although small in size, the material gives valuable information on the time of the wing-feather moult and also indicates which categories are present in the various moulting areas.

In five shooting seasons (1. Oct.–29. Feb. 1968/69–1972/73), the Game Biology Station examined a large number of ducks shot by sportsmen and sent to game dealers. The aim was to study species-, age- and sex-composition of the bag, but also data concerning the late wing moult of adult females was obtained. Table 3 gives information on the number of eiders and scoters examined in October, November and December and the number of birds with new, but not fully developed wings. A number of wings of *S. mollissima* were measured, and Table 4 and Fig. 5 illustrate the growth in adult females and adult males of this species.

Although important information has been found through examination of collection specimens and birds bagged by sportsmen, the material probably does not permit conclusions to be made concerning the more detailed composition of populations of moulting seaducks. The number of collection skins is too small for this, and there is evidence that the composition of the bag does not illustrate the actual

	GBS (1970–1971) ♂♂	♀♀	Total	ZM (1886–1962) ♂♂	♀♀	Total	Total
S. mollissima	41	10	51	23	7	30	81
M. fusca	9	8	17	2	3	5	22
M. nigra	4	8	12	5	8	13	25

Table 2. The number of specimens examined of *S. mollissima*, *M. fusca* and *M. nigra* in the collections of the Game Biology Station (GBS) and the Zoological Museum, Copenhagen (ZM). Only birds of more than 12 months age from June–September (all specimens) and October (only specimens with not fully developed new wings) are included. Information on each specimen is given in Appendix 2.
Tabel 2. Antal undersøgte skind af ederfugl, fløjlsand og sortand i Vildtbiologisk Stations (GBS) og Zoologisk Museums (ZM) samlinger. Materialet omfatter kun fugle mere end 12 måneder gamle fra månederne juni-september (alle skind) og oktober (kun skind med endnu ikke fuldt udviklede nye vinger). Oplysninger om hvert skind er givet i Appendix 2.

Species, month *Art, måned*	No. examined *Antal undersøgt*		No. flightless (+ not yet moulted) *Antal afslået (+ endnu ufældet)*	
	Ad. ♂	Ad. ♀	Ad. ♂	Ad. ♀
S. mollissima				
October	957	696	2	39(+13)
November	311	214	–	2
December	530	430	–	–
M. fusca				
October	134	59	1	17(+1)
November	77	35	–	–
December	133	68	–	–
M. nigra				
October	671	139	3	74(+5)
November	118	31	–	2
December	240	61	–	1

Table 3. Wing-feather moult in adult (more than one year old) *S. mollissima*, *M. fusca* and *M. nigra* in October–December. Material from birds killed by sportsmen and sold to game dealers over five years (1968–72). The number of birds examined and the number flightless (+ not yet moulted), is indicated.
Tabel 3. Svingfjerfældning hos voksne (mere end et år gamle) ederfugle, fløjlsænder og sortænder i oktober–december. Materiale af fugle nedlagt af jægere og solgt til vildthandlere i fem jagtsæsoner (1968–1972). Antal undersøgte fugle og antal afslåede (+ antal endnu ikke afslået).

composition in the field. The bias is created by the fact that the shooting pressure on flightless and on flying birds is not the same. Contrary to what one would expect, flightless birds are generally more difficult to shoot than birds capable of flying. Only when the sea is flat calm is shooting of the persistently diving moulters profitable, and furthermore many sportsmen do not consider the shooting of flightless birds to be a sport. Therefore it is most likely that among females flightless birds are under-represented in the bag, and accordingly also that females in general are under-represented.

INFORMATION IN LITERATURE

In addition to the reports by SALOMONSEN mentioned in the introduction, literature from later years contains quite a lot information which together with data obtained in the present study illustrates the moult migration and moult of seaducks. Most reports describe the moult migration prior to the wing moult, e.g. JÖGI (1970, 1971) (Estonia) and PYNNÖNEN (1941) (Finland). At Kalmarsund in SE. Sweden, where waterfowl movements can be observed from the shore, continuous observations have been carried out for several years, and some of the reports give valuable information on movements during summer (SVÄRDSON 1958, 1959, RODEBRAND 1972a, 1972b, EDELSTAM 1972). The migration across S. Jutland

and N. Germany has been described in several reports (BEHRENDS 1955, 1966, BEHRENDS & PALM 1950, JØRGENSEN 1941, ROED 1971, BAUER & VON BLOTZHEIM 1969), and scattered information on moult migration through Danish waters can be found in several papers and notes in the magazines Dansk Ornithologisk Forenings Tidsskrift and Feltornithologen from later years (e.g. PREUSS 1957, RABØL 1967, RABØL & NOER 1970). During proof reading F. D. PETERSEN supplied a copy of a report on the migration of ducks at Blåvandshuk, W. Jutland (PETERSEN in press).

There is very little information in the literature with original data on the distribution, numbers of birds etc. during the moult in Danish waters, e.g. CHRISTIANSEN 1944, SALOMONSEN 1950 and JOENSEN 1965. A very important report by DRENCKHAHN (1969) should, however, be mentioned. During an oil spill in September-October 1968 at Eiderstedt in the German Waddensea (about 50 km. south of the Danish-German border) several hundred seaducks killed by oil were examined and important data concerning the late wing-feather moult of the females were collected.

Results

In this chapter the results of the study in 1966–1972 concerning *S. mollissima, M. fusca, M. nigra, A. marila* and *M. serrator* are presented. The amount of data is very large particularly from aerial surveys and other observations, and it has neither been possible nor reasonable to give all the details here. The description of the species is thus very much summarized (e.g. on maps) and the text only contains primary information of special interest. The following items will be treated in the extent to which data is available: A) The pattern and sequence of the moult migration. B) The distribution and numbers moulting in Danish waters. C) The age- and sex-composition and the time of the moult. D) The moulting habitat.

EIDER *(Somateria mollissima)*

Throughout the year *S. mollissima* is by far the most widespread and numerous diving duck in Danish waters. The Danish breeding population has increased considerably in the last decades, and in 1970 comprised about 7,500 pairs, of which two-thirds bred in three colonies (Christiansø in the Baltic Sea, Saltholm in the Øresund, and Samsø in the S. Kattegat) (JOENSEN 1973). However both during moulting and wintering seasons the Danish breeding population is greatly outnumbered by eiders breeding in the Baltic Sea (Sweden and Finland), which have their principal wintering areas in Danish waters (PALUDAN 1962), and also by birds breeding in S. Norway, recently demonstrated to be wintering in the N. Kattegat (MARTINSEN & HAGEN 1970, 1972). The population during winter (November–February) in Danish waters exceeds half a million (PALUDAN 1962, and unpublished count data), and large concentrations are found in all waters except the SE. parts of the country, the Limfjord and along the W. coast of Jutland N. of Blåvand (JOENSEN 1968).

Depending on the climatic conditions of the winter, eiders tend to scatter in late February or early March, and in March migration towards the breeding areas begins. In most years the majority of eiders leave Danish waters for the Baltic Sea in the beginning of April, corresponding to

a peak in northward movements at Kalmarsund in Sweden about the middle of this month (SVÄRDSON 1958, 1959, RODEBRAND 1972b). Both in Denmark (particularly S. Sealand) and Scania migrating eiders often cross land (SWEGEN 1972). The Danish breeding eiders start laying in the first or second week of April.

Each of the three categories: juveniles (1-year old birds), adult males and adult females has its own pattern of moult migration, pre-moult distribution and moult. Therefore each category is described separately, starting with adult males, for which our present knowledge is better than for the two other categories.

Adult males (⩾ 2-year old birds)

Moult migration and pre-moult distribution

In late April and early May the number of eiders of all categories in Danish waters is at its lowest level. In late April adult birds are found near the breeding colonies, but elsewhere the numbers are very small. At the largest Danish colony on Samsø, adult males have been observed in numbers corresponding to the breeding population (about 2,000 pairs) until the first week of May, but later in this month they gradually disappear and presumably move to some of the nearby moulting areas. Two important moulting areas (the Waddensea and Svanegrunden in the S. Kattegat) have been surveyed in May 3–4 times during the study period, and the number of adult males comprised 10–20 % of the numbers moulting here about two months later.

In the early part of June the majority of adult males breeding in the Baltic Sea are still present there (ALMQUIST & ANDERSSON 1972). But from the middle of the month a slight increase in numbers has been noted in several Danish waters, particularly in the Belts and the Kattegat in areas known as typical winter haunts (see Fig. 3) whereas adult males only comprise 5–20 % of the birds in the juvenile roosting areas in the southeastern waters. In some areas both adult males and juvenile birds are equally well represented (S. Kattegat and S. Funen archipelago), but as a whole the two categories are well separated in May and June. A few observations indicate that a large proportion of the increase in numbers of adult males in early June is due to sub-adult birds (2–3 years old, without fully developed adult plumage, see Appendix 2, notes). In the Waddensea and Svanegrunden the number of birds had doubled since May, and adult males comprised 85–90 % and 50–60 % respectively of the birds present there.

In the last days of June and early July a rapid increase in the number of adult males has been recorded in most of the important moulting areas (see Fig. 4), and all the birds which moult there from late July have arrived by around the middle of the month. In the Waddensea and Svanegrunden the mid-July population has been recorded as 3–6 times higher than the mid-June population, and about 5–10 times higher than the mid-May population. This notable and rather rapid increase in the numbers of adult males coincides with many observations of large scale movements. At Kalmarsund, a distinct peak in southbound migration has been recorded in the last week of June and first days of July (SVÄRDSON 1958, 1959, RODEBRAND 1972a, 1972b), and in the last week of June and the first week of July a great number of observations have been made

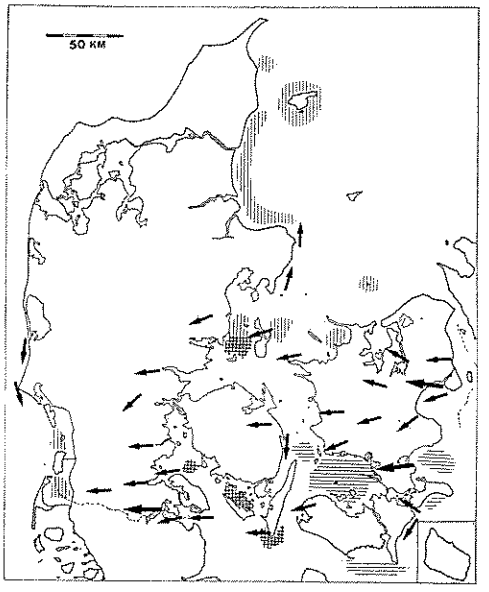

Fig. 3. The principal pre-moult roosting areas (May–June) of *S. mollissima* (vertical hatching ad. ♂♂, horizontal hatching juveniles). Arrows indicate localities where moult migration in May–July (including all categories of eiders) has been observed (mostly across land).
Fig. 3. De vigtigste rastepladser i maj–juni for ederfugle (lodret skravering gamle hanner, vandret skravering juvenile fugle). Pile viser steder, hvor fældningstræk er observeret i maj–juli, omfattende alle kategorier af ederfugle.

of adult male eiders moving through Danish waters, and often crossing land on a westbound migration. Movements across S. Jutland have been described by BEHRENDS (1955, 1966) and ROED (1971), and in later years very many observations have been made in other parts of the country, particularly in E. and S. Sealand and adjacent islands (see Fig. 3). The eiders often congregate into flocks of hundreds or even a few thousand before crossing the shoreline. Crossing mainly takes place at dusk and dawn at rather high altitudes. In late June and early July about 90 % of the eiders passing Blåvandshuk, predominantly on a southbound migration, are males (PETERSEN, in press).

The moult distribution and numbers

The map Fig. 4 shows the distribution and numbers of moulting eiders recorded in the present study. In all the main concentration areas, adult males comprise the great majority (95–99 %) of the birds recorded in July-August. Therefore the map first and foremost illustrates the distribution and numbers of this category. The figures on the map refer to the largest numbers recorded, but since they represent minimum numbers present in the area surveyed and some large parts of our waters have been insufficiently covered (see page 7) the map only gives a minimal picture of the distribution and numbers.

During the moult, adult male eiders are widespread and extremely numerous in several areas in Danish waters. The main concentration areas are:

1) The Waddensea. 30,000 moulting birds have been recorded in successive years. Most birds moult in waters S. of Rømø (around the little island of Jordsand and partly in German territorial waters E. of the island Sylt), but substantial numbers are also found between Rømø and Mandø. Also further south in the German Waddensea, substantial numbers of adult males have been recorded during the summer, e.g. 11,500 at Amrum and Föhr on 7. Sept. 1969 (DRENCKHAHN 1969). Further south at Eiderstedt, however, the oil-kill in Sept.–Oct. 1968 showed little evidence of the presence of adult males in this area (DRENCKHAHN 1969).

2) The North Kattegat. Moulting eiders have been recorded in many parts of the N. Kattegat, and as mentioned earlier (see page 7) the species is probably more widespread and numerous than indicated in Fig. 4. The largest concentrations have been found in areas S. and SE. of the island Læsø. This area was surveyed by aircraft in four successive years (1968–

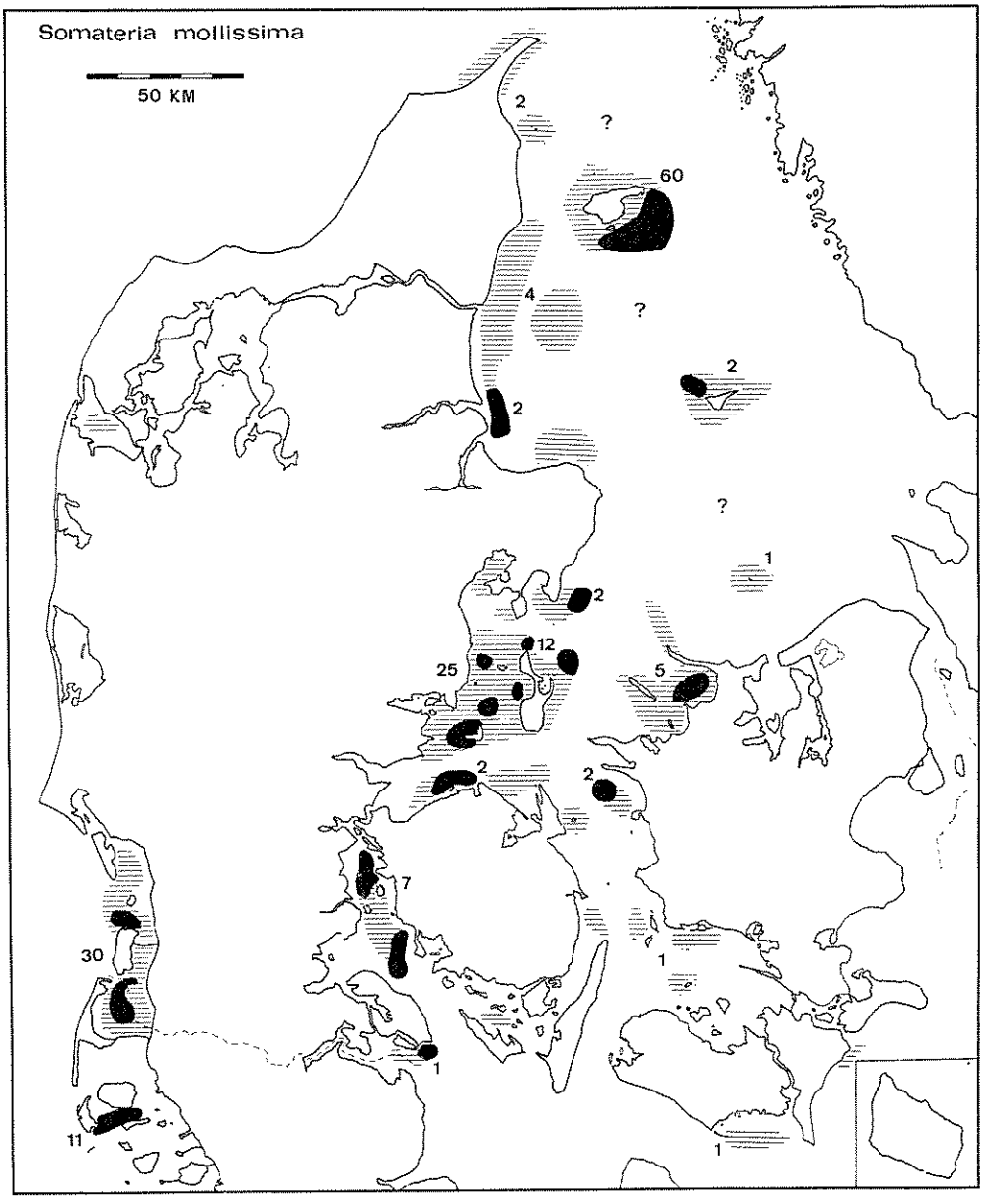

Fig. 4. Moulting distribution of *S. mollissima* in July–August. Black: areas with large concentrations. Hatching: areas with smaller numbers, found less regularly. Numerals indicate maximum numbers recorded in thousands.
Fig. 4. Udbredelsen af fældende ederfugle i juli–august. Sort: områder med store koncentrationer. Skraveret: områder med spredte bestande mere uregelmæssigt. Tal angiver de maksimale antal registreret (tusinder).

71), but only in two of the years were the very large concentrations found (5. Aug. 1968 60,000, 6. Aug. 1969 33,000), whereas the numbers recorded on one flight in 1970 and two in 1971 were around or below 10,000. In our view the most obvious reasons for the low numbers recorded were that weather conditions on the three last mentioned flights were not perfect, and/or that the birds were present in other parts of the N. Kattegat, of which virtually only a small part could be covered (see Fig. 2). One cannot however exclude the possibility that the number of moulting birds varies from year to year. Moulting eiders have also been recorded in other parts of the N. Kattegat totalling about 10,000–15,000 birds.

3) SW. Kattegat. Between Sealand, Funen and the E. coast of Jutland moulting eiders have been recorded in nearly all areas, including several notable concentrations. The most important moulting area is Svanegrunden (about 15,000 birds in successive years) but at Tunø Knob, Endelave, Issehoved, Vejrø, Ærbelø, Hjelm and in Sejerø Bugt large concentrations have also been recorded on most flights. The total number of birds is estimated to be about 40,000.

4) Other waters have only been surveyed a few times, and the information is insufficient. In the Lillebælt about 8,000 moulting eiders have been recorded, and in the Northern Storebælt about 2,000, whereas other parts of the southern and southeastern waters only have a few scattered and relatively unimportant moulting areas with probably less than 5,000 birds.

From addition of the above-mentioned figures, approximately 160,000 eiders (mainly ad. ♂♂) are estimated to moult in Danish waters in late July and August. In the Waddensea and the S. Kattegat the number of birds has been quite consistent during the study period, whereas numbers in the N. Kattegat are more questionable in this respect. Altogether the above total figure must however be considered to represent the minimum number of birds moulting in Danish waters. The eiders breeding in Denmark only account for a relatively small proportion of the birds, while much larger numbers derive from breeding grounds in the Baltic and presumably also S. Norway. The size of the breeding populations in these areas is not known. ALMQUIST & ANDERSSON (1972) estimated the population in some of the most important areas in E. Sweden to be 80,000 pairs, and it is known that numbers in Finland are also extremely high. No doubt a large proportion of the adult males from the Baltic Sea spend the moulting period in Danish waters. However an unknown number of birds moult in home waters (ALMQUIST & ANDERSSON 1972, CARLSSON 1962, JÖGI 1970).

Time of moult

Adult males are present on moulting grounds about mid-July but very few flightless birds have been observed at this time. The majority of birds lose their wing feathers almost simultaneously in the last week of July and first week of August. On 23.–26. July 1970 65–75 % of the birds in the Waddensea were flightless, and on 4.–6. August 1970 practically all birds at Svanegrunden were flightless. The earliest adult males flying on new wings were recorded about 20. August, and in early September practically all birds are flying. Of 957 birds bagged in October only two (both 17 months old) were still flightless (Table 3), and the average wing length in birds from October (N = 16) was only 1 % less than in birds from later months (N = 177). In November the average wing

length (N = 28) was 0.3 % less than in birds from later months (N = 149). The few adult males found in the Eiderstedt oil-kill (German Waddensea) in September–October 1968 had fully developed wing feathers (DRENCKHAHN 1969).

In June–September 1970–71 41 male eiders were collected in various moulting areas, mainly at Rømø in the Waddensea (13) and at Svanegrunden (16). In both areas old males with fully developed plumage (3 years old or more) were dominant (22 birds), but also five 2-year and two 1-year old birds were collected.

Adult females

Moult migration and pre-moult distribution

In the later half of April and first half of May, adult females are closely linked to the breeding grounds and in this period extremely few have been recorded more than a few kilometres away from the colonies. Later in May females with their broods scatter over larger areas and are often found many kilometres from nearest colony. At the same time flocks of females without broods have been recorded in several areas, and both the number of flocks and their size increase during June. Most flocks have 10–30 birds, but occasionally as many as 200–300 have been observed. The total number of flocking females without broods cannot be estimated, but it is relatively small. The flocks probably consist mainly of birds from Danish and other nearby colonies, which have either lost their eggs or young at an early stage. A few observations in June indicate that some juvenile (12–13 months old) females join the flocks and probably some non-breeding (24–25 months old) females also do.

During the mass migration of adult males in late June and early July (see page 11), most flocks observed in detail contained only a small proportion of females, on average probably of the order of 10–15 %. Considering the magnitude of this migration the number of females in Danish waters is however estimated to increase considerably. After the migration of adult males has stopped around mid-July, females continue and peak numbers have been observed on Sealand and in S. Jutland in the last week of July and first half of August. At Kalmarsund a peak in southbound eider migration has been observed from late July to mid-August comprising a large proportion of females (S. RODEBRAND, pers. comm.).

The moult

Moulting female eiders have been recorded in nearly all Danish waters. In late July and early August the number of females observed in several of the principal moulting areas shown on Fig. 4 (solid black) is extremely small, ranging from 1 % to 5 % of the total number of birds present. The female populations here are known to increase slightly during August, but most of the females moulting in Danish waters spend the flightless period singly or in small flocks scattered over much larger areas of water. This distribution pattern makes it virtually impossible to estimate their numbers in aerial surveys. and it is impossible to assess the total number in Danish waters. A tentative calculation based on the fact that 1) the Danish breeding population about 1970 was 7,500 pairs, 2) many thousand females move into Danish waters together with

adult males in late June – early July, and 3) probably even more females arrive during the peak of their moult migration in late July and August, suggests that tens of thousands of females moult in Danish waters.

A few moulting females have been recorded about 10. August, but most birds lose their wing feathers in the period 20. August–20. September. This was demonstrated by DRENCKHAHN (1969), who examined the state of moult in 136 adult females killed by oil in the German Waddensea in Sept.–Oct. 1968. All birds were still growing new wing feathers, and about 30 % were not yet able to fly. Among 696 birds shot in October in Denmark 13 (1.9 %) had not yet lost their wing feathers, and 39 (5.6 %) were moulted and not yet able to fly (Table 3). Even in November two birds unable to fly were found among 214 birds examined. In October the average wing length in birds presumably able to fly (wing > 22 cm.) was 8 % less (N=190) (1.-15. Oct. 10 %, 16.-31. Oct. 4 %), and in November 1.5 % less (N = 75) than in birds from later months (Dec.–Feb., N = 265) (see Table 4 and Fig. 5). From the available data it is seen that adult females moult their wing feathers over a longer period, and approximately one month later, than adult males.

Of ten specimens collected in the period June–October 1970 8 were old females with broad oviducts, and two were about 15 months old birds with narrow oviducts

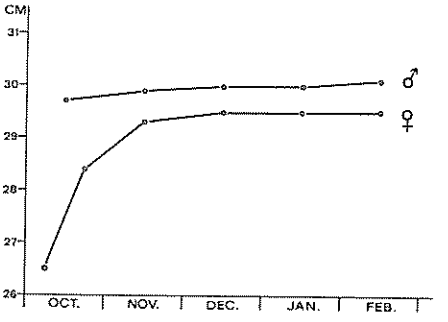

Fig. 5. Average wing length of moulted *S. mollissima* able to fly on new wings (wing > 22 cm.) in the months October–February. Birds bagged by sportsmen: 193 ♂♂, 530 ♀♀.
Fig. 5. Den gennemsnitlige vingelængde hos fældede ederfugle, som var i stand til at flyve med nye svingfjer (vingen > 22 cm). Fugle nedlagt under jagt: 193 ♂♂, 530 ♀♀.

Period	No. examined	No. flightless[1]) (+ not yet moulted)	Additional wings measured		No. in interval mm.				
			No.	Length mm. average	221–240	241–260	261–280	281–300	>300
Periode	*Antal undersøgt*	*Antal afslået[1]) (+ endnu ufældet)*	*Yderligere vinger målt Antal*	*Gensn. længde mm*	*Antal i interval*				
1–15. Oct.	414	19(+3)	122	265	12	31	60	16	3
16–31. Oct.		8(+2)	68	284	1	6	18	37	6
November	140	–	75	293	–	1	7	49	18
December	207	–	111	295	–	–	5	90	16
January	220	–	40	295	–	–	–	35	5
February	316	–	114	295	–	–	4	82	28

Table 4. Wing moult and measurements of adult ♀♀ *S. mollissima* in the shooting seasons 1970/71–1972/73, see also Fig. 5. [1]) wing size max. 220 mm. (For method of measuring the wing see THOMSON (1964) p. 450).
Tabel 4. Vingefældning og vingemål hos voksne ederfuglehunner i jagtsæsonerne 1970/71–1972/73, se også Fig. 5. [1]) Vingen højst 220 mm lang.

(Appendix 2). Since the breeding origin of the individual specimens is not known, nothing certain can be said about which categories perform moult migration from the Baltic Sea into Danish waters in July–August. One may assume that unsuccessful breeders make up the majority, but also sub-adult non-breeders and even successful breeders which have left their young may be represented in this group.

Juveniles (13–17 months old)

Moult migration and pre-moult distribution

While the number of adult eiders in Danish waters is notably reduced in April when only the relatively small local breeding population remains, the juvenile birds stay to a great extent within Danish waters throughout spring and summer. In late April and early May large concentrations of juvenile birds have been recorded. In 1969 (after the very good production year of 1968) altogether tens of thousands were seen, and in other years several thousand birds have been observed. In June the number of juveniles increases, presumably due to the immigration of birds which left Danish waters during the spring migration. The distribution of juvenile birds in May–June is shown in the map Fig. 3, and it is seen that apart from a few areas which overlap, juvenile birds are distinctly separated from adult males, and the largest numbers are found in the SE. parts of the country, in waters which in other seasons contain very small numbers of eiders.

The peak number of birds in the juvenile pre-moult concentration areas is found between mid-June and mid-July, and occasionally in late July. Several observations indicate that during May and June juvenile males and females are mixed and present in approximately equal numbers.

In the course of July the juvenile birds start moving away from the pre-moult concentration areas. In some areas the immigration took place during most of the month, and in other cases all birds left within a few days very late in the month. In S. Jutland there is good evidence that juvenile birds cross land on a westbound migration simultaneously with adult females in late July and early August, but sufficient information seems to be lacking from other parts of the country. This may be due to the fact that juvenile birds cross the islands to a lesser extent than adult birds, and perform most of their movements in smaller concentrations over the sea.

The moult

Moulting juvenile eiders are found in several waters. Juvenile males have in some cases been observed together with adult males in the main moult concentration areas (see Fig. 4), but most of them, as well as most if not all of the juvenile females, are widely scattered over large bodies of water. The total number of juvenile eiders moulting in Danish waters cannot be estimated on the basis of aerial survey data from the moulting period itself. Counts in pre-moult concentration areas indicate that in some years some tens of thousands are present. However the number will vary much from one year to another in accordance with the production in the previous breeding season.

The late migration movements, the state of wing moult in the few collection specimens examined, and the material of birds bagged in October (only two of the 17 months old birds were still flightless) indicate that juvenile males moult a little later than adult males, but have on the

whole completed development of new wing feathers by early October. For juvenile females there is virtually no information available, but it is suggested that both sexes have their main moult period from mid-August to mid-September.

Moult habitats and habits

The distribution pattern seen in Fig. 4 (mainly covering adult males), shows that the main moulting areas are found in very shallow areas. Most of the very large concentrations are found around small shoals and underwater banks with depths of 1–2 and seldom more than 5 metres. The distribution pattern is very similar to the winter distribution of the eider, but during winter very large flocks are more often found in deeper water.

As mentioned earlier female and juvenile eiders usually moult singly or in small groups scattered over vast areas of water, while adult males congregate in very large flocks. Several observations indicate that in the early morning the adult males are scattered over large areas, probably following feeding dispersal during night, while during daytime they gather in extremely dense flocks (often about 1 bird per m^2.), and often many thousand birds together (up to 40,000 in one flock). In the Waddensea, which is the only area with a typical tide (in the southern part approx. 2 m. difference between ebb and flood) eiders tend to disperse for feeding during high tide and concentrate in dense flocks during low tide, when they often sit on dry sand banks, a habit very seldom seen in other waters.

After the flightless period the eiders often stay in or near the moulting areas, although in less dense concentrations. The immigration of birds from the main breeding areas in the Baltic Sea starts in late September and continues to the middle or end of November.

VELVET SCOTER *(Melanitta fusca)*

The velvet scoter does not breed in Denmark but is a common and locally numerous winter visitor in Danish and other N. European waters. The main concentrations in Denmark are found in the Kattegat, the Storebælt and the Lillebælt. Velvet scoters start spring migration later than eiders and common scoters (see page 10 and 22). Large flocks can still be seen in Denmark around the middle of May, and at Kalmarsund in SE. Sweden the northbound migration peaks at this time too, although birds can be seen moving as late as the beginning of June.

Moult migration

In late May and early June the number of velvet scoters in Danish waters is very small, and mainly consists of males which are presumably not yet fully mature birds. From late June and in July an increase in numbers has been recorded in several waters, and late in the month the birds concentrate in the moulting areas. The increase in June and early July is mainly due to adult males, but also females and

juvenile birds have been recorded in the moulting areas, particularly in the later part of this period. Little is known about movements through Danish waters. The few observations of birds crossing land (Sealand and S. Jutland) give no indication of peaks or lows in the migration intensity. It is suspected that the lack of records is caused by the fact that movements mainly take place during night.

At Kalmarsund in SE. Sweden southbound migration has been observed from mid-June onwards to November, and the intensity curve shows several indistinct peaks and lows. The first peak falls in middle and late July, followed by very low intensities. In the course of August large numbers move south, and this peak again is followed by a period with low numbers around 1. September. It is suggested that the two peaks are dominated by adult males and adult females respectively, but the data available is too scarce for definite conclusions. Later in the autumn (from late September to late November) large scale movements take place at Kalmarsund, at least in the later part of this period including the young produced in the summer on their way to the winter quarters (SVÄRDSON 1958, 1959, RODEBRAND 1972a, 1972b).

Moult

Adult males

The distribution of moulting areas and maximum numbers recorded in late July and August are shown in the map Fig. 6. The most important moulting area is in the central part of the Limfjord (Løgstør Bredning) where large concentrations of up to 16,000 birds have been recorded in several years during the study period. Notable numbers also moult each year north of Djursland and in the Sejerø Bugt, whereas the concentrations at Læsø and west of Samsø seem less constant. In addition to these areas which hold thousands of velvet scoters in dense concentrations, smaller flocks of up to a few hundred have been recorded more or less regularly in many other waters. The minimum number of birds present in the moulting areas shown in Fig. 6 in late July and August is about 45,000. At this time adult males comprise probably 80 % or more of the birds seen in the flocks.

Adult male velvet scoters moult at roughly the same time as adult male eiders. In the very last days of July 1970 it was estimated that one-third of the birds in the Limfjord were still able to fly, and in other areas practically all birds were fligthless in the period 5.–10. August. Observations and one collection specimen indicate that the wing is fully grown by the end of August. 22 males killed by oil in Sept.–Oct. 1968 in the German Waddensea all had full new wings (DRENCKHAHN 1969), and among 134 adult males shot in October in Denmark only one bird was still flightless (Table 3).

Adult females

Adult females apparently arrive later than adult males. They have been recorded in several of the moulting areas of adult males, but also in many other waters. They mostly occur in small assemblies scattered over large water bodies, and therefore it has not been possible to estimate the total number moulting in Danish waters. No doubt the population amounts to several thousand birds.

Flightless adult females have been col-

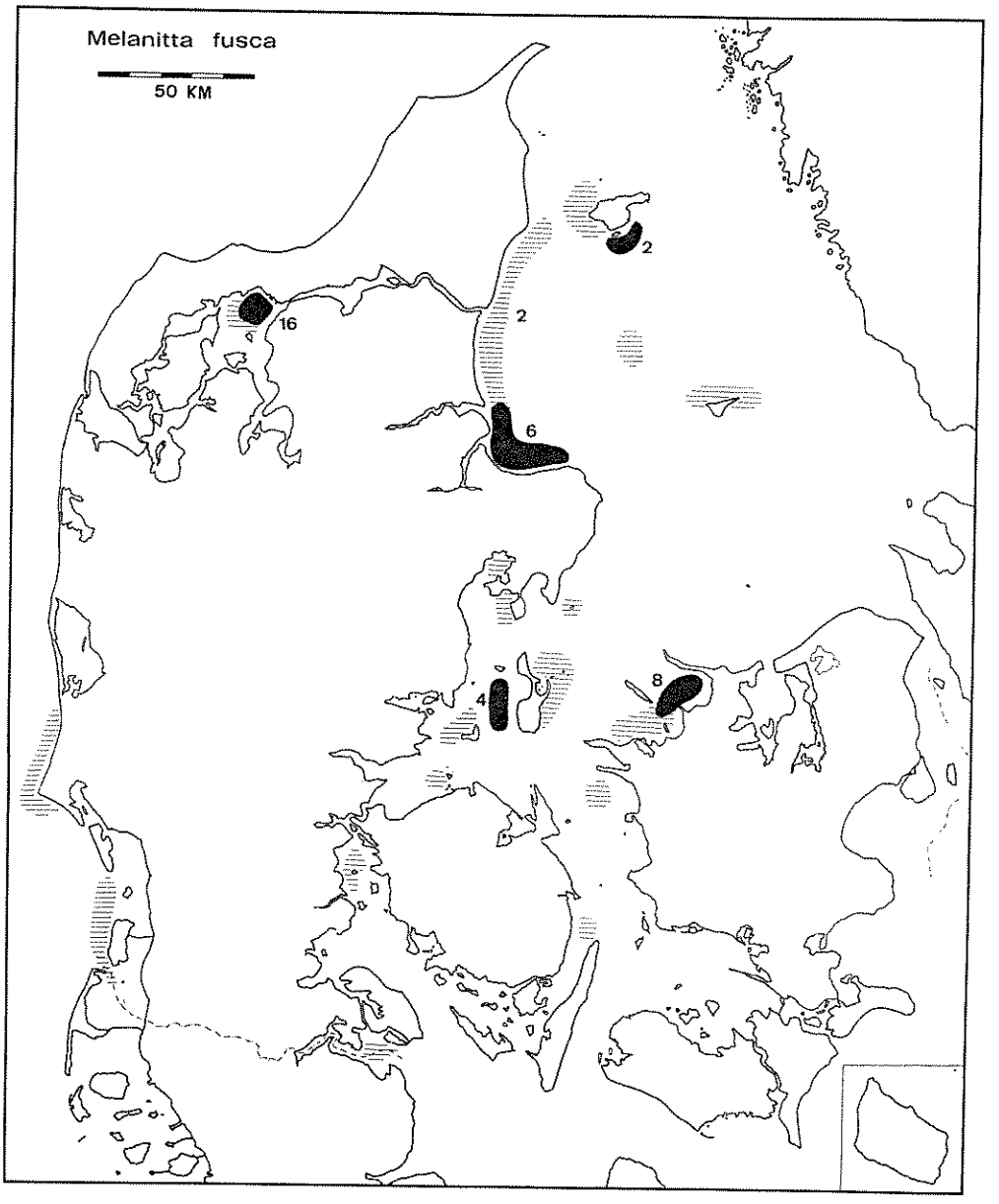

Fig. 6. Moulting distribution of *M. fusca* in July–August. Black: areas with large concentrations. Hatching: areas with smaller numbers, less regularly occurring. Numerals indicate maximum numbers recorded in thousands.
Fig. 6. Udbredelsen af fældende fløjlsænder i juli–august. Sort: områder med store koncentrationer. Skraveret: områder med spredte bestande mere uregelmæssigt. Tal angiver det maksimale antal registreret (tusinder).

lected as early as 6. August, but most birds start moulting about one month later than the adult males i.e. in late August and early September (Appendix 2). 16 ad. ♀♀ killed by oil in Sept.-Oct. 1968 in the German Waddensea all had wings with primaries less than 3/4 of their full length (DRENCKHAHN 1969). Of 59 birds shot in October in Denmark one had not yet lost its wing feathers and 17 (total 31 %) had not yet attained new wing feathers enabling them to fly (Table 3). Flightless adult females have been recorded as late as 21. Oct. (Appendix 2).

Juvenile birds (12–17 months old)
The data available concerning the moult migration and first wing moult of one-year old birds is too scarce for detailed conclusions (see Appendix 2, notes on field characters). Among specimens in the collections three juv. ♂♂ were present in June, and 1 juv. ♂ was flightless in early August.

Moult habitats and habits

The main moulting areas of the velvet scoter are all with one exception also typical winter haunts, although the species frequents more waters and larger areas during the winter months. The exception is the Limfjord, where the number of wintering birds is usually very small. During the flightless period velvet scoters are mostly found in very shallow water with depths of less than five metres. In early morning hours the birds are much more scattered than later in the day, and feeding probably takes place mainly during night and dawn. During daytime fligthless adult males are often seen in huge dense flocks (up to 10,000 birds were recorded in one single flock in the Limfjord), whereas females are mostly much more scattered. Small numbers of flightless birds have occasionally been observed sitting on sand banks north of Djursland.

After the moult the males leave the Limfjord in Sept.–Oct., but in other areas the birds stay throughout the autumn and numbers here are increased in Oct.–Nov. by the immigration of birds from the Baltic.

COMMON SCOTER *(Melanitta nigra)*

The common scoter is one of the most numerous migratory waterfowl in Northwest Europe, but little is known of the winter and moult distribution. The species is more confined to open water far from coasts than other seaduck species treated here, and also the fact that most of the migratory movements probably take place during night is responsible for the scarcity of information. In the present report it is attempted to summarize the existing knowledge concerning the moult migration, and for Denmark the information obtained in 1963–1972 concerning the wing-feather moult. It must however be stressed that in many respects our knowledge is still very sparse, and some of the theories presented here need to be checked in the future.

The common scoter does not breed in Denmark, but is a very abundant winter visitor. Large concentrations can be found particularly in the Northern Kattegat and in the North Sea off SW. Jutland. Impor-

tant wintering areas have also been recorded further to the southwest in Europe (BAUER & VON BLOTZHEIM 1969 p. 295), and although the numbers recorded here are rather small, it is most probable that Danish waters in general hold the northernmost relatively small fraction of the Western European wintering population.

Movements and distribution during April–June

From the middle of March migrating common scoters have been recorded along the W. coast of Jutland, but in other waters movements normally start 2–3 weeks later. In April large scale movements through Danish waters (and occasionally across land) have often been recorded, at Skagen (N. Jutland) mostly in a NE. direction (DANTOFT et al. 1971), and elsewhere more or less due east. In the eastern parts of Denmark (Sealand) migration diminishes in the first week of May, and there are few records of movements later than 10. May. At Kalmarsund northward spring migration has been observed between 20. April and 20. May, and peak numbers are mostly seen in the days around 1. May (SVÄRDSON 1958, 1959, RODEBRAND 1972a, 1972b). In S. Finland a mass migration in a NE.-E. direction takes place from 10. May to the end of the month, and the total number passing has been estimated at 1.5 million birds (BERGMAN & DONNER 1964).

Data from aerial surveys show that during the spring migration period the number of adult males and females in Danish waters decreases notably, and in the eastern parts of the country movements stop in early May. In the North Sea and the Kattegat there is a simultaneous increase in the number of juvenile birds (11–12 months old), which in the middle of June comprise a minimum of 50–80 % (and occasionally 90 %) of the birds in the large flocks recorded (see Appendix 2, notes on field characters). Aerial surveys in June are not sufficient to estimate the total number of common scoters present in Danish waters, but observations of more than 30,000 birds along the W. coast of Jutland and several thousand in the Kattegat, as well as of large flocks crossing the Jutland peninsula in both easterly and westerly directions indicate the presence of quite substantial numbers. The available information shows that a large number of juvenile common scoters stay within Danish waters throughout the spring and summer.

Moult migration during July–September

The mass movement of common scoters on moult migration in Northern Europe has been described by several authors. In Finland large scale movements have been recorded in July-August (PYNNÖNEN 1941). The movements in Estonian SSR have been described by JÖGI (1970, 1971). Here in most years the migration is seen from mid-July and through August. Observations in 1968 indicated that several hundred thousand birds passed both land and sea. The strongest migration was recorded in the evening and during night, and radar studies showed that a large proportion flew so high that they could not be observed from the ground.

At Kalmarsund and Ottenby in SE. Sweden the number of common scoters recorded on southbound migration in the summer months is much smaller than in

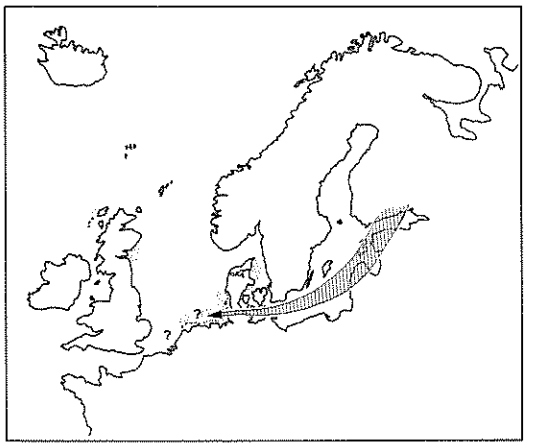

Fig. 7. The main moult migration route from the Baltic and the known and probable main moulting areas of *M. nigra* in the North Sea area.
Fig. 7. Hovedvejen for fældningstræk fra Østersøen og de kendte og formodede fældningsområder for sortand i Nordsøområdet.

Estonia. There is very little migration in May–June, followed by an increase in July and large numbers pass during August–September. There are peaks and lows in the intensity, but when comparing different years the picture becomes rather confusing. This might indicate considerable variation from year to year, but it seems more probable that the relatively small migration along this part of the Swedish coast does not always illustrate the typical features of the main migration, which no doubt passes through the Baltic Sea further south (see Fig. 7). However, a common feature of the Swedish data is that migration in late August is less intensive than both before and after (SVÄRDSON 1958, 1959, RODEBRAND 1972a, 1972b, EDELSTAM 1972).

In Denmark and southernmost Sweden, moult migration of the common scoter in July–August is a very well-known phenomenon. Although movements across land mostly take place during dusk and night, the birds are often recorded by the wing-beat sound and the characteristic voice, which in Denmark long ago gave rise to the onomatopoetic name »gyvfugl« (fugl = bird). A large number of published and unpublished reports show that »gyvfugle« are recorded in all parts of Denmark, both over the sea and crossing land. Large numbers have been observed in the southernmost parts of Denmark (PREUSS 1957, and other information), and also large flocks have been seen in the Fehmarn Belt between Lolland and Fehmarn (BAUER & VON BLOTZHEIM 1969).

However the most intensive migration has been recorded across the southern part of the Jutland peninsula, particularly at Schlei south of the Danish-German border. JØRGENSEN (1941) has described this phenomenon. Movements have been seen from early July to the end of August, and occasionally in early September. Most flocks comprise 75–200 birds, but during peak migration numbers reach 500–2000. On good days many large flocks can be seen at the same time. Most migration takes place during evening and night.

In northern West Germany there are several other reports on migrating common scoters (BAUER & VON BLOTZHEIM 1969). Of special interest is the report from the island Wangerooge (by H. R. HENNEBERG in BAUER & VON BLOTZHEIM) 1950–61. Movements start about 10. June, increase in strength about ten days later, and decrease in August with a new peak late in this month. Early in the period day-totals were 500–2000 birds, but during

peak migration 1000–2000 birds per hour were recorded. The birds flew from NE. and ENE. towards W. In 1952 the total number of common scoters passing Wangerooge was estimated at one million, of which males comprised about 75 %.

Little information on the age- and sex-composition in the July–September moult migration is available. This is due to difficulties in identifying the different categories at the heights and times of the day in which birds mostly move. The following general pattern is suggested from aerial surveys of roosting areas in Denmark and other observations, although further data are most desirable for final conclusions. In June most birds moving are juveniles (see page 22), while in July and in the first half of August adult males comprise the majority of birds on moult migration. In early August adult females are also seen and the impression is that they increase in number in late August and particularly in September.

Moult distribution

Moulting common scoters have been recorded in most Danish waters (see Fig. 8), but the most important grounds are found in the North Sea.

The North Sea

In 1963 aerial surveys were conducted over waters west of the Danish Waddensea, and ground observations were made along the west coast of Jutland further north (JOENSEN 1965). The main results of this study were: On 5. June large concentrations were seen off Rømø. On 16. June there were at least 50,000 (95% ♂♂) birds still flying in the same area. On 29. July an estimated 100,000–150,000 birds were recorded from aircraft west of Fanø, Mandø and Rømø. They were nearly all flightless, and females comprised less than 10 %.

In most years of the study period 1966–72, aerial surveys have been conducted in coastal waters of W. Jutland (Table 1, Appendix 1), and additional observations have been made from the shores, including search for feathers. Moulting common scoters can be found along the entire west coast of Jutland from Skagen in the north to Rømø in the south. In most years only few and small flocks are found north of Blåvandshuk. Far more important are the waters south of Blåvandshuk, where the large concentrations were found in 1963. The flights conducted in 1966–72, however, resulted in much fewer birds than in 1963. The largest number was recorded in 1967 (20,000), but in all other years less than 10,000 were found. There are several possible reasons for the discrepancy between findings in 1963 and in later years:

1) The aerial surveys in 1963 were conducted during perfect weather, but on most later flights conditions were not perfect, which may have caused considerable underestimation of the numbers present in the areas covered (see page 6).

2) Off SW. Jutland there are more than 1,300 km². of water with less than 15 m. depth, areas which seem suitable for moulting common scoters. In all flights (also in 1963) virtually only a small proportion of this area was covered, and large numbers may thus have been overlooked.

3) The numbers recorded on moult migration indicate that the moulting population is extremely large, comprising several hundred thousand birds. Very little information is available on the moulting distri-

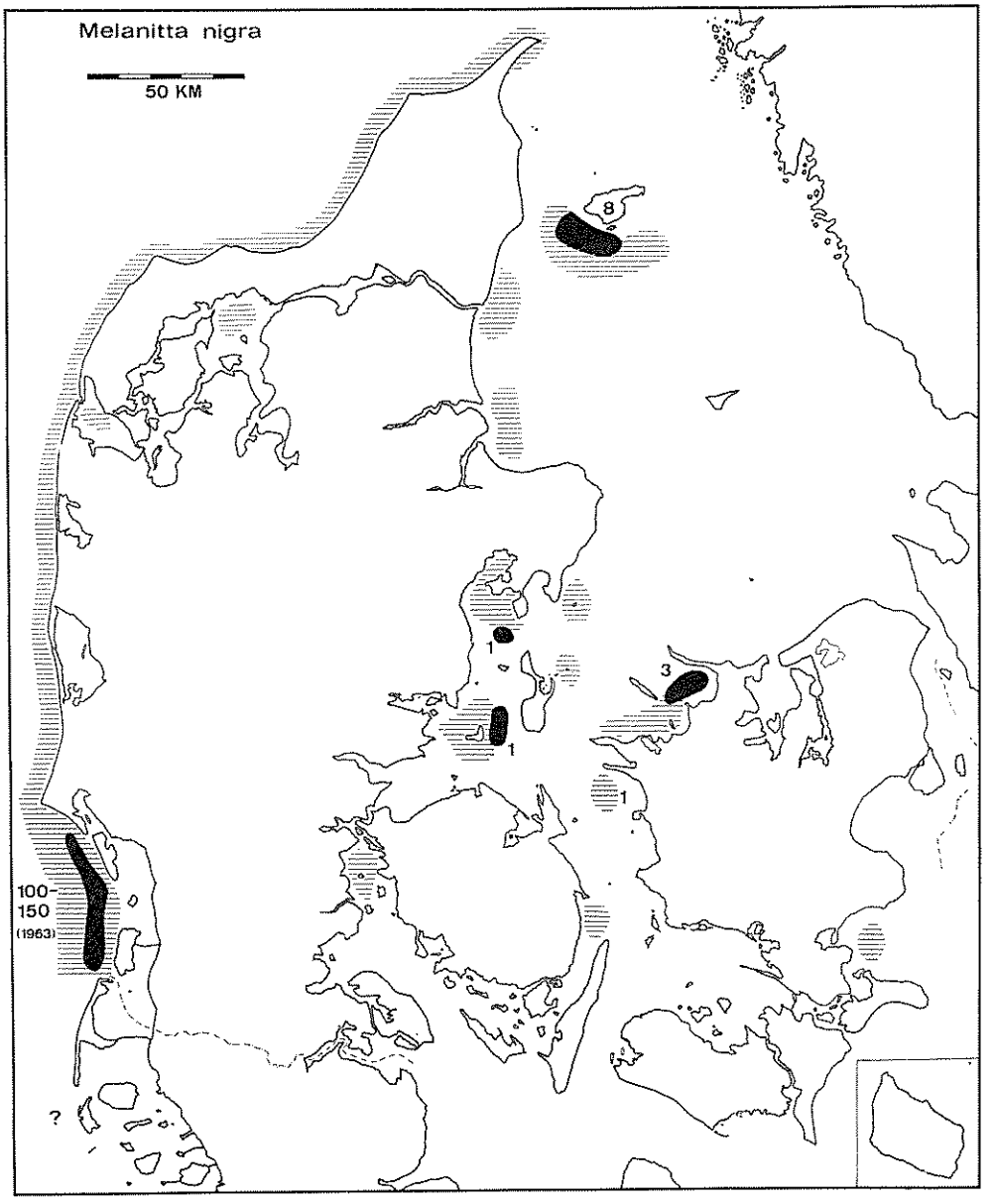

Fig. 8. Moulting distribution of *M. nigra* in July–August. Black: areas with large concentrations. Hatching: areas with smaller numbers found less regularly. Numerals indicate maximum numbers recorded in thousands.

Fig. 8. Udbredelsen af fældende sortænder i juli–august. Sort: områder med store koncentrationer. Skraveret: områder med spredte bestande mere uregelmæssigt. Tal angiver de maksimale antal registreret (tusinder).

bution of these large numbers, but it is likely that Danish territorial waters in general only comprise the northernmost relatively small fraction of the moulting populations. The location of the main moulting areas can only be guessed. Observations of the moult migration indicate that the birds are heading towards areas further south in the North Sea, but there is astonishingly little evidence of moulting here. Only relatively small numbers of flightless common scoters have been recorded (DRENCKHAHN 1969, BAUER & VON BLOTZHEIM 1969). In our opinion this may be due to the lack of aerial surveys over offshore waters. In the Danish moulting areas most birds have been found so far from the coasts that during (and often also before and after) the flightless period they could not possibly have been recorded from the nearest coasts. One might expect that large numbers of feathers on the shores would indicate moulting in the neighbourhood. However particularly in the southern part of the North Sea, the currents and tides could scatter the feathers over vast areas and thus leave very little evidence on the beaches. Large stretches of water in the southern North Sea seem suitable as moulting areas, and whether large numbers of moulting common scoters are to be found here or not, only aerial surveys in the future can tell.

The Kattegat and adjacent waters

Moulting common scoters have been observed in several places in the interior Danish waters, particularly in the Kattegat (Fig. 8). In July–August the largest numbers have been observed at Læsø (up to 8,000) and in waters around Samsø (up to 10,000 in several areas). The number of birds however varies from year to year, and in July–August the total number probably does not exceed 20,–30,000.

Time of moult

Juvenile birds

In early June large numbers of common scoters have already gathered in the North Sea moulting areas, and there is good evidence that juvenile birds predominate. In 1963 females comprised less than 5 %, but in later years their proportion was found to be higher (15–20 %). As early as June, wing feathers have been found on the shores of NW. Germany (DRENCKHAHN 1969), and on Rømø (1966, 1968, 1971) findings of light brown primaries and secondaries in late June and early July show that many juvenile birds start their moult much earlier than in the other seaduck species treated here. About mid-July a large proportion of the birds are flightless. Only four specimens were available for examination: two flightless ♂♂ in early July and mid-September resp., and two ♀♀ – one still with old wing feathers in late July and one flightless in late October. This small material suggests that the moult in juveniles covers a rather long period, and that females moult later than males. However more data are needed for further conclusions.

Adult males

In July and August the number of adult males increases by immigration (see page 22). Findings of blackish primaries and secondaries including the characteristic 10th primary (2nd outermost) along the W. Jutland coast show that wing moult starts about 20. July. Furthermore, observations show that the majority of birds already present are flightless in mid-

August. Most birds are able to fly on new wings in September (DRENCKHAHN 1969), but occasionally flightless birds are seen in early October (Table 3, Appendix 2).

In August, many small flocks capable of flying and with males predominating have been observed roosting in all Danish waters. Presumably these flocks consist of both 14-months old males, which have completed their wing-feather moult, and older males which either have not yet started or already have completed their moult.

Adult females

The main immigration of adult females to the moulting areas takes place in September. The first moulting birds have been observed early in that month, but most birds lose their wing feathers from mid-September to mid-October. Among the 230 birds killed by oil in the German Waddensea (DRENCKHAHN 1969) in this period, 21 % still had the old wing feathers, 70 % had recently lost them and were flightless, and only a few percent were flying again on new wings. It was demonstrated that immigration of birds which had not yet moulted took place in late September and early October. More than half of the birds shot by Danish sportsmen in October (mostly in the Kattegat and adjacent waters) were flightless, and a few individuals were still unable to fly in November–December (Table 3). See also Appendix 2.

In September–October, moulting adult females have been observed in all Danish waters, particularly in the Kattegat. During the moult, the birds are found singly or in small widely scattered groups. The total number can therefore not be assessed with any accuracy, but it is estimated that several thousand, maybe some tens of thousands, of adult females spend their flightless period in Danish waters.

Moult habitats and habits

The moulting areas of the common scoter are further out at sea and mostly in deeper waters than those of the other seaduck species treated in this report. In 1963 most birds in the North Sea were found between four and ten kilometres from the nearest coasts (depth 3–8 m.), and in 1966–72 moulting flocks have occasionally been found about 13 km. from the coast (depth 10–12 m.). In late July 1962 some dense flocks with 2000–5000 birds were observed, but the general impression from both 1963 and later years is that the moulters in July–August mostly occur in flocks of a few hundred to one thousand birds. Adult females are generally widely scattered during their wing-feather moult.

After the moult, flocks of common scoters can be found in all Danish waters, although the main concentrations are often seen in or near the moulting areas. At Blåvandshuk in W. Jutland, where continuous observations have been made over several years, large numbers are often seen moving, mostly towards the south in compensatory movements following current drift. Thus on 21.–22. September 1968 70,–90,000 common scoters were recorded here (Feltornithologen 1968 p. 165). The autumn migration into Danish waters mostly takes place in November.

SCAUP *(Aythya marila)*

The scaup is a very abundant winter visitor to Denmark and in recent years a few records of breeding in the SE. part of the country have been made. The winter visitors leave Danish waters in April, although a few flocks remain until the middle of May.

During surveys in the summers of 1966–1972 few observations of this species were made. The map Fig. 9 shows the distribution of moulting birds recorded. The small dots indicate flocks of less than 25 birds recorded in July–September; in several cases adult males were recognized to be present, and the information (see below) shows that their moult often takes place in September simultaneous with ad. ♀♀ and thus later than in other seaducks. Compared with other species of diving ducks the number of adult male scaup moulting in Danish waters is however negligible, probably not exceeding a total of a few hundred birds.

In the southern part of the Limfjord (Lovns Bredning) a regular moulting area for adult females exists. These birds arrive in September, and during the latter part of this month and the first half of October they complete their wing moult. The moulting area was reported for the first time in 1969, but may well have been overlooked in previous years, and in 1969–1971 the number of birds varied from 500 to 1000.

In 1970 the wings of 26 birds shot by sportsmen in the first few days of October in Lovns Bredning were examined, comprising 19 ad. ♀♀ (all flightless), 4 ad. ♂♂ (3 flightless, 1 with new wings) and 3 juv. (3–4 months old). In the collection of Game Biology Station there are three specimens from Lovns Bredning 23. Sept. 1971 (2 ad. ♀♀, one flightless, one with new wings, both with broad oviduct, 1 ad. ♂ flightless), and one from Holbæk 5. Oct. 1971 (ad. ♀ not yet moulted, oviduct broad).

The first autumn migrants in Danish waters are recorded about 1. September, and later in this month large flocks are frequently to be seen. The presence of juveniles from the same year among the moulting adult females shows that the moult migration is in fact part of the true autumn migration of the species.

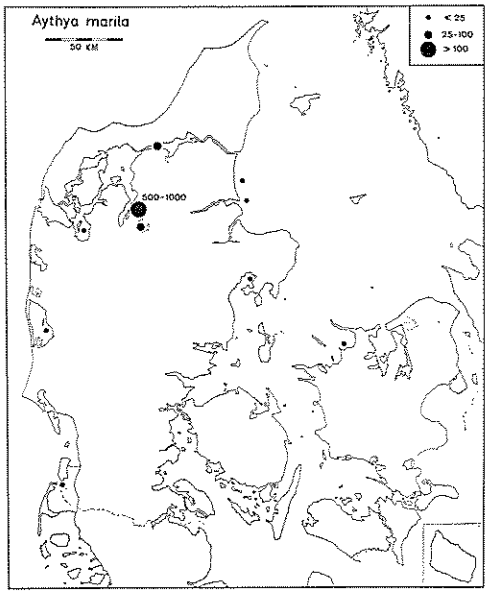

Fig. 9. The distribution of moulting *A. marila* in July–October.
Fig. 9. Udbredelsen af fældende bjergænder i juli–oktober.

RED-BREASTED MERGANSER *(Mergus serrator)*

The red-breasted merganser is a common breeder along most coasts in Denmark, and locally also in fresh-water areas. The species is mostly resident, and many birds breeding in the Baltic and Norway presumably winter in Danish waters (SALOMONSEN 1967).

Pre-moult distribution

During the summer surveys of 1966–72 red-breasted mergansers were recorded in all Danish waters. In the pre-laying period in May, most birds seen were in pairs and very small assemblies, but flocks of 25–150 birds also occurred in several waters, particularly the Limfjord and the Kattegat. In June (the principal incubation month) single individuals and very small flocks were dominant but in the Limfjord as many as 7–800 birds were seen together.

The non-distinctive summer plumages and the shyness of the mergansers (outside the flightless period they also often dive and scatter when disturbed) makes sex- and age-determination in the field rather difficult. A few good observations indicate that in the large flocks seen in late May and in June in the Limfjord adult males are dominant, while juvenile birds are often seen in the smaller assemblies in other waters.

The moult

In late June and July broods can be observed in great numbers in nearly all waters, and at the same time the flocks in the Limfjord grow rapidly. The map Fig. 10 shows the distribution in July–August of flocks with more than 100 birds. Assemblies of 50–100 have also been indicated, whereas smaller congregations (mostly broods) which have been recorded in practically all waters, are not included.

The main moulting concentrations have been found in the Limfjord. In Løgstør Bredning around the island of Livø about 6,000 birds have been counted in several years during 1966–72, and smaller flocks have been found in several other parts of the Limfjord. The total number of birds moulting in flocks in the Limfjord amounts to about 8,000. In Ringkøbing Fjord, at Læsø, east of Mariager Fjord, and at Gylling Næs and Endelave in the Kattegat moulting flocks with several hundred birds have also been recorded regularly. The total number of birds moulting in flocks is about 12,000, but it is probable that in waters around Funen and Sealand in particular some concentrations have not been recorded.

In the Limfjord and the Ringkøbing Fjord, observations show that peak numbers are present in the moulting areas in mid-July. Already at this time a few flightless birds are to be seen, but most birds lose their wing feathers very late in July and in the first half of August. On 29.–30. July 1970 six birds were collected in Løgstør Bredning in the Limfjord, all ad. ♂♂ of which five had just lost their wing feathers, while one bird was still able to fly with old feathers. Both in the Limfjord, the Ringkøbing Fjord and the S. Kattegat visual observations show dominance of adult males, although juvenile birds have also been recorded.

In the early morning (and presumably also during the night), the moulting birds are often widely scattered and generally found on very shallow water (less than 2 m.) near the coasts. During the day they tend to concentrate and move to deeper water further away from the

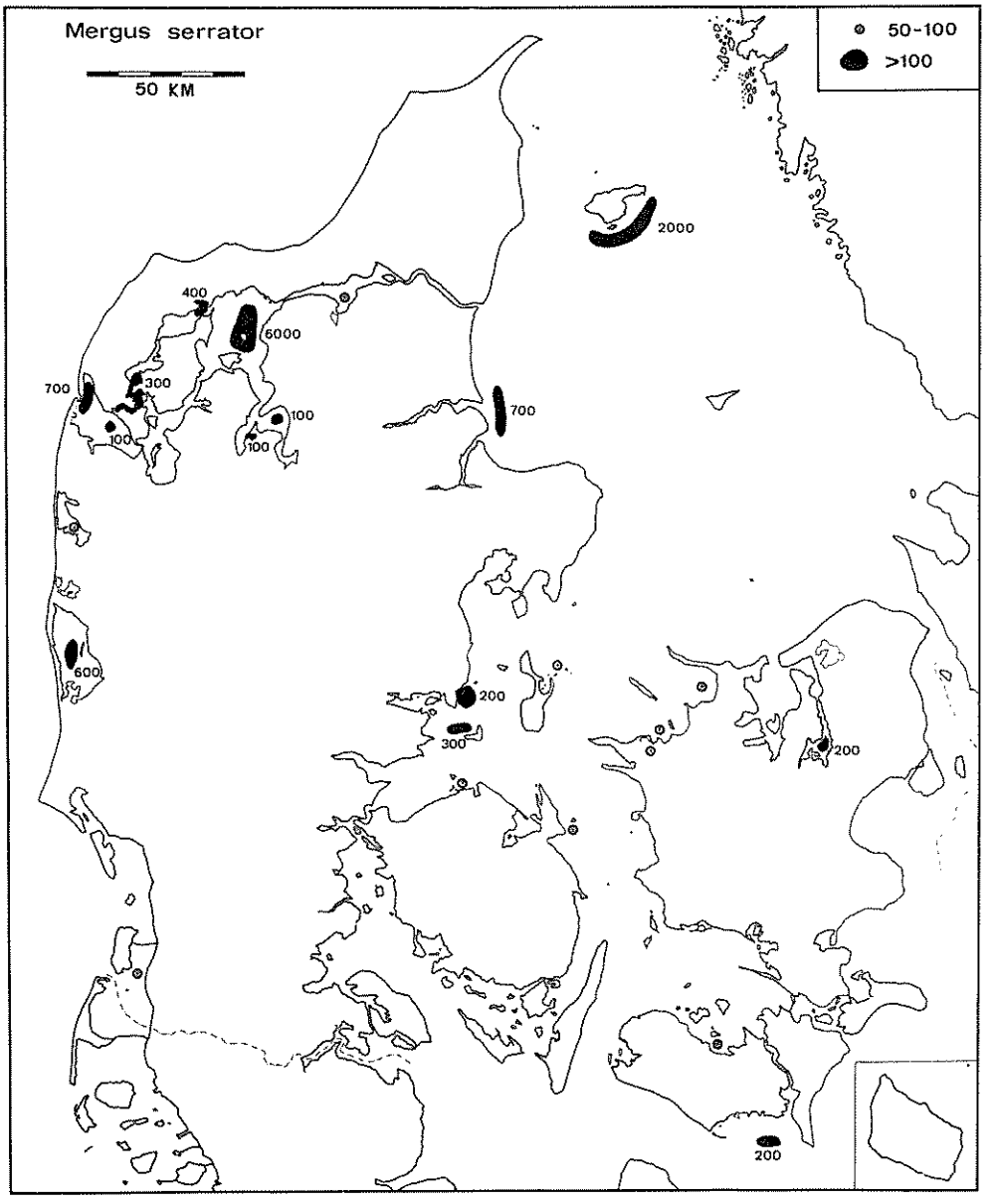

Fig. 10. The distribution of concentrations of *M. serrator* moulting in July–August. Black: more than 100 birds. Circle with dot: 50–100 birds. Smaller flocks (mostly broods) are not indicated. Maximum numbers recorded are given.

Fig. 10. Udbredelsen af større flokke af toppede skalleslugere fældende i juli–august. Sort: mere end 100 fugle. Cirkel med prik: 50–100 fugle. Mindre flokke (oftest kuld) er ikke vist. Det maksimale antal registrerede fugle er anført.

shores. The main daytime roosts in Løgstør Bredning are found about 4 km. from the nearest coast, in water of 6–10 m. depth. When disturbed they dive and scatter very rapidly.

Adult females do not concentrate during their wing moult, but are found widely scattered in all Danish waters. In July and most of August many birds still flying with old wing feathers have been observed, and presumably most adult females are flightless from the end of August to mid-September. 29 adult females examined at game dealers in October (1968–1972) all had well developed new wing feathers.

The breeding origin of the red-breasted mergansers moulting in Danish waters is not known with certainty, but it is very likely that most of them come from nearby (i.e. mostly Danish) breeding areas. The Danish breeding population is not known but probably amounts to some thousand pairs, and it can account for at least the majority if not all of the birds moulting from late July to mid-August. The adult females moulting later are presumably all local breeding birds.

Summary and discussion

The presence during summer of wing-moulting seaducks in Danish waters has been known for many years, but in several respects the previous knowledge was very insufficient. This was the background for the survey by the Game Biology Station, which started in 1966 and as far as the general mapping is concerned terminated in 1972. The most important part of the study consisted of more than 200 hours of aerial survey. The use of aircraft is the only method by which a representative picture of the distribution and numbers of seaducks in Danish waters can be obtained. During the present study it was however found that weather conditions only seldom permit satisfactory estimates, and therefore the figures obtained in general not only represent minimum numbers but also often represent only a relatively small proportion of the birds present in the areas covered (see page 5–6). Furthermore some waters off southeastern Denmark were only superficially covered, and in some of the more extensive parts of the North Sea and the Kattegat large areas were omitted from the surveys (see page 7 and Fig. 2). As a whole the study can be characterized as being very extensive, covering six species over a very large area. Consequently many aspects which need more intensive and detailed studies have only been superficially covered. In the present report it has been attempted to summarize the existing knowledge on moult migration and the moult itself. It must however be stressed, firstly that the data obtained in the present study only gives a minimal description of the distribution and numbers of moulting seaducks in Danish waters, and consequently further studies probably will reveal more moulting areas and larger total numbers than have been found by the Game Biology Station in 1966–72; and secondly that several questions are still too sparsely illustrated to be answered, and that some of the theories presented here are based on rather little data and are thus certainly theories in the true sense of the word.

TIME OF MOULT MIGRATION AND MOULT

Fig. 11 gives a rough summary of the information presented in previous chapters concerning the time of the moult migration and the moult. The figure is based on both well-documented facts and theories.

Adult males

The main moult migration from foreign breeding grounds to the moulting areas in Danish and neighbouring waters takes place about 1. July *(S. mollissima)* or during July and early August *(M. fusca* and *M. nigra)*. August is the principal moult month for adult males of all species, and very few flightless individuals are found by early September. Adult males moult almost simultaneously and occur in larger and denser flocks than other categories.

Adult females

Some adult females arrive from abroad at the moulting areas during the peak moult migration of the adult males, but most come later, i.e. from late July to early October. The moult takes place 4–6 weeks later than in adult males. Both moult migration and moult cover longer periods than in adult males. The succession in which the three most numerous species migrate and moult is: *S. mollissima, M. fusca* and *M. nigra*. Around 1. Oct. most *S. mollissima* (and all *M. serrator)* have completed the wing moult, while a large proportion of *M. fusca* and most of the *M. nigra* (and *A. marila)* are still flightless. The adult female *A. marila* arrives in the moulting areas in September together with juv. birds on normal autumn migration, while in *S. mollissima, M. fusca* and *M. nigra* there is an interval of about one month between the latest moult migration of adult females and the first autumn migration of juv. birds. During the moult, adult females of all species except *A. marila* are found in most Danish waters, mostly widely scattered and occurring singly or in small groups.

Juveniles (12–18 months old)

A large number of juvenile *S. mollissima* and *M. nigra* (and possibly also *M. fusca)* stay in Danish or neighbouring waters throughout spring and summer. In May–July *S. mollissima* are mainly found in the SE. parts of Denmark, and in July and early August they move to the moulting areas. During the moult in August–September the birds are widely scattered.

In May–June most juvenile *M. nigra* are found in or near the main moulting areas in the North Sea, but vagrant flocks are seen in all other waters. Moulting takes place from late June to September, in males probably in the first part, and in females the later part of this period.

SIZE OF THE MOULTING POPULATIONS

The following numbers of seaducks have been estimated to moult in Danish waters:

S. mollissima: min. 160,000 ad. ♂♂, some tens of thousands ad. ♀♀, and after good production years tens of thousands juveniles. Total probably close to a quarter million.

M. fusca: Min. 45,000 ad. ♂♂, several thousand ad. ♀♀, and unknown but probably smaller numbers of juveniles. Total probably min. 60,000.

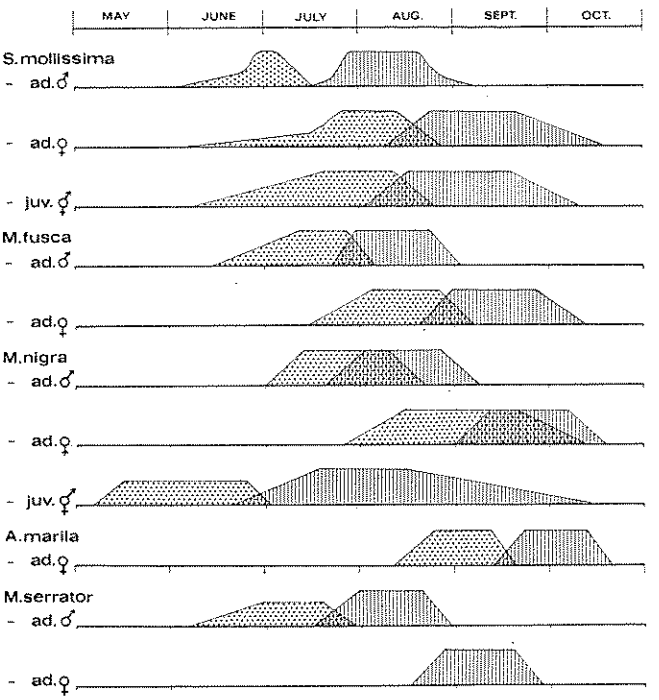

Fig. 11. The approximate periods of moult migration (dotted) and wing-feather moult (hatched) in the main categories of seaducks moulting in Danish waters.
Fig. 11. De omtrentlige perioder for fældningstræk (prikket) og vingefældning (skraveret) hos de vigtigste kategorier af havænder fældende i danske farvande.

M. nigra: In the North Sea up to 100,000–150,000 birds (mostly ad. ♂♂ and juv.) have been recorded in Danish territorial waters, but numbers moulting elsewhere (in the North Sea?) are probably much larger. In the Kattegat and adjacent waters the number of moulting ad. ♂♂ and juv. does not exceed 20,000–30,000, but in addition many thousands of adult females moult here. Total numbers in Danish waters up to 150,000–200,000.

A. marila: Max. a few hundred ad. ♂♂, and in addition 500–1000 ad. ♀♀ in one area in the Limfjord.

M. serrator: Min. 12,000 ad. ♂♂ moulting in flocks have been recorded, but many birds moult singly including some thousand adult females. Total about 20,000.

B. clangula: 12,–14,000, see Jepsen & Joensen 1973.

MOULTING HABITATS

In all the five species treated in this report, moulting takes place exclusively in a marine habitat. The summer roosting and moulting areas with a few exceptions are also typical haunts during autumn, winter and spring, although seaducks outside the moulting period have a much wider distribution in Danish waters. The exceptions are 1) the pre-moult roosting areas of juvenile *S. mollissima* in SE. waters where numbers found during winter are very low, and 2) the moulting areas of *M. fusca* in the Central Limfjord, where this species is very scarce outside the summer.

During the moult seaducks are mostly

found in very shallow water around shoals and underwater banks. The depth of the water is probably of importance, since the ability to dive may well be reduced during the flightless period. Feeding mainly takes place during night and dawn, when the birds are fairly scattered over areas with a depth of 1–3 m. During daytime they often move to deeper water, and adult males may congregate into large flocks with thousands or even tens of thousands of birds lying closely together. *M. nigra* is mostly found in much deeper water, e.g. in the North Sea at depths of 3–12 m.

In all moulting areas there is an abundance of food, including molluscs, the principal food of seaducks. The three typical shallow water bottom communities *(Macoma, Syndosmya* and *Venus,* PETERSEN 1918, THORSON 1957) are all represented in several of the most important moulting areas, and none of the seaduck species treated here apparently show particular preference for any of these communities. However most moulting areas of *S. mollissima* have a very rich epifaunal bottom element, including beds of blue mussels *(Mytilus edulis),* by far the most important food item for the eider (MADSEN 1954).

Most large concentrations of moulting birds are found several kilometres from the nearest coast, and there is a tendency for the birds to concentrate in waters where sea-traffic is reduced. In the Waddensea, most *S. mollissima* moult in areas where tidal currents make navigation very difficult, and in the North Sea the main moulting grounds of *M. Nigra* are found in military training areas, where sea-traffic is greatly limited. Waters south of Læsø in the Northern Kattegat are too remote for traffic by small tourist boats, and in many places too shallow for commercial fishing. The same is true of some important moulting areas in the Central and Southern Kattegat (e.g. Svanegrunden). The disappearance in later years of moulting seaducks from some areas in the Southern Kattegat where tourist boat traffic has greatly increased indicates that during the flightless period the birds are rather sensitive to disturbance.

Although the rapidly increasing traffic at sea causes some conservation problems for the bird fauna in general (e.g. disturbance on small islands during the breeding season), there are probably no immediate dangers for the moulting seaducks, which still have vast little disturbed and apparently suitable areas at their disposal in the remoter parts of Danish waters.

The population of *S. mollissima* moulting in the Waddensea is distinctly separated from that of *M. nigra* moulting in the North Sea further to the west. In the Kattegat, *S. mollissima, M. fusca* and *M. nigra* are often found in the same type of habitat, but although the two *Melanitta*-species are occasionally seen together, most birds are separated into flocks consisting of only one species.

THE IMPORTANCE OF DANISH WATERS AS MOULTING AREAS

The total number of seaducks moulting in Danish waters can only be roughly estimated. The data presented suggest close to 250,000 *S. mollissima,* a min. of 60,000 *M. fusca,* an order of 150,000–200,000 *M. nigra,* about 20,000 *M. serrator,* about 1000 *A. marila* and about 12,000–14,000 *B. clangula* (JEPSEN & JOENSEN 1973). The grand total for Danish waters is close to half a million seaducks, and in addition several hundred thousand *M. nigra* are thought to moult

in adjacent waters further southwest.

Danish breeding populations probably represent the majority of the moulting *M. serrator*, and a small proportion of the moulting *S. mollissima*. However the large majority of birds derives from foreign breeding grounds. Probably most of the adult male eiders breeding in the Baltic Sea moult in Danish waters, and in addition it is strongly suspected that some birds from S. Norway are present. The moulting *M. fusca* probably represent a very large proportion of the NW. European population, and the large numbers of *M. nigra* moulting in the North Sea also no doubt represent most of the birds breeding in N. Europe and possibly also W. Siberia.

The information presented in this report clearly illustrates the importance of Danish waters for huge numbers of moulting seaducks. The size of some of the concentrations is unique, and comparable only to a few other moulting concentrations in the world, such as the moulting areas of the shelduck *(Tadorna tadorna)* in the North Sea off NW. Germany, the assemblies of dabbling ducks in some areas of the Southern Soviet Union, and the congregations of eiders and king eiders *(S. spectabilis)* along the coasts of W. Greenland (SALOMONSEN 1968). In addition to diving ducks Danish waters have notable concentrations of moulting mute swans *(Cygnus olor)* (37,000 recorded in 1968 by ANDERSEN-HARILD (1971)).

There is a close connection between the abundance of moulters during summer and the huge concentrations of waterfowl occurring in Denmark and surrounding waters during autumn, winter and spring. Particularly for diving ducks Danish waters, during winter holding more than one million birds, are extremely important for the NW. European populations.

Dansk resumé

Havændernes fældningstræk og svingfjerfældning i Danmark.

I sommerhalvåret opholder store mængder af dykænder sig i de danske farvande, hvor de gennemfører svingfjerfældningen. Det drejer sig ganske overvejende om fugle fra yngleplads i de nordligere dele af Europa.

I årene 1966–72 gennemførte Vildtbiologisk Station en undersøgelse af havændernes fældningstræk og svingfjerfældning i Danmark. Oplysninger om fuglenes antal og udbredelse blev først og fremmest tilvejebragt gennem optælling over havområder fra mindre fly (56 flyvninger med i alt over 200 flyvetimer i maj–september, se Fig. 1 og 2, Tabel 1, Appendix 1), og der suppleredes med observationer fra kyst og båd. Desuden foretoges analyse af skindmateriale i museumssamlinger (Tabel 2, Appendix 2), samt fugle nedlagt af jægere og indhandlet til vildthandlere (Tabel 3 og 4). I denne rapport er fremlagt resultater vedrørende fem arter: Ederfugl, fløjlsand, sortand, bjergand og toppet skallesluger. Hvinandens forekomst er behandlet særskilt af JEPSEN & JOENSEN (1973).

Det samlede antal havænder, som fælder i danske farvande, er omkring en halv million. Dette og andre registrerede antal skal på grund af de vanskeligheder, der er forbundet med optælling af havænder i selve fældningsperioden, betragtes som minimumstal. For de enkelte arter er registreret og anslået følgende an-

tal fældende fugle: Ederfugl (Fig. 3 og 4) i alt ca. en kvart million (160.000 ad. ♂♂ registreret, titusinder af ad. ♀♀ og visse år også titusinder af juv. anslået). – Fløjlsand (Fig. 6) i alt ca. 60.000 (45.000 ad. ♂♂ registreret, flere tusinder ad. ♀♀ anslået, samt formentlig mindre antal juv. fugle). – Sortand (Fig. 7 og 8) i alt 150.000–200.000. I 1963 registreredes 100.000–150.000 i den danske del af Nordsøen, men det formodes at bestanden i andre dele af dette farvand er væsentlig større. Hovedparten af de fældende fugle er ad. ♂♂ og juv. fugle, men desuden fælder mange tusinde ad. ♀♀. – Bjergand (Fig. 9) i alt ca. 1000 fugle, hvoraf hovedparten er ad. ♀♀, som fælder i Lovns Bredning i Limfjorden i september–oktober. – Toppet skallesluger (Fig. 10) i alt henved 20.000 fugle, formentlig hovedsagelig lokale ynglefugle. Omkring 12.000 ad. ♂♂ registreret i flokke, desuden nogle tusinder ad. ♀♀ spredt.

Fig. 11 giver en forenklet oversigt over fældningstrækkets og svingfjerfældningens forløb hos de enkelte arter og kategorier. Gamle hanners træk foregår ret koncentreret omkring 1. juli (ederfugl) eller i juli og begyndelsen af august (fløjlsand og sortand), og fældningen gennemføres hovedsagelig i august. Gamle hunners træk og fældning strækker sig over længere perioder og falder 4–6 uger senere end hannernes (Tabel 3 og 4, Fig. 5). Hos sortanden er en betydelig del af de gamle hunner endnu i oktober ude af stand til at flyve. Ungfugle (et-årige) forbliver i vid udstrækning i danske farvande forår og forsommer (se f. eks. ederfugl Fig. 3). Fældningen strækker sig fra slutningen af juni til september hos de forskellige arter.

Hos ederfugl, fløjlsand og toppet skallesluger fælder hannerne i store og tætte flokke, mens hunnerne er spredt over store havområder. Hos sortand ligger både hanner og hunner oftest mere spredt.

De vigtigste fældningsområder ligger i lavvandede havområder, oftest flere kilometer fra kysten, og fuglene synes at foretrække havområder med ringe trafik.

Резюме на русском языке

Миграции на линьку и линька маховых перьев морских уток в Дании

В летнем полугодии большие количества нырковых уток находятся в датских водах, где происходит линька их маховых перьев. Речь идет главным образом о птицах из местностей гнездования в более северных краях Европы.

В течение 1966–72 г. Станция Исследования Биологии Дичи провела исследование миграций на линьки и линьки маховых перьев морских уток в Дании. Сведения о численности и распределении птиц главным образом были получены учетами над морскими пространствами с небольших самолетов (56 полетов общей длительностью более 200 часов с мая по сентябрь, см. фиг. 1, фиг. 2, табл. 1, приложение 1), и дополнялись наблюдениями с суши и с лодок. Кроме того был произведен анализ материала шкурок в коллекциях музеев (табл. 2, приложение 2), а также птиц, убитых охотниками и купленных торговцами дичью (табл. 3, табл. 4). В этой статье опубликованы результаты, касающиеся пяти видов: *Somateria mollissima, Melanitta fusca, Melanitta nigra, Aythya marila* и *Mergus serrator*. Наблюдения *Bucephala clangula* обсуждены в отдельной статье (JEPSEN и JOENSEN 1973).

Общее число линяющих в датских водах морских уток составляет около полумиллиона. Это число, как и другие зарегистрированные числа, следует рассматривать как минимум, ввиду затруднений, связанных с учетом морских птиц в течение самого периода линьки. По отдельным видам зарегистрированы и оценкой опре-

делены следующие количества линяющих особей:

Somateria mollissima (фиг. 3, фиг. 4) общим числом прибл. четверть миллиона (160.000 взрослых ♂♂ зарегистрированы, по оценке десятки тысяч взрослых ♀♀, а в некоторых годах, также по оценке, десятки тысяч молодых особей).

Melanitta fusca (фиг. 6) всего прибл. 60.000 (45.000 взрослых ♂♂ зарегистрированы, по оценке несколько тысяч взрослых ♀♀, и вероятно меньшее число молодых птиц).

Melanitta nigra (фиг. 7, фиг. 8) всего 150.000–200.000. В 1963 г. было зарегистрировано 100.000–150.000 в датской части Северного моря, но предполагается, что популяция в других частях этого моря значительно более многочисленна. Большинство линяющих птиц составляют взрослые ♂♂ и молодые особи, но кроме того линяют много тысяч взрослых ♀♀.

Aythya marila (фиг. 9) всего прибл. 1.000 птиц, из которых большинство является взрослыми ♀♀, линяющими в заливе Лоунс Бреднинг в Лимфиорде в сентябре и октябре.

Mergus serrator (фиг. 10) всего около 20.000 птиц, большинство котовых вероятно гнездует в той-же местности. Зарегистрировано около 12.000 взрослых ♂♂, встреченных стаями, а кроме того несколько тысяч рассеянных взрослых ♀♀.

Фиг. 11 показывает упрощенное обозрение хода миграции на линьку и линьки маховых перьев у отдельных видов и категорий. Миграции старых самцов происходят довольно концентрировано около 1 июля *(Somateria mollissima)* или в июле и начале августа *(Melanitta fusca* и *Melanitta nigra)*, а линька главным образом происходит в августе. Миграции и линька старых самок происходят в течение более длительных периодов, и на 4–6 недель позднее, чем у самцов (табл. 3–4, фиг. 5). У *Melanitta nigra*, значительная часть старых самок еще в октябре не способны летать. Молодые (годовалые) птицы в большом количестве остаются в датских водах весной и в предлетнюю пору (см. напр. фиг. 3). У разных видов линька продолжается с конца июня до сентября.

У *S. mollissima*, *M. fusca* и *M. serrator* самцы линяют большими и густыми стаями, между тем как самки рассеяны по обширным морским районам. У *M. nigra* как самцы, так и самки в большинстве случаев более рассеяны.

Главными районами линьки являются мелководные морские пространства, в большинстве случаев на несколько километров от берега, и кажется, что птицы предпочитают участки моря с незначительным корабельным движением.

Literature

Almquist, B. & Andersson, Å., 1972: Flygtaxering av gudingflockar *Somateria mollissima* – en metod att beräckna häckande ejderbestånd. – Vår Fågelvärld 31: 237–240.

Andersen-Harild, P., 1971: En undersøgelse af knopsvanens *(Cygnus olor)* fældningspladser i Danmark. – Dansk Ornith. Foren. Tidsskr. 65: 89–97.

Bauer, K. M. & von Blotzheim, G., 1969: Handbuch der Vögel Mitteleuropas. 3 Anseriformes 2 Teil. – Frankfurt am Main.

Behrends, O., 1955: Maritimt sommertræk over det østlige Sønderjylland. – Flora og Fauna 61: 1–16.

Behrends, O., 1966: Om ederfuglens *(Somateria mollissima* (L.)) sommertræk over Sønderjylland. – Flora og Fauna 72: 101–104.

Behrends, O. & Palm, B., 1950: Ederfugle *(Somateria mollissima* (L.)) på tidligt »fældningstræk«. – Dansk Ornith. Foren. Tidsskr. 44: 174.

Bergman, G. & Donner, K. O., 1964: An Analysis of the Spring Migration of the Common Scoter and the Long-tailed Duck in Southern Finland. – Acta Zoologica Fennica 105: 1–59.

Carlsson, C.-I., 1962: Höststräcket vid Torhamn 1957–58. – Vår Fågelvärld 21: 5–14.

Christiansen, A., 1944: Fugletrækket ved Jordsand. – Dansk Ornith. Foren. Tidsskr. 38: 129–162.

Dantoft, O., Hansen, P. L. & Zobbe, B., 1971: Systematisk liste over forårets fugle. – Dansk Ornith. Foren. Tidsskr. 65: 148–163.

Drenckhahn, D., 1969: Mauser und Vorkommen von Eiderente, *Somateria mollissima*, Trauerente, *Melanitta nigra*, und Samtente, *Melanitta fusca*, während der Ölpest im Herbst 1968 an

der Nordseeküste Schleswig-Holsteins. – Corax 3: 23–30.

EDELSTAM, C., 1972: The Visible Migration of Birds at Ottenby, Sweden. – Vår Fågelvärld, supplementum 7, 360 pp.

JEPSEN, P. U., 1973: Studies of the Moult Migration and Wing-feather Moult of the Goldeneye *(Bucephala clangula)* in Denmark. – Danish Review of Game Biology Vol. 8 no. 6, 23 pp.

JEPSEN, P. U. & JOENSEN, A. H., 1973: The Distribution and Numbers of Goldeneye *(Bucephala clangula)* Moulting in Denmark. – Danish Review of Game Biology Vol. 8 no. 5, 8 pp.

JOENSEN, A. H., 1965: En undersøgelse af Sortandens *(Melanitta nigra)* fældningsområder ved Jyllands sydvestkyst, sommeren 1963. Med bemærkninger om Gravandens *(Tadorna tadorna)* og Ederfuglens *(Somateria mollissima)* forekomst i det danske vadehav. – Dansk Ornith. Foren. Tidsskr. 58: 127–136.

JOENSEN, A. H., 1968: Wildfowl Counts in Denmark November 1967 and January 1968 – Methods and Results. – Danish Review of Game Biology Vol. 5 No. 5, 72 pp.

JOENSEN, A. H., 1973: Ederfuglen *(Somateria mollissima)* som ynglefugl i Danmark. – Danske Vildtundersøgelser 20, 36 pp.

JÖGI, A., 1970: Migration of the waterfowl in Estonia. – In »Waterfowl in Estonia« p. 47–62. – Tallinn.

JÖGI, A., 1971: Zum Mauserzug der Schellente *(Bucephala clangula)* und Trauerente *(Melanitta nigra)* in der Estnischen SSR. – Ornithologische Mitteilungen 23: 65–67.

JØRGENSEN, J., 1941: Sortandens *(Melanitta nigra)* Juli–Augusttræk. – Dansk Ornith. Foren. Tidsskr. 35: 137–143.

MADSEN, F. J., 1954: On the Food Habits of the Diving Ducks in Denmark. – Danish Review of Game Biology 2, part 3, p. 157–266.

MARTINSEN, M. & HAGEN, Y., 1970: Ringmerkning av forskjellige fuglearter i 1966 og 1967. – Meddelelser fra Statens Viltundersøkelser 2. Serie, nr. 34, 64 pp.

MARTINSEN, M. & HAGEN, Y., 1972: Ringmerkning av forskjellige fuglearter i 1968 og 1969. – Meddelelser fra Statens Viltundersøkelser 2. Serie, nr. 37, 61 pp.

PALUDAN, K., 1962: Ederfuglene i de danske farvande. – Danske Vildtundersøgelser 10. 87 pp.

PETERSEN, C. G. JOHS., 1918: The sea bottom and its production of fish-food. A survey of the work done in connection with the valuation of the Danish waters from 1883–1917. – Rep. Danish Biol. Stat., vol. 25, 62 pp.

PETERSEN, F. DALBERG, in press: Trækket af ænder *(Anatidae)* ved Blåvandshuk 1963–1971. – Dansk Ornith.Foren. Tidsskr.

PREUSS, N. O., 1957: Træk af Sortand *(Melanitta nigra* (L.)) ved Bøtø. – Dansk Ornith. Foren. Tidsskr. 51: 42–43.

PYNNÖNEN, A., 1941: Über den Zug der Trauerente, *Oidemia n. nigra* (L.), im inneren Finnlands. – Ornis Fennica 18: 36–39.

RABØL, J., 1967: Ederfugletræk. – Feltornithologen 9: 93.

RABØL, J. & NOER, H., 1970: Svømmefugletrækket ved Knudshoved, Østfyn. – Flora og Fauna 76: 1–18.

RODEBRAND, S., 1972a: Fågelsträcket gennom Kalmarsund 1962 och 1963. – Vår Fågelvärld 31: 247–251.

RODEBRAND, S., 1972b: Fågelräckningarna i Kalmarsund, 1972. – Calidris 1972: no. 2 p. 9–14, no. 3 p. 5–9, no. 4 p. 17–22.

ROED, U., 1971: Fældningstræk over Sønderjylland og ved Kalmarsund. – Flora og Fauna 77: 45–51.

SALOMONSEN, F., 1950: Oversomrende Sortænder *(Melanitta nigra* (L.)) ved Jyllands Vestkyst. – Dansk Ornith. Foren. Tidsskr. 44: 171–172.

SALOMONSEN, F., 1967: Fugletrækket og dets gåder. – 2nd ed. p. 128–144. – København.

SALOMONSEN, F., 1968: The moult migration. – Wildfowl 19: 5–24.

SALOMONSEN, F., 1972: Fugletrækket og dets gåder. 3rd ed. p. 134–153. – København.

SVÄRDSON, G., 1958: Sjöfågelsträcket i Kalmarsund. – Svensk Jakt 96: 135–137, 159.

SVÄRDSON, G., 1959: Sjöfågelsträcket i Kalmarsund 1958. – Svensk Jakt 97: 128–130.

SWEGEN, H., 1972: Ejderns *Somateria mollissima* sträck över land i södra Sverige. – Vår Fågelvärld 31: 183–190.

THOMSON, A. LANDSBOROUGH, ed., 1964: A New Dictionary of Birds. – London.

THORSON, G., 1957: Bottom Communities (Sublittoral or Shallow Shelf). – Treatise on Marine Ecology and Palaeoecology, vol. 1 p. 461–354. Geol. Soc. America, Memoir 67.

Appendix 1. Aerial surveys May–September 1963–1972.

For each flight the following information is given: a) date, b) weather conditions (I = poor, II = good, but not III = perfect, see also page 6), c) areas surveyed with degree of coverage indicated (1 = transect flight through the area or less than 25 % covered, 2 = coverage of 25–75 % of the area, and 3 = very complete coverage (75–100 %)), d) total flying time/survey time (hours:minutes). For division of Danish waters see Fig. 1.

1963 (see JOENSEN 1965).

16. June III, Aa2, Ab2, Ac2. (0:20/0:20).
29. July III, Aa2, Ab2, Ac2, Ad2, Ba2. (2:00/1:50).

1966

18. Sept. III, Bb2, Bc3, Bd3. (3:30/2:00).

1967

6. May II, Aa2, Ab2, Ac2, Ad2, Ba2, Bb2, Bc3, Bd3. (4:00/3:00).
7.–8. May II-III, Ca2, Cb2, Cc3, Cd2, Ce2, Cg3, Eb1. (6:05/5:30).
6. Aug. II, Aa2, Ab2, Ac2, Ad2. (2:00/1:50).
7. Aug. II–III, Ca2, Cb3, Cc3, Cd3, Ce3, Cf3, Cg3. (4:30/4:15).
8. Aug. III, Ba2, Bb3, Bc3, Bd3, Ca2, Cd3, Ce3, Ch3, Da2. (3:50/3:20).
29. Aug. II, Ma1, Oa1. (3:00/2:30).

1968

7. May I–II, Ca2, Cb1, Cc2, Cd2, Ce2. (2:55/2:45).
12. May II, Eb1, Ec2, Ef1, Ma1, Oa1. (6:00/5:00).
13. May I–II, Aa2, Ab2, Ac2, Ad2, Ba2, Bb1, Bc3, Bd3, Ca2. (3:45/3:30).
22. July III, Cf3, Eb2, Ef3, Fa1. (2:35/2:10).
5. Aug. III, Eb3, Ec3, Ed1, Ef2. (2:40/2:20).
9. Aug. III, Ca2, Cb3, Cc2, Cd1, Ce2. (2:25/2:20).
23. Aug. III, Fa2, Fb3, Fc3, Sb2. (2:45/2:35).

1969

11. May II, Ka3, Kb2, Ma2. (4:20/4:00).
13. May III, Fb2, Fc3, Sb3. (2:00/1:50).
22. May III, Eb2, Ec2, Ef2. (2:15/1:35).
6. June II, Ca2, Cb3, Cc3, Ce3, Cf3, Cg3. (4:55/3:50).
9. June II, Fb2, Ja2, Jb2, Jc2, Ka1. (2:30/2:20).
10. June II, Fc3, Ka1, Kb2, Ma2, Mb2, Na2, Oa3, Ob1, Sb1. (3:45/3:40).
19. June II, Cd2, Ce1, Cf2, Ch2. (2:45/2:00).
5. July I–II, Aa3, Ab3, Ac3, Ad2, Ba2, Bb2. (3:30/3:20).
16. July II, Ce3, Cf3, Ch2. (5:00/4:00).
22. July II, Ma2, Mb3, Na2, Oa3, Ob2, Sb2. (5:05/4:30).

Appendix 1. Oversigt over flytællinger maj–september 1963–1972.

For hver flyvning er anført: a) dato, b) vejrforholdene (I = dårlige, II = gode, men ikke III = perfekte, se side 6), c) områder undersøgt og dækningsgraden (1 = transekt flyvning gennem området eller under 25 % af arealet dækket, 2 = mellem 25 % og 75 % af arealet dækket, og 3 = mellem 75 % og 100 % af arealet dækket), d) total flyvetid og /tælletid (timer:minutter). Inddelingen af Danmark og omliggende farvande er vist på kortet Fig. 1.

25. July II–III, Fb2, Fd2, Ja3, Jb3, Jd3, Ka2. (3:40/3:20).
6. Aug. III, Eb2, Ec3, Ed1, Ee3, Ef3. (4:20/4:00).
13. Sept. III, Aa3, Ab3, Ac3, Ad3, Ba2, Bb3, Bc2. (6:35/5:10).
17. Sept. II–III, Ec1. (1:00/0:30).

1970

11. May II, Ea2, Eb3, Ec3, Ed1, Ee3, Ef3, Fa3, Fb2, Fc3. (5:35/5:00).
11. May I–II, Aa3, Ab3, Ac3, Ad3, Ba2, Bb3, Bc3, Bd3. (4:45/3:55).
12. May I–II, Fb3, Fd2, Fe2, Sa2, Sb3. (3:10/2:40).
12. May I–II, Ca3, Cb3, Cc2, Ce2, Cf3, Cg3. (6:00/4:40).
7. July II–III, Fa2, Fb2, Fc3, Fd2, Na1, Sb3. (5:25/4:15).
8. July II–III, Aa3, Ab3, Ac3, Ad1, Ba2, Bb2, Bc3, Bd3, Ca1, Cb1, Ce3, Cf3. (5:45/4:50).
25. July I–II, Aa3, Ab3, Ac2. (1:20/1:20).
29. July II–III, Cd1, Ce3, Cf2, Cg3. (2:25/2:20).
3. Aug. II, Fb3, Fc3, Fd2. (2:20/2:05).
18. Aug. I–II, Aa3, Ab3, Ac3, Ad3, Ba2, Bb3, Bc3, Bd3. (5:45/4:30).
26. Aug. II–III, Ea2, Eb2, Ec3, Ed1, Ee3, Ef3, Fa1, Fb1. (5:30/5:10).
12. Sept. II, Aa3, Ab3, Ac3, Ad3, Ba2, Bb3, Bc3, Bd3. (5:15/3:45).
28.–29. Sept. I–II, Ca3, Cb3, Cc3, Ce3, Cf3, Cg3. (8:35/6:30).
30. Sept. II–III, Fa1. (1:05/0:15).

1971

9. May III, Ca1, Cb1, Cc1, Cd1, Ce1, Cf1, Cg1, Eb1, Ec1, Ef1. (4:00/3:00).
9. May II, Jb1, Ka2, Kb2, Ma2, Mb2, Na1, Oa2, Ob2. (5:15/5:00).
13. May II, Aa2, Ab2, Ac2, Ad2, Ba2, Bb3, Bc3, Bd3, Ca2. (4:00/3:45).
19. May II, Fb3, Fc3. (3:00/2:55).
26. July III, Fa3, Fb3, Fc3, Fd2, Na1, Sb3. (5:05/4:00).
27. July III, Aa3, Ab3, Ac3, Ad3, Ba2, Bb3, Bc3, Bd3. (6:30/4:25).

28. July II–III, Ce3, Cf2, Ea2, Eb3, Ec3, Ed1, Ee3, Ef2. (7:15/6:15).
18. Aug. II–III, Ea2, Eb3, Ec3, Ed1, Ee3, Ef2. (5:55/5:15).

1972
31. May I–II, Fc3. (1:00/0:30).
29. Aug. III, Bb2, Bc3, Bd2. (2:45/1:45).
11. Sept. II, Cf2. (1:20/0:50).

Appendix 2. Collection specimens of *S. mollissima*, *M. fusca* and *M. nigra*.

Birds of more than 12 months age from June-September (all specimens) and October (only specimens with not fully developed new wings), are included. For each specimen the following information is given: a) date and year of collection, b) locality, c) sex and estimated age in months, d) state of wing moult (OW = old wing feathers still present, MW = wing moulted and the bird flightless, FW = fully winged with new feathers, the bird flying again), and e) in females the shape of the oviduct (broad/narrow indicates that the female has/has not laid eggs). The notes give information on the characters used for sex- and age-determination during summer.

Somateria mollissima ♂♂

Game Biology Station (41)
9. June 1970. Kalø Vig – Tunø. 3: 2 49 + months (OW), 1 13 months (OW).
17. June 1970. Kalø Vig. 1 49 + months (OW).
21. June 1970. Gerrild. 1 49 + months (OW).
18. July 1970. Hjelm. 2: 1 50 + months (OW), 1 38 months (OW).
24. July 1970. Rømø. 13: 8 50 + months (2 OW, 6 MW), 1 38 months (OW), 2 26 months (OW), 2 14 months (OW).
4.–5. Aug. 1970. Svanegrunden. 16: 13 39 + months (1 OW, 12 MW), 3 27 months (MW).
6. Aug. 1970. Kalø Vig. 2: 1 39 + months (MW), 1 27 months (MW).
2. Sept. 1970. Hjelm. 1 40 + months (FW).
19. Sept. 1971. Hjelm. 1 40 + months (FW).
27. Sept. 1970. Nr. Rønner. 1 40 + months (FW).

Zoological Museum (23)
26. June 1886. Smålandshavet. 1 13 months (OW).
27. June 1905. Issefjorden. 2: 1 13 months (OW), 1 49 + months (OW).
7. July 1905. Rørvig. 1 14 months (OW).
9.–10. July 1905. N. Sealand. 7: 3 14 months (OW), 2 26 months (OW), 2 50 + months (OW).

Appendix 2. Undersøgte skind af ederfugl, fløjlsand og sortand.

Der er kun medtaget fugle, som er mere end 12 måneder gamle og indsamlet i månederne juni-september (alle skind) og oktober (kun eksemplarer med endnu ikke fuldt udvoksede nye vinger). For hvert eksemplar er flg. oplyst: a) dato og år for indsamlingen, b) lokalitet, c) køn og anslået alder i måneder, d) vingens fældningsstadium (OW = gammel ufældet vinge, MW = vingefjerene tabt – fuglen ude af stand til at flyve, FW = ny vinge udviklet, fuglen atter i stand til at flyve), og e) hos hunner æggelederens form (bred/snæver viser at fuglen har/ikke har lagt æg). Noterne rummer oplysninger om køns- og alderskendetegn om sommeren.

18. July 1907. Storebælt. 1 14 months (OW).
23. July 1905. Issefjorden etc. 4: 2 14 months (OW), 2 50 + months (OW).
28. July 1918. Romsø. 1 14 months (OW).
4. Aug. 1903. Stensmark. 1 39 + months (MW).
15. Aug. 1934. Sejerø Bugt. 1 39 + months (MW).
18. Aug. 1919. Frederikshavn. 1 39 + months (MW).
25. Aug. 1919. Asâ, Jylland. 1 15 months (MW).
31. Aug. 1909. Frederikshavn. 1 39 + months (FW).
22. Sept. 1907. Issefjorden. 1 29 months (FW).

Somateria mollissima ♀♀

Game Biology Station (10)
3. June 1970. Kalø Vig. 1 ad (OW, oviduct broad).
18. July 1970. Hjelm. 1 ad (OW, oviduct broad).
24. July 1970. Rømø. 1 15 months (OW, oviduct narrow).
4.–5. Aug. 1970. Svanegrunden. 3 ad (OW, oviduct broad).
6. Aug. 1970. Kalø Vig. 1 15 months (OW, oviduct narrow).
10. Oct. 1970. NW. Sealand. 3 ad (MW, oviduct broad).

Zoological Museum (7)
26. Aug. 1905. Amager. 1 15 months (OW).
31. Aug. 1909. Frederikshavn. 1 ad (OW, oviduct broad).
22. Sept. 1907. Issefjorden. 4: 2 16 months (OW), 2 ad (MW).
3. Oct. 1962. Sjællands Odde. 1 ad (MW).

Melanitta fusca ♂♂
Game Biology Station (9)
17. June 1970. Kalø Vig. 5: 2 ad (OW), 3 12 months (OW).
29. July 1970. Livø. 2 ad (MW).
6. Aug. 1970. Kalø Vig. 1 14 months (MW).
20. Aug. 1971. Kalø Vig. 1 ad (FW).

Zoological Museum (2)
12. Aug. 1917. Jylland. 1 ad (MW).
28. Sept. 1903. Thisted Bredning. 1 ad (FW).

Melanitta fusca ♀♀
Game Biology Station (8)
6. Aug. 1970. Kalø Vig. 2: 1 ad (MW, oviduct broad), 1 ad (MW, oviduct narrow).
20. Aug. 1971. Kalø Vig. 1 ad (MW, oviduct narrow).
C. 10. Oct. 1970. NW. Sealand. 4 ad (MW, oviduct broad).
C. 10. Oct. 1969. Grenå. 1 ad (MW, oviduct broad).

Zoological Museum (3)
1. Sept. 1918. Kjerteminde. 1 ad (OW, oviduct broad).
5. Oct. 1903. Thisted Bredning. 1 ad (MW).
21. Oct. 1925. Limfjorden. 1 ad (MW, oviduct broad).

Melanitta nigra ♂♂
Game Biology Station (4)
5. July 1970. Uggerby, N. Jutland. 1 13 months (MW).
31. July 1970. Hjarbæk Fjord. 1 ad (OW).
5. Oct. 1971. Ribe. 1 ad (MW).
12. Oct. 1971. Ribe. 1 ad (MW).

Zoological Museum (5).
1. June 1908. Stensmark. 1 ad (OW).
23. Aug. 1912. Thisted. 1 ad (FW).
2. Sept. 1914. Lyngvig. 1 ad (FW).
13. Sept. 1903. Thisted Bredning. 1 ad (FW).
16. Sept. 1911. Nymindegab. 1 16 months (MW).

Melanitta nigra ♀♀
Game Biology Station (8)
13. Oct. 1970. NW. Sealand. 5 ad (MW, oviduct broad).
27. Oct. 1970. Randers. 2 ad (MW, oviduct broad).
5. Nov. 1971. Svanegrunden. 1 ad (MW, oviduct broad).

Zoological Museum (8)
25. July 1903. Fornæs. 1 14 months (OW).
11. Sept. 1912. Hals Barre. 1 ad (OW).
18. Sept. 1909. Thisted. 1 ad (OW, oviduct broad).
3. Oct. 1903. Thisted Bredning. 1 ad (OW).
7. Oct. 1912. Skagen. 1 ad (OW).
21. Oct. 1904. Kalvebod. 1 ad (MW, oviduct broad).
21. Oct. 1925. 1 17 months? (MW, oviduct narrow).
31. Oct. 1928. Sejerø Bugt. 1 ad (MW).

NOTES

Somateria mollissima

1) Age given in months calculated from hatching in May.

2) Age determination is based on the wing pattern: *Juvenile* (1-year old) birds retain at least some juvenile wing feathers until the wing-feather moult is nearly completed at the age of 15–16 months. A few upper wing coverts from the juvenile wing may remain till new primaries are about half grown, but they may also be totally absent, thus not enabling separation in females between 15–16 month-old and older birds. *Adult males* have been separated into three age groups. Birds which in May are two years (24 months) old have a broad blackish band on the fore-edge of the wing and most lesser wing coverts are dark (this character is easily seen in the field). After the moult at the age af 26–27 months, the new wing has a narrow dark band on the fore-edge (only rarely to be seen in the field) and white lesser coverts. At the age of 38–39 months this is replaced by a wing with an entirely (or almost) pure white fore-edge. In some cases skins from the 4+– year-old (48–50 + months) birds have been recognized by the pure white fore-edge not yet moulted, but in cases where these feathers were absent and/or new ones were developing, it was impossible to separate 3+-year-old birds from older ones (see Svanegrunden August contra Rømø July, 1970). *Females* are easily separated in two categories (juvenile and older birds) before and during most of the wing moult period, but difficulties arise when the new wing is developing (see above). No plumage characters have been discovered which enable certain separation between 1½-year-old and older females in the autumn. The presence of a

narrow oviduct indicates that the bird has not yet laid eggs, but this may also be the case in 2½-years or older birds. Before the wing moult juvenile females are most often easily distinguished from older birds in the field by their greyish-brown wings, in contrast to the reddish warm-brown wings of older females. It must however be emphasized, that wings of old females in May–July are faded and often very worn, and in most birds the two white wing bands on the secondaries and secondary coverts have disappeared.

Melanitta fusca

1) Age given in months is calculated from hatching in June.

2) Males and females can only with certainty be separated into two categories, viz. juveniles and older birds. Even this separation is difficult in the very advanced state of the wing-feather moult when all wing feathers are lost, although other plumage characters can often be used. In both sexes at least a few juvenile-type feathers on the underparts are found throughout the summer, and in males juvenile birds have less orange on the bill and darker feet than older birds. In a very few males from the autumn examined at game dealers, the underparts were not as dark black as in the typical old male, indicating 1½ years age. However this character is probably not consistantly found in this age class, and 1½-year-old males cannot generally be separated from older birds.

In the field, separation between adult males and other categories is more difficult in the velvet scoter than the common scoter. When deep black males are seen together with dark brownish-black females and juveniles, separation is often possible, but when only colouration is present, it is often difficult to determine which of them it is. At close range the orange bill of the adult male is a very distinct character. Distinction between old females and juvenile birds cannot normally be made.

Melanitta nigra

1) Age given in months is calculated from hatching in June.

2) Both males and females can only be separated with certainty into two categories, viz. juveniles and older birds. Even when all juvenile wing feathers are absent (during the later part of the wing-feather moult) juvenile colouration of the underparts can be used. In this species also a few apparently 1½-year-old males without deep black underparts have been recorded in the autumn, but in most cases it is not possible to distinguish this age group from older birds.

In the field, the uniformly black adult males are easily distinguished from the light brown juvenile and adult females. In this species, however, the juvenile males present problems in late spring and early summer. Some individuals are easily recognized by their speckled light brown and black plumage, but in others (in June probably the majority) their black plumage has developed to such an extent that they are not easily distinguished from older males. Under good observation conditions the greyish black wing can be used, but at the distances at which this rather shy species is mostly observed this character has little practical value. Differences in orange colouration of the bill cannot be used in the field.

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