WEST GERMANY

VERFAHREN BEI DER BEURTEILUNG VON DEN VARIATIONEN DER GRÖSSE DER WILDBESTÄNDE UND JAGDAUSBEUTE VON JAHR ZU JAHR UND DIE WEITERE AUSNUTZUNG DIESER AUSKÜNFTE

Professor *F. Nüsslein*
Hann.-Münden

1. Welche Methoden werden zur Herbeischaffung der Auskünfte benutzt?

a) Mitteilung aus Beobachtungsrevieren.

b) Auswertung von Abschußlisten. Die Abschußliste gibt den Abschuß aller Wildarten an; die einzelnen Bundesländer erfassen allerdings die Wildarten nicht einheitlich.

c) Fragebögen werden an alle Kreisjägermeister eines Landes oder der Bundesrepublik zur Klärung von Spezialfragen gesandt.

2. Werden die Auskünfte in Ziffern oder als Schätzungen im Verhältnis zu einem Mittelwert ausgedrückt (unter Mittel, Mittel, über Mittel, o.ä.)?

Auskünfte aus Beobachtungsrevieren werden meist als Schätzung angegeben. Die Ergebnisse aus Abschußlisten liegen in Ziffern vor.

3. Umfaßt die Beurteilung sowohl die Größe des Wildbestandes als der Jagdausbeute?

In der Abschußliste werden für Schalenwild (außer Schwarzwild) und Auer- und Birkwild neben dem Jahresabschuß auch die Bestände der Wildarten (Grundlage für den Abschußplan) angegeben. Bei allem übrigen Wild werden nur die Abschußzahlen erfaßt.

4. Welche Wildarten werden von der Beurteilung umfaßt?

Erfaßte Wildarten siehe Nr. 3.

5. Wie groß ist die jährliche Wildausbeute dieser Wildarten (gesammelte Ziffern oder spezifiziert)?

Jahresstrecken in der Bundesrepublik siehe Anlage.

6. Umfaßt die Beurteilung das ganze Land oder werden kleinere Gebiete als Basis der Beurteilung benutzt? Wie groß ist das Areal, das in dem Fall von der Wildstatistik umgefaßt wird?

Die eigentliche Wildstatistik erfaßt auf Grund der ausgefüllten Abschußlisten die gesamten Länder.

7. Wie groß ist die Anzahl der Jäger, die von der Statistik berührt werden?

Durch die Statistik werden alle Revierinhaber durch Auswertung der Ab-

schußlisten erfaßt. Zahl der Revierinhaber nicht bekannt. Zahl der Jahresjagdscheininhaber 1956: 136 850, davon 70% im DJV.

8. Durch welche Zeiträume hat die Beurteilung stattgefunden (Jahreszahl)?

Erste umfassende Jagdstatistik 1934–1939 (siehe Jahrbücher). Ab 1953 wieder unvollständige Statistik, vollständig ab 1955 (mit Ausnahme einiger Wildarten).

9. Welche Instanzen organisieren die Sammlung des Materials, dessen Bearbeitung (Statistik) und dessen weitere Ausnützung?

Die Sammlung des Materials für die Statistik erfolgt durch die Jagdbehörden. Die Auswertung erfolgt durch die Jagdverbände und Jagdbehörden (Abschußgestaltung).

10. Zu welchen Zwecken werden die herbeigeschafften Auskünfte benutzt (Schonungen, Festsetzung von Jagdzeiten, wissenschaftliche Untersuchungen u.s.w.)?

Die Statistik dient zu wissenschaftlichen Untersuchungen, Wildstandsbewirtschaftung und Festlegung von Hegemaßnahmen.

11. Hat die Wildforschung des Landes Verbindung mit und eventuell Einfluß auf die Zurechtlegung und die Ausnutzung der Wildstatistik?

Die Wildforschung kann die Ergebnisse der Statistik verwerten. Die Erhebung wird allerdings durch andere durchgeführt. (s. Ziff. 9.).

12. Welche Kontakte bestehen eventuell zwischen den einzelnen Ländern mit Bezug auf gegenseitig Auswechslung der Auskünfte z.B. durch Organisationen wie "The International Wildfowl Research Bureau" oder ähnliches?

Internationale Kontakte zwecks Bekanntgabe der Statistiken bestehen m. E. nicht. Vielleicht gibt es Verbindungen, um die Schonung einzelner Flugwildarten zu erreichen. Veröffentlichungen "Jahrbücher der Deutschen Jägerschaft", "Grundlagen Moderner Jagdwirtschaft", Statistik des DJV im "DJV-Kalender".

GREAT BRITAIN

METHODS FOR ESTIMATING THE YEAR-TO-YEAR VARIATIONS IN SIZE OF THE GAME POPULATIONS AND/OR BAGS, AND THE UTILIZATION OF THIS INFORMATION

V. P. W. Lowe
The Nature Conservancy, Edinburgh

Red deer only considered

1. Which methods are used for obtaining the information?

At present the main work consists of a survey of the red deer in Scotland. Estates are being systematically surveyed and the deer counted on them. This is

Anlage

	Rotwild	Damwild	Rehwild	Schw. Wild	Hasen	Kaninchen	Füchse + Dachse	Fasanen	Rebhühner	Enten
Schleswig-Holstein										
1954/55	200	900	11 200	500	58 400	125 400	3 700	6 800	21 400	17 900
Nordrhein-Westfalen										
1954/55	2 100	200	33 100	3 800	128 000	318 400	25 600	87 700	90 100	15 200
Rheinland-Pfalz										
1954/55	1 900	–	16 800	6 600	45 000	38 000	20 100	1 000	23 400	2 800
Hessen										
1954/55	3 000	200	34 200	6 000	61 300	13 400	23 600	?	26 100	5 900
Baden-Württemberg										
1954/55	1 000	100	48 300	5 500	68 500	9 100	30 900	5 100	14 200	8 600
Bayern										
1954/55	4 200	–	85 800	?	?	?	?	?	?	?
Niedersachsen (Staat)										
1954/55	2 100	200	6 400	1 700	?	?	?	?	?	?

done by direct counting of the beasts; no other census methods being necessary owing to the open nature of the country. This census is being carried out all the year round, except during the stalking season for stags, August–October. The results of this work will be used for establishing conservation and management principles for red deer and not for game interests alone. In fact, deer are being considered for their own sake and not as a game species for sporting interests. Thus bag records are not being especially collected except from the estates being surveyed.

2. Is the information expressed in numbers or as variations about a mean value (above mean, below mean, etc.)?

In numbers, with acreage, description of ground and annual cropping figures over the past 5 years at least.

3. Does the estimate include the size of the stock of game as well as the bag?

See above.

4. Which game species are included in the estimate?

Red deer only.

5. The size of the yearly bag of these species (the grand total or according to species)?

Variable and unknown.

6. Does the estimate cover the whole country, or is it based on smaller areas? In the latter case: what is the size of the area?

See under 1.

7. The number of sportsmen supplying data for the estimate?

Two stalkers are employed full time for this work.

8. Over which period of years have the estimates been made?

The survey was started in 1952 and will continue for some years yet.

9. Which authorities organize the collecting of data, the statistical analysis and the further utilization of the data?

The Nature Conservancy, 12 Hope Terrace, Edinburgh 9.

10. For which purposes is the information used (preservation, game legislation, scientific research etc.)?

For the conservation of Scottish Red Deer.

11. Has the game research of your country connection with, and possibly, influence upon the preparation and utilization of the game census?

None.

12. Which connections, if any, exist between the individual countries as regards mutual exchange of information, for instance through organizations such as "The International Wildfowl Research Bureau" or others?

None.

METHODS FOR ESTIMATING THE YEAR-TO-YEAR VARIATIONS IN SIZE OF THE GAME POPULATIONS AND/OR BAGS, AND THE UTILIZATION OF THIS INFORMATION

Dr. *T. H. Blank*
Fordingbridge, England

Partridge only considered.

1. Which methods are used for obtaining the information?

The breeding density of partridges is accurately censused on several estates in different parts of the country (total acreage 25–30,000 acres) by the staff of the Game Research Station. This is followed up in August by a sample count, to give the young-to-old ratio. This provides an indication of the survival of young, and an estimate of the total pre-shooting population. Bag records are collected from many estates.

2. Is the information expressed in numbers or as variations about a mean value (above mean, below mean etc.)?

In numbers. The breeding density is used as an index. The sum of (a) the birds to be left for breeding, and (b) the estimated total winter loss, is deducted from the estimated pre-shooting population, to set a bag limit.

3. Does the estimate include the size of the stock of game as well as the bag?

See 1 and 2 above.

4. Which game species are included in the estimate?

Partridge (Perdix perdix) and Red-legged Partridges (Alectoris rufa).

5. The size of the yearly bag of these species (the grand total or according to species)?

Not known for the country, but extremely variable.

6. Does the estimate cover the whole country, or is it based on smaller areas? In the latter case: what is the size of the area?

See under 1.

7. The number of sportsmen supplying data for the estimate?

The main counts are carried out on about twelve estates. A large number of sportsmen provide subsidiary information.

8. Over which period of years have the estimates been made?
From 1951 on outside estates, and since 1947 on our own estate.

9. Which authorities organize the collecting of data, the statistical analysis and the further utilization of the data?
The I.C.I. Game Research Station, Burgate Manor, Fordingbridge, Hants.

10. For which purposes is the information used (preservation, game legislation, scientific research etc.)?
Primarily to encourage the preservation and increase of these game species in Britain.

11. Has the game research of your country connection with, and possibly, influence upon the preparation and utilization of the game census?
Intimately connected.

12. Which connections, if any, exist between the individual countries as regards mutual exchange of information, for instance through organizations such as "The International Wildfowl Research Bureau" or others?
None.

METHODS FOR ESTIMATING THE YEAR-TO-YEAR VARIATIONS IN SIZE OF THE GAME POPULATIONS AND/OR BAGS, AND THE UTILIZATION OF THIS INFORMATION

Dr. *G. V. T. Matthews*
The Wildfowl Trust, Slimbridge, England

Ducks and Geese only considered.

1. Which methods are used for obtaining the information?
(a) Monthly sample census of bodies of water and stretches of coast, by some eight hundred voluntary observers.
(b) Capture-recapture technique through ringing large numbers of birds by rocket-propelled nets and by rounding up when flightless.
(c) Estimate of breeding success by brood size and adult : juvenile ratio.
(d) Estimation of mortality rates from large-scale ringing results.

2. Is the information expressed in numbers or as variations about a mean value?
(a) & (c) as indices, (b) in numbers.

3. Does the estimate include the size of the stock of game as well as the bag?
Estimation of population only.

4. Which game species are included in the estimate?

(a) All wild duck and geese whether protected or legitimate quarry.

(b) Pink-footed Goose only thus far.

(c) All ducks and geese where possible.

5. The size of the yearly bag of these species?

Not known. An estimate of 12,000 has been made for the Pink-footed Goose.

6. Does the estimate cover the whole country, or is it based on smaller areas?

England, Wales, Scotland and Northern Ireland with varying degrees of coverage.

7. The number of sportsmen supplying data for its estimate?

Rather few, informants are mainly ornithologists.

8. Over which period of years have the estimates been made?

(a) 1947 to date.

(b) 1950 to date.

(c) & (d) from well pre-war.

9. Which authorities organize the collecting of data, the statistical analysis and the further utilization of the date?

The Wildfowl Trust carries out the research. Executive action if needed by the Nature Conservancy.

10. For which purpose is the information used?

Basic research, legislation, conservation measures.

11. Has the game research of your country connection with, and possibly, influence upon the preparation and utilization of the game census?

Intimately connected.

12. Which connections, if any, exist between the individual countries as regards mutual exchange of information?

Strong links with workers in American research bodies and on the Continent. International Wildfowl Research Bureau has intended function of correlation.

HOLLAND

METHODS FOR ESTIMATING THE YEAR-TO-YEAR VARIATIONS IN SIZE OF THE GAME POPULATIONS AND/OR BAGS, AND THE UTILIZATION OF THIS INFORMATION

W. J. Schuitemaker
Department of Wildlife Management, The Hague

1. Which methods are used for obtaining the information?
   a. Questionnaires to be answered by all licence holders or a fixed percentage of licence holders?
   b. Information from special observers distributed all over the country?
   c. Other methods?

a. Yes, by all licence holders. These questionnaires however were handed out this year (shooting season 1956/1957) for the first time. Whether the results will be reliable remains thus far an open question. We now get yearly the results of the duckdecoys, the catches of netters of golden plovers and the catches of the netters of geese.

b. Data acquired from the personnel of the Institute for Field Ecological Research (c/o M. F. Mörzer Bruyns, Utrecht) are sometimes useful for the understanding of habits of game animals. Since 1948 periodical counts of waterfowl are made from August till April by the Institute for Biological Field Research (I.T.B.O.N.), Arnhem. Now and then counts are made for the Black Grouse.

c. Counts or estimates of the stock of deer and roedeer are made by personnel of the division of Game Management and the I.T.B.O.N. For counts of noxious game as for instance rooks help is requested from local authorities and volunteers.

2. Is the information expressed in numbers or as variations about a mean value (above mean, below mean etc.)?

Yes, in more or less exact figures.

3. Does the estimate include the size of the stock of game as well as the bag?

Preferably the stock (deer, roedeer, rooks, black grouse, ducks). The bag will appear, as we hope, out of the questionnaires given to the licence holders. For shooting deer, roedeer, fallowdeer, moufflon and the ordinary sand or Harbour-seal a special permit is necessary. The total yearly bag is exactly known therefore. For foxes and woodpigeons a premium is paid. So the number of foxes killed pro year is exactly known. Premium for woodpigeons are paid only for the six summermonths, so the exact—or almost exact—total of the bag for those months only is known.

4. Which game species are included in the estimate?

As soon as the questionnaires (see 1a) have been handed in again the bag of all game animals (the species mentioned above included) will be known (with the restrictions, see 1a). These are for mammals: Deer, roedeer, fallowdeer, moufflons, wild boar, hares, rabbits, foxes, polecats, badgers, stoats, weasels, squirrels, seals, otters, beech or stonemartens and pinemartens. There is no open season however, for beechmartens, stonemartens, badgers and otters, so that these species are in fact fully protected.

Gamebirds are: pheasants, black grouse, partridges, stockdoves, woodpigeons, woodcocks, golden plovers, snipes, great snipes, jacksnipes, coots, carrion crows, hooded crows, rooks, jackdaws, magpies, jays and all kinds of geese and ducks. (There is no open season for red-crested pochards, eiders, shelducks, brent-geese, barnacle geese and canadageese).

5. The size of the yearly bag of these species (the grand total or according to species)?

According to species. In 1956 1673 foxes were killed, ± 110 roedeer, 122 deer, 63 fallowdeer and 4 moufflons. Furthermore about 100.000 woodpigeons and ± 1200 seals and a few hundred-thousand ducks (spec. div.).

6. Does the estimate cover the whole country, or is it based on smaller areas? In the latter case: what is the size of the area?

The whole country.

7. The number of sportsmen supplying the data for the estimate?

Let us hope all. They all (± 20.000) got a questionnaire, but answering is not obligatory.

8. Over which period of years have the estimates been made?

Deer, roedeer and seals estimates or more or less exact counts of stock for the last two years, woodpigeons for the last three years (bag), foxes (bag) for the last three years, black grouse (stock) for eight years and ducks (stock of different species in decoys) for eight years.

9. Which authorities organize the collecting of data, the statistical analysis and the further utilization of the data?

Personnel of the Division of Game Management and of the I.T.B.O.N.

10. For which purposes is the information used (preservation, game legislation, scientific research etc.)?

For several purposes e.g. preservation of the species, for protection of agriculture, for scientific research and for the carrying out of the law.

11. Has the game research of your country connection with, and possibly, influence upon the preparation and utilization of the game census?

Yes. One may consider it as an interaction.

12. Which connections, if any, exist between the individual countries as regards mutual exchange of information, for instance through organizations such as "The International Wildfowl Research Bureau" or others?

Incidentally only. The International Wildfowl Bureau is subsidized by us. Seals are counted by the Netherlands and Germany jointly. As one of the results of a meeting in Arnhem in 1955 there is now a closer contact between "repellentbiologists". The minutes of this meeting will appear in print before long.

NORWAY

METHODS FOR ESTIMATING THE YEAR-TO-YEAR VARIATIONS IN SIZE OF THE GAME POPULATIONS AND/OR BAGS, AND THE UTILIZATION OF THIS INFORMATION

Dr. *Y. Hagen*
Oslo

1. Which methods are used for obtaining the information?

a) There are no questionnaires to be answered by all licence holders or percentage of licence holders.

b) Information (2 annual reports) from a special parochial (municipal) elected committee (viltnemnda) all over the country, which has this duty. Mostly they again build their report on information from more observers.

c) Direct census methods, for instance: counting of reindeer from aeroplane.

2. Is the information expressed in numbers or as variations about a mean value (above mean, below mean etc.)?

Both, depending on species of game.

3. Does the estimate include the size of the stock of game as well as the bag?

Partly size of stock (relatively or in absolute numbers), partly bag; in some few cases, for instance reindeer, both.

4. Which game species are included in the estimate?

All our most important game species.

5. The size of the yearly bag of these species (the grand total or according to species)?

Partly the size of yearly bag, for districts as well as the grand total. Partly the yearly bag for limited districts. Always separated for each, clearly distinguishable, species or group species.

6. Does the estimate cover the whole country, or is it based on smaller areas? In the latter case: what is the size of the area?

The whole country regarding the yearly bag for big game, for mammals of prey or other kind of "Vermin". Sometimes for smaller areas, differing for the different species of game. Relative estimates mostly cover the whole country.

7. The number of sportsmen supplying data for the estimate?

Data for estimate of the kind mentioned under 1b: About 1000 reporters.

8. Over which period of years have the estimates been made?

Since about 1930 (upwards of 25 years), for some of them.

9. Which authorities organize the collecting of data, the statistical analysis and the further utilization of the data?

As to the first question: At present the State Game Department (Viltstyret) and the Norwegian League of Hunters and Fishers (Norsk Jeger- og Fiskerforbund). The statistical analysis not definitely organized, has partly been made by the Norwegian State Game Research (Statens viltundersökelser), partly by the State Bureau for Statistics (Statistisk Sentralbyrå). Further utilization: Both the State Game Department and the State Game Research.

10. For which purposes is the information used (preservation, game legislation, scientific research etc.)?

Departmental administration of the game management, and for scientific research. Also influences game legislation.

11. Has the game research of your country connection with, and possibly, influence upon the preparation and utilization of the game census?

Yes, both, at least with few exceptions.

12. Which connections, if any, exist between the individual countries as regards mutual exchange of information, for instance through organizations such as "The International Wildfowl Research Bureau" or others?

Some connections with Denmark, Sweden and Finland.

POLAND

VERFAHREN BEI DER BEURTEILUNG VON DEN VARIATIONEN DER GRÖSSE DER WILDBESTÄNDE UND JAGDAUSBEUTE VON JAHR ZU JAHR UND DIE WEITERE AUSNUTZUNG DIESER AUSKÜNFTE

Prof., Dr., Ing. *D. J. Tilgner* und Dilp. Ing. *E. Frankiewicz*

1. Welche Methoden werden zur Herbeischaffung der Auskünfte benutzt?

Zur Herbeischaffung der Unterlagen über Wildbestand und Jagdausbeute werden Fragebogen betr. Abschußplanung benutzt.

2. Werden die Auskünfte in Ziffern oder als Schätzungen im Verhältnis zu einem Mittelwert ausgedrückt (unter Mittel, Mittel, über Mittel, o.ä.)?

Auskünfte werden als Schätzungen in Ziffern ausgedruckt.

3. Umfaßt die Beurteilung sowohl die Größe des Wildbestandes als der Jagdausbeute?

Die Beurteilung umfaßt sowohl die Größe des Wildbestandes als auch die Jagdausbeute.

4. Welche Wildarten werden von der Beurteilung umfaßt?

5. Wie groß ist die jährliche Wildausbeute dieser Wildarten (gesammelte Ziffern oder spezifiziert)?

Große und Jagdausbeute beim Wildbestand Polens.

	Wildbestand per 1. 4. 57.	Jagdausbeute im Jahre 1956
Hirsche	32.000	7.500
Rehwild	108.000	23.000
Schwarzwild	30.000	29.000
Füchse	35.000	12.920
Hasen	700.000	463.000
Auerhahn	500	15
Birkwild	5.000	139
Fasanen	6.000	1.800
Rebhühner	500.000	222.000

6. Umfaßt die Beurteilung das ganze Land oder werden kleinere Gebiete als Basis der Beurteilung benutzt? Wie groß ist das Areal, das in dem Fall von der Wildstatistik umgefaßt wird?

Die Zahlen umfassen das ganze Land, d.i. ca. 25 Millionen ha des Poln. Jagdverbandes und 1.700.000 ha des Forstministerium.

7. Wie groß ist die Anzahl der Jäger, die von der Statistik berührt werden?
Die Anzahl der Jäger umfaßt in Polen 36.000.

8. Durch welche Zeiträume hat die Beurteilung stattgefunden (Jahreszahl)?
Die angeführte Beurteilung basiert auf Jahresplanung.

9. Welche Instanzen organisieren die Sammlung des Materials, dessen Bearbeitung (Statistik) und dessen weitere Ausnützung?
Die Sammlung des statistischen Materials, dessen Bearbeitung und weitere Ausnützung wird durch den Polnischen Jagdverband Polski Zwiazek Lowiecki durchgeführt, wobei die Ausnützung gleichzeitig durch das polnische Forstministerium durchgeführt wird.

10. Zu welchen Zwecken werden die herbeigeschafften Auskünfte benutzt (Schonungen, Festsetzung von Jagdzeiten, wissenschaftliche Untersuchungen usw.)?
Die statistischen Unterlagen dienen zur Festsetzung des Abschusses unter Jagdzeiten.

11. Hat die Wildforschung des Landes Verbindung mit und eventuell Einfluß auf die Zurechtlegung und die Ausnutzung der Wildstatistik?
Die polnische Wildforschung hat keinen Einfluß auf die Zurechtlegung und Ausnutzung der Wildstatistik.

12. Welche Kontakte bestehen eventuell zwischen den einzelnen Ländern mit Bezug auf gegenseitig Auswechslung der Auskünfte z. B. durch Organisationen wie "The International Wildfowl Research Bureau" oder ähnliches?
Es besteht bisher kein Kontakt mit anderen Ländern bezüglich Austausch der Auskünfte und Erfahrungen.

SWEDEN

METHODS FOR ESTIMATING THE YEAR-TO-YEAR VARIATIONS IN SIZE OF THE GAME POPULATIONS AND/OR BAGS, AND THE UTILIZATION OF THIS INFORMATION

Viltforskningsrådet
Stockholm

1. Which methods are used for obtaining the information?
a. Questionnaires to be answered by all licence holders or a fixed percentage of licence holders?
b. Information from special observers distributed all over the country?
c. Other methods?

Answer: b. Information from special observers.

2. Is the information expressed in numbers or as variations about a mean value (above mean, below mean etc.)?

Generally as variations about the mean value. For certain species, however, such as elk, red deer, larger predators, and infrequently occurring mammals and birds the numbers are given.

3. Does the estimate include the size of the stock as well as the bag?

Yes.

4. Which game species are included in the estimate?

All species.

5. The size of the yearly bag of these species (the grand total or according to species)?

No numbers given.

6. Does the estimate cover the whole country or is it based on smaller areas? In the latter case: what is the size of the area?

The whole country.

7. The number of sportsmen supplying the data for the estimate?

The number of sportsmen affected by the statistics is not known.

8. Over which period of years have the estimates been made?

Since 1925.

9. Which authorities organize the collecting of data, the statistical analysis and the further utilization of the data?

The County Sporting Associations. The statistical analysis is carried out by the Swedish Hunting Association.

10. For which purposes is the information used (preservation, game legislation, scientific research etc.)?

For game legislation and close-time regulations. Furthermore the material are used for game research purposes.

11. Has the game research of your country connection with, and possibly, influence upon the preparation and utilization of the game census?

The information obtained will be worked up by the Game Research Institution of the Swedish Hunting Association.

12. Which connection, if any, exist between the individual countries as regards mutual exchange of information, for instance through organizations such as "The International Wildfowl Research Bureau" or others?

The Scandinavian sportsmens coordinating committee has agreed that any game census is made available to the committee.

YUGOSLAVIA

METHODS FOR ESTIMATING THE YEAR-TO-YEAR VARIATIONS IN SIZE OF THE GAME POPULATIONS AND/OR BAGS, AND THE UTILIZATION OF THIS INFORMATION

Professor *Stane Valentincic*
Ljubljana.

1. Which methods are used for obtaining the information?
a. Questionnaires to be answered by all licence holders or a fixed percentage of licence holders?
b. Information from special observers distributed all over the country?
c. Other methods?

a. Yes, all licence holders, with the exception of those in the little federal republic Monte negro, are obliged to fill in questionnaires concerning their bag.

In Serbia, Macedonia, and Bosna the licence holders are expected to keep an account of the bags for each hunting. In Slovenja and Croatia a questionnaire is filled in at the end of the season.

The reports are sent to the hunters' organizations and from there to the authorities.

b. The professional game-keepers send in reports concerning the size of the population of game species.

c. As a control, censuses may be carried out, but only infrequently.

2. Is the information expressed in numbers or as variations about a mean value (above mean, below mean etc.)?

Always in numbers.

3. Does the estimate include the size of the stock of game as well as the bag?

Only the professional game-keepers report as well the size of the stock of game as the bag. The licence holders only the bag.

4. Which game species are included in the estimate?

All but the migratory species.

5. The size of the yearly bag of these species (the grand total or according to species)?

Answer:

Red deer	635	Wolf	2.340
Roe deer	3.570	Foxes	47.100
Chamois	498	Shakal	318
Bear	37	Wild boar	617

Hare	680.000	Capercaillie	222
Pheasant	21.220	Hazelgrouse	1.382
Partridge	67.900	Black grouse	105
Alectoris graeca	12.000		

6. Does the estimate cover the whole country, or is it based on smaller areas? In the latter case: what is the size of the area?

The estimate covers the whole country.

7. The number of sportsmen supplying the data for the estimate?

About 100.000 (without Monte negro).

8. Over which period of years have the estimates been made?

The estimate covers mainly the post-war period. Before the war some counts were carried out mainly in Slovenja and Croatia. From these republics some figures are available from the beginning of the 19th century (f.i. concerning red deer and big game in general).

9. Which authorities organize the collecting of data, the statistical analysis and the further utilization of the data?

The collecting of data is organized by the hunters' superiour organizations (republical as well as federal) and by the administrative authorities.

10. For which purposes is the information used (preservation, game legislation, scientific research etc.)?

The information is used for statistical purposes as well as for planning bag limits prior to the hunting season.

11. Has the game research of your country connection with, and possibly, influence upon the preparation and utilization of the game census?

Not much so far, but the game research services are now gaining influence.

12. Which connections, if any, exist between the individual countries as regards mutual exchange of information, for instance through organizations such as "The International Wildfowl Research Bureau" or others?

There are certain connections between our country and Italy and Austria but not so much regarding population sizes as regarding diseases.

WEDNESDAY, 16 OCTOBER

15,00 – Reception in the Town Hall of Aarhus.
Introductions to the films.

THE RED DEER OF THE MOUNTAINS

G. Kenneth Whitehead
England

To the majority of Europeans, the red deer is a native of forests and wooded hillsides—a truly forest creature. In Great Britain, however, apart from the few deer living in the south west of England—which enjoy the shelter and rich feeding of the wooded valleys of Devon and Somerset—the red deer of Scotland have, in the main, no such forests in which to seek shelter during the winter storms but have to eke out a thrifty existence on some bleak mountain side or windswept glen devoid of all trees. It is true that much of this country is called "deer forest"—but it is forest in name only—a name inherited from the day when, centuries ago, all this wild country was clothed in forest which has long since been destroyed by the hand of man.

Man has, therefore, been responsible for a change in habit and habitat of deer in Scotland, and it speaks much for the hardiness of this fine animal that it has been able to acclimatise itself to suit the changed conditions.

In recent years they have had to contend with another evil—and that is the exploitation of the highlands for hydro-electric schemes. This has resulted in large areas of their accustomed winter feeding grounds being flooded, and in consequence, in areas where this has occurred, in severe winters, casualties have been extremely high. However, taking Scotland as a whole, there is no shortage of red deer—indeed, I estimate that the stock today is between 130,000 and 180,000 deer.

The film, *Red Deer of the Mountains*, depicts the life routine of mountain red deer in the British Isles. Commencing in the spring, it first shows the shedding of the old antlers by the stags and the new growth commenced. By early June the hinds will have calves at foot and at this season, the stags with their antlers heavy in velvet, will be herded together.

By the latter part of August the stag's antlers will be clean of velvet, and during the next two months, particularly when the weather is hot, the stags are frequent visitors to their mud wallows.

By mid September the stags' parties will commence to break up, as each stag starts to collect his harem of hinds together. The rut has started, and this is a season of much noise, as each stag roars a challenge to other beasts in the vicinity. Battles between stags are of frequent occurrence, but seldom does the conflict end fatally.

By November the rut is over and peace returns once more to the glen. Winter, however, is a testing time for deer, and prolonged periods of snow cause a heavy mortality among the deer, particularly among yearling animals and the older stags not properly recovered from the exertion of the rut.

PÈRE—DAVID DEER

G. Kenneth Whitehead

England

The Père David deer, *Elaphus davidianus*—formerly a native of China where it is now extinct, is probably the only living mammal in the world which, so far as is known, no man has ever seen in an entirely wild state. The history of the discovery of this remarkable animal is as follows:—

This deer, which originated from the Honan district of China, takes its present name from the French missionary and traveller, Père Armand David who, one September day in 1865, first discovered the deer in the Imperial Hunting Park of Peking—known as Nan Hai-tze, or South Lake. Its native name would appear to have been milou, Sen-pou-siang, or Ssu-pu-hsiang.

Anxious to secure some specimens for the Paris Museum, Père David accordingly made arrangements with some of the park keepers to obtain for him the hides and bones of a pair of deer for which he would recompense them with twenty *taels*. It was, apparently, not without some difficulty and danger that the transaction was completed, for not only did each party mistrust the other, but it was strictly against orders for specimens to leave the park. However, one dark January night in 1866 the specimens were duly handed over the wall to Père David and the keepers received their reward. Shortly after this, M. Henri de Bellonet, Chargé d'Affaires of the French Legation in Peking, managed to secure a living pair, but the male did not survive long.

The discovery of this new species of deer, quite naturally, aroused the interest of the Zoological Society of London, and through the good offices of M. de Bellonet, a pair was placed at the disposal of the Society. Unfortunately, both

died before reaching London. Eventually, on August 2, 1869, after several other unsuccessful attempts, a pair of deer reached London alive, but within twelve months both had died, leaving no progeny.

During the next ten years a few more specimens reached zoos in Paris and Berlin, but it was not until 1883 that another pair was received in London from the Paris Zoo. Once again, however, both animals died without leaving any progeny, the hind on June 23, 1885 and the stag on June 28, 1891.

Then in 1894 tragedy descended upon the Nan Hai-tze herd which, until then, had been carefully preserved for the sport of the Chinese Court. A flood from the river Hun-Lo, which flows through the park, breached the wall in several places, and through the gaps thus made, the bulk of the deer escaped to be killed and devoured by the famine-stricken peasantry. It is believed, however, that a small remnant managed to survive and remained in the park until 1900 when, during the Boxer outbreak, it was broken into by allied troops marching to the relief of the foreign legations in Peking and the deer were either killed or captured, a few being shipped to Europe.

About 1898 a pair of young Père David's deer arrived at Woburn from a zoo in Paris, and in due course began to breed, first in a paddock and later in the open park.

During the next few years other specimens were obtained from zoos in Paris, Antwerp and Berlin, the French and Belgian stock proving the most satisfactory, as the Berlin hinds were all sterile. In due course all the specimens in the European zoos had died off and Woburn thus became the only home of the species. Since then a few animals have been sent, not only to Whipsnade and Regent's Park in England, but to zoos in Australia, Switzerland and New York, etc., and have started breeding in all places. During the last two years a few young deer have been sent to China, so if they should breed, once again this deer will be represented in its native land. Nevertheless, Woburn still remains the only place in the world where this animal can be seen living in conditions probably somewhat comparable to those enjoyed by the mi-lou in Nan Hai-tze-park.

Its physical attributes are unique. For a deer this animal which is somewhat larger than a red deer carries a remarkably long tail—a full 24 inches long to its extremity—its hooves are wide and somewhat similar to those of a reindeer, which suggests they were designed to travel over snow. The antlers appear to be worn back-to-front, with no forward-pointing tines, but with an extremely long back tine which terminates in a number of small jags.

Occasionally, and particularly when given special feeding, the stag will grow two pairs of antlers during a year, which is a remarkable achivement for any deer. When this occurs the summer antlers are generally shed about October or

November and a small pair, simple in structure, are grown and shed within a space of about three months, so as to allow the second full growth antler to be complete by the rut which takes place in July. Gestation lasts about ten months —about six weeks longer than that of the red deer.

The film starts in the month of May, a month when the antlers of the big stags are almost ready to shed the velvet from their queer shaped antlers, and the season's calves will soon be born.

At birth, and during its early life, the young Père David calf behaves like most other young deer—lying perfectly still when left by its mother, hoping to escape detection.

At this season some of the older animals—and in particular the barren and yeld hinds—will have their beautiful red summer coat which stands in marked contrast to the untidy appearance of the majority still carrying the faded grey coat of winter.

Père David deer are extremely fond of water and throughout the spring, summer and early autumn, whenever the weather is warm, they will frequently resort to one of the several lakes in Woburn Park.

When they move off in a herd, there is a characteristic "clicking" sound which emanates from their hooves—a sound very similar to that heard when reindeer move off.

By the end of June the herds will be collecting on their rutting grounds, and it is a common sight to see one stag master of perhaps fifty hinds. They keep very closely to their territory, which soon becomes quite bare of grass.

Around mid-morning, the whole herd will generally be seen resting, all packing tightly together with the master stag in the middle. When an animal gets up, it is surprising how it can tread its path through the tightly packed herd.

If an animal wishes to lie down in the middle of the herd, it will strike a recumbent beast with its foreleg until it gets up, and makes room for it. A stag will also bring a hind to her feet in similar manner.

During the rut, the stags roar frequently, and fight among themselves. Occasionally a stag is so injured in a fight that he has to be disposed of.

By early autumn the rut is over and the deer will soon assume the grey coat of winter. Hinds at this season appear somewhat quarrelsome and may frequently be seen engaged in "boxing matches".

The herd at Woburn today numbers about 250 animals.

THURSDAY, 17 OCTOBER

9,00 Chairman: H. Gäbler. Secretary: Johs. Andersen.

REGULATION OF BLOOD PRESSURE IN THE RED DEER (CERVUS ELAPHUS L.)

Zbigniew Jaczewski and *Janusz Gill*

Departement of Animal Physiology, College of Agriculture, Warsaw.

Three Red Deer stags were cast and transported about 100 km to the laboratory. During transportation they were anaesthetized with chloralhydrate. After a few days the same stags were anaesthetized again with a larger dosis of chloralhydrate, and an experiment was made in which blood pressure and respiration were recorded directly. The right vagus nerve was stimulated, then dissected and the peripheric and centripetal ends of this nerve were stimulated again. Then acethylocholine and adrenaline were administered. After this a glass cannula was inserted into the femoral artery and the animals were bled as much as possible (to death).

The particulars of these experiments are as follows:

1. Stag born in May, 1953, 4 years old, with hard antlers. The animal was transported on April 12th, 1957. It was cast at 15:21, after 10 minutes chloralhydrate was administered (10 g in 500 ml H_2O), per rectum. Respiration rate was over 80/min. At 18:15 it received again 5 g chloralhydrate in 250 ml H^2O. It was released on his paddock at 20:00. The transportation lasted over 4 hours.

On the next day (April 13th) at 15:30 the same stag received 20 g chloralhydrate per rectum in 1000 ml H_2O. The animal's weight 128 kg. Heart rate was over 100/min., respiration rate nearly 40/min. At 16:40 it received 10 g chloralhydrate in 100 ml 0,9 per cent. NaCl intravenously, but no profound narcosis ensued. At 16:45 the next 10 g chloralhydrate was administered with same result. At 17:00 the animal received again 10 g chloralhydrate and then reflexes were stopped. Then the operation started. Blood was heparinized (50.000 u.i.). A glass cannula was inserted into the carotid artery and connected with a mercury manometer. A tracheal tube was connected with a membrane manometer. Both respiration and arterial pressure were recorded. Then the right vagus nerve was stimulated, with electric current of 10,42, 105 volts. Afterwards the vagus nerve was dissected (at 19:00) and the centripetal and peripheric ends

were stimulated. About 20:00 the stag received 0,2 acetylocholine intravenously. This dose was repeated after 20 minutes. Afterwards 0,002 adrenaline was given. 20 minutes later 0,001 adrenaline was given.

During the course of the experiment the stag received 10 g of chloralhydrate intravenously at 18:40, 20:00, 21:30. It was indispensable, for reflexes became evident. It means, that during the whole experiment this stag received 60 g chloralhydrate intravenously and 20 g per rectum.

At 21:50 bleeding from the carotid artery was started. Till 22:15, when the heart ceased to beat, 5300 ml of blood were collected. The blood pressure remained on nearly the same level to the moment when 3 litres of blood were collected.

2. Stag born in May, 1950, 7 years old, with antlers in velvet. It was transported on May 14th, 1957. It was cast at 12:04, after 15 minutes chloralhydrate was administered (15 g in 750 ml H_2O). Respiration rate was over 30/min. At 14:00 it received again 10 g chloralhydrate in 500 ml H_2O. It was released on his paddock at 15:30. The transportation lasted nearly 3,5 hours.

On May 16th, 1957, it was cast again. Weight 158 kg. Heart rate was nearly 80/min., respiration rate nearly 15/min. At 14:10 it received 30 g chloralhydrate (in 300 ml 0,9 per cent. NaCl) intravenously. It was anaesthetized, respiration rate 9/min., heart rate 100/min. As reflexes still persisted by incisions, 10 g of chloralhydrate were added at 14:40. Operation was made in the same manner as in the first case. At 15:45 the right vagus was stimulated. After dissection of the vagus centripetal and peropheric ends of the vagus were stimulated. (Fig. 1).

At 17:15 0,2 acetylocholine was given intravenously (fig. 4). At 17:50 0,001 adrenaline was given intravenously. Between 18:00 and 19:30 laparatomy was performed and an attempt was made of recording the intestinal movements. No movements were recorded, even after administration of acetylocholine, perhaps for the reason of narcosis.[1])

During the course of the experiment chloralhydrate was given (10 g) at 17:45, 18:30, 19:35, so in general this stag received 70 g of chloralhydrate intravenously.

At 20:00 a glass cannula was inserted into the left femoral artery and bleeding was started (at 20:10). The heart ceased to beat at 20:32, and 5800 ml of blood were collected. Possibly a large amount of blood was retained in the antlers, as they were on a much lower level than the rest of the body (fig. 1). Blood pressure remained on nearly the same level till the moment when 3 litres of blood were collected.

3. Stag born in May, 1955, over 2 years old, with antlers in velvet. It was transported on June 6th, 1957. It was cast at 12:30. At 12:35 it received 800 ml

[1]) Recording of the intestinal movements was made with the help of lek. wet. S. Kozniewski.

of a 2 per cent. solution of chloralhydrate. Respiration rate was nearly 40/min. At casting it has broken its antlers, but they remain in place supported by the velvet. It was released on his paddock at 16:00. The transportation lasted nearly 3,5 hours.

On June 7th, 1957, it was cast again. Weight 94 kg. At 12:45 it received 25 g of chloralhydrate in 250 ml of 0,9 per cent. NaCl solution intravenously. The operation started, and proceeded in the same manner as in the first case (figs. 2 and 3). At 14:22 the right vagus was stimulated, with electric current of 10,42,105 volts. After dissection of the vagus (14:40), centripetal (fig. 5) and peripheric (fig. 6) ends of the nerve were stimulated.

At 15:25 0,2 acetylocholine was injected intravenously (fig. 7). At 15:36 0,0005 adrenaline was given intravenously, at 15:40 this dose was repeated. At 15:44 0,001 adrenaline was given intravenously (fig. 8).

During the course of the experiment chloralhydrate was given (10 g) at 15:25, 16:15, thus on the whole this stag received 45 g chloralhydrate intravenously (fig. 9).

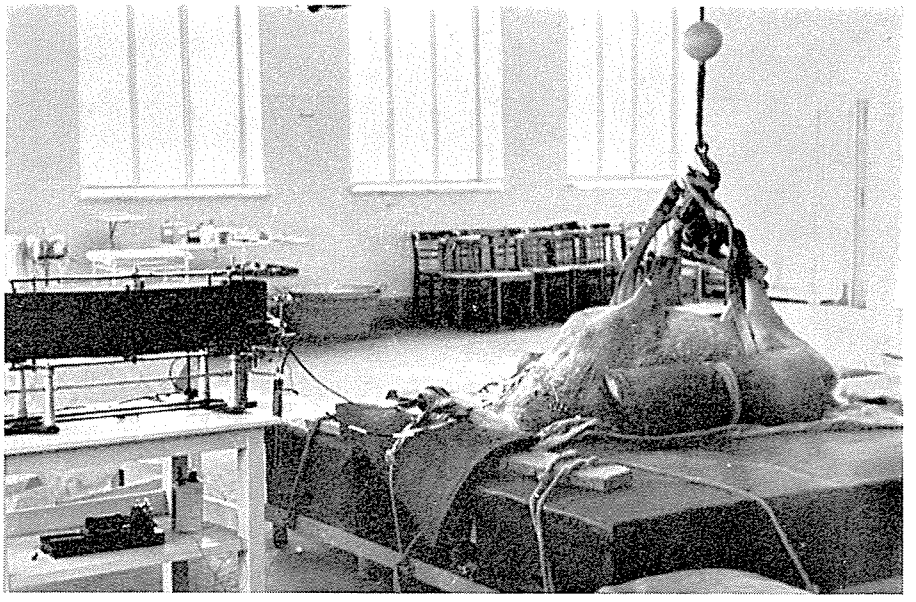
At 17:00 a glass cannula was inserted into the right femoral artery and bleeding started (at 17:02). The heart ceased to beat at 17:15, and 3650 ml of blood were collected. A large amount of blood was lost during the operation of the femoral artery (about 750 ml). The dose of heparine was also 50.000 u.i. The blood pressure did not change very much till the moment when 1 litre of blood was collected (1750 ml).

Summary of results.

Red deer stags are very tolerant to chloralhydrate narcosis. The narcotic dose seems to be nearly 25 g intravenously per 100 kg of body weight; or 0,25 per 1 kg. This narcosis is good for operations and lasts about 2 hours[2]).

The dose of acetylocholine of about 0,1 intravenously, and of adrenaline of about 0,0005—0,001 intravenously seems to be within „physiological" limits.

[2]) A similar narcosis was applied in the case of an operation made on May 25th, 1957, on a one year old stag (born in May, 1956). It was an operation of free grafting of an antler (Z. Jaczewski, Bull. Acad. Polon. Scie. Cl. II, vol. IV, No. 3, 1956). At 14:30 this stag was cast. Weight 58 kg. AT 14:50 it received 20 g of chloralhydrate in 200 ml of 0,9 per cent. NaCl solution, intravenously. Respiration rate 19/min. All reflexes were stopped. At 16:00 the operation was finished, the stag was then untied and laid on his paddock. Respiration rate 10/min. At 17:20 the stag began to awaken, but it could not rise. Lying it ate with great appetite grass and branches on which it was lying. It tried several times to rise, but did not succeed. At 17:57 the stag rose. At 19:00 it walked almost normally. The operation was succesful and to the present day this stag is in good health and in excellent condition.

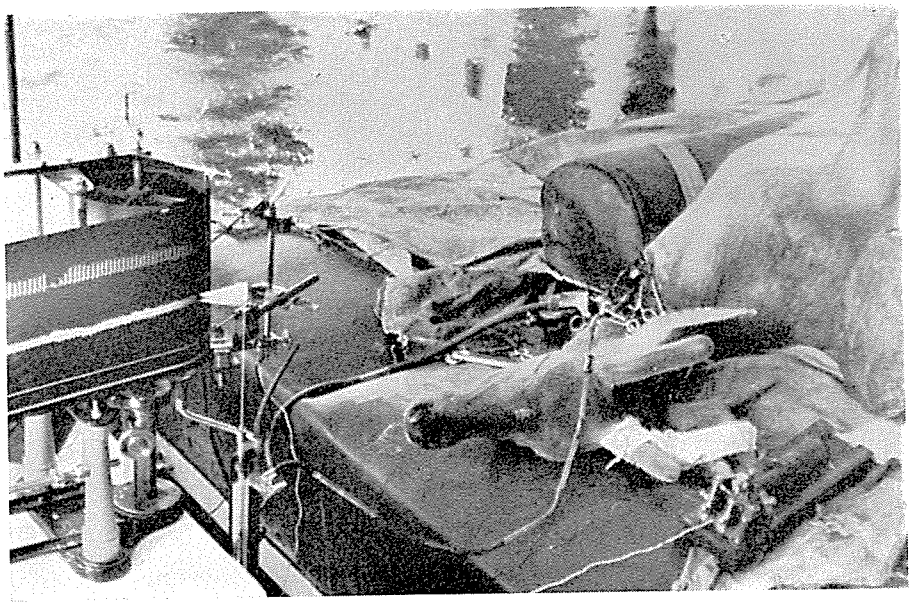


1. Stag No. 2 during the operation.

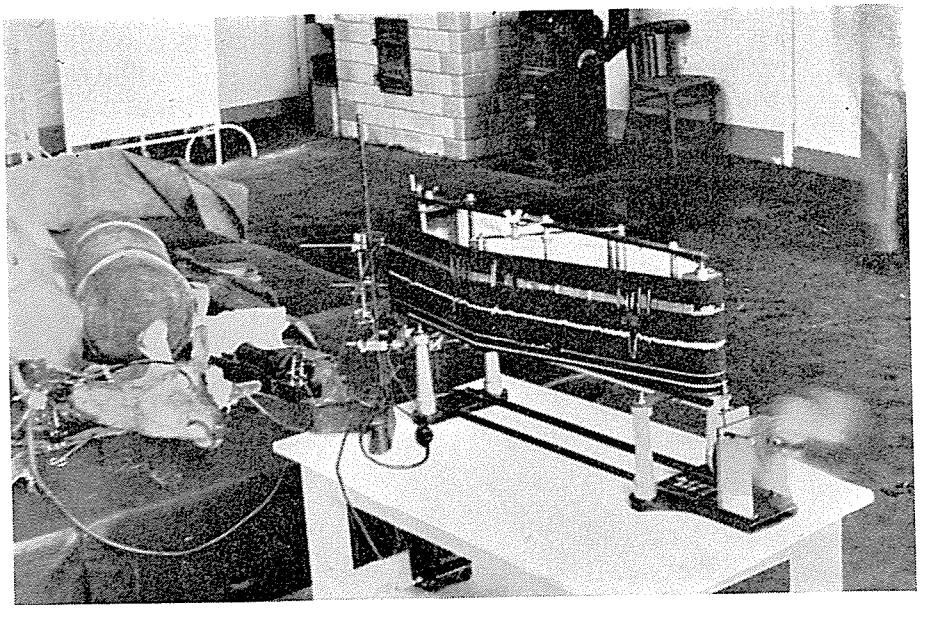
The reaction of blood pressure following vagus stimulation is typical, but it seems that red deer stags are more susceptible to stimulation of the sympathetic system (mobilization, fear), to adrenaline, than to vagus stimulation.

The blood volume which may be obtained by direct bleeding of stags is about 4 per cent. of the body weight.

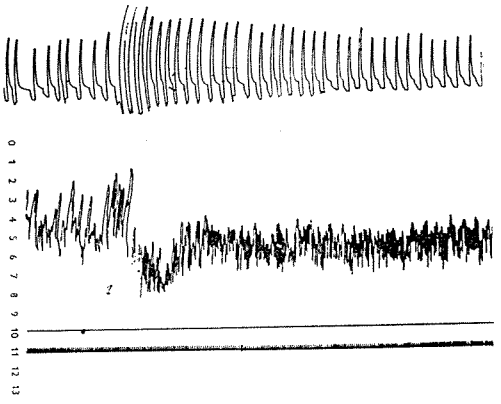
The blood volume, which a red deer stag can lose without serious disturbances in the blood pressure is about 2 per cent. of the body weight.



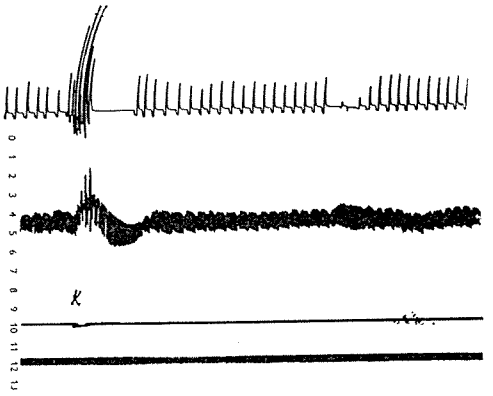
2. Stag No. 3 during the operation.



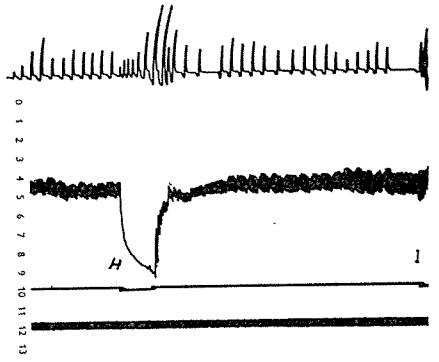
3. Stag No. 3 during the operation.



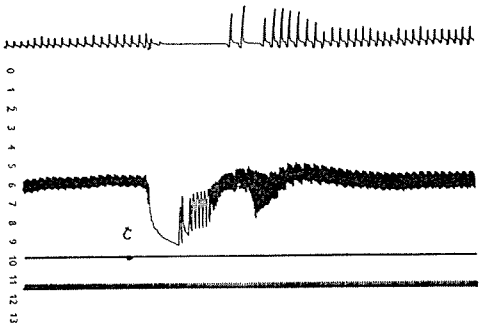
4. Effect of acethylocholine administration (0,2 g). Stag No. 2. On the left scale in centimetres. Time in seconds.



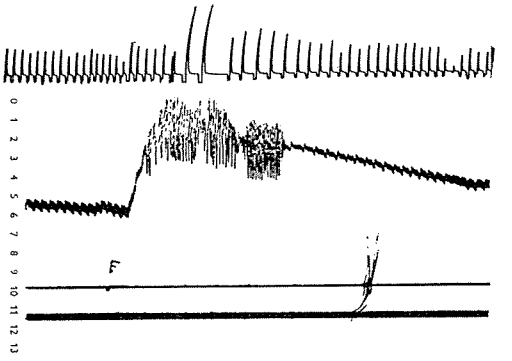
5. Effect of stimulation of the centripetal end of the right vagus nerve. On the left scale in centimetres. Time in seconds. Stag No. 3.



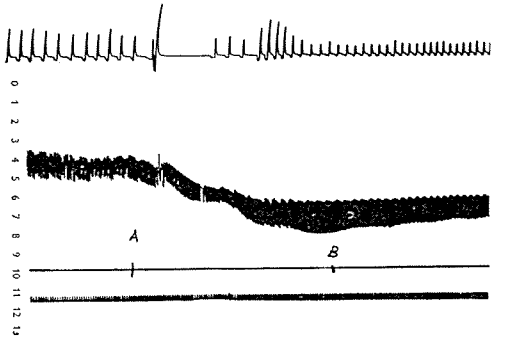
6. Effect of stimulation of the peripheric end of the right vagus nerve. Stag No. 3.



7. Effect of acethylocholine administration (0,2 g). Stag No. 3.



8. Effect of adrenaline administration (0,001 g). Stag No. 3.



9. Effect of chloralhydrate administration (10 g). Stag No. 3. (at 16:15).

THURSDAY, 17 OCTOBER

CAPACITY OF THE DIFFERENT PARTS OF THE DIGESTIVE TRACT IN THE RED DEER (CERVUS ELAPHUS L.)

Janusz Gill and *Zbigniew Jaczewski*
Department of Animal Physiology, College of Agriculture, Warsaw.

The investigations were made on three Red Deer stags, same as in the experiments on circulation (4). Stag No. 1 was bled on April 13th, 1957; stag No 2 —on May 16th, 1957; and stag No. 3—on June 6th, 1957. After the death the length of each stag was measured from the upper margin of the muzzle to the base of the tail (6). After dissection of the abdominal wall several ligatures were tied and the digestive tube was removed (1). After separation of the mesentery the total weight of the stomach was established, and afterwards the total weight of the intestine. Than, the length of the intestine was measured and the intestinal contents were washed out several times with water. The stomach was washed out in the same manner.

The capacity measurements of the different parts of the digestive tract were made according to the method of Kwasnicki (5). A washed out part of the digestive system is placed in a big vessel with water, and filled out with water. One end of this part is held in a position 10 cm over the level of water. In this manner immersed part of the digestive tube is filled out with water under a pressure of 10 cm of water. Afterwards the volume of water which filled this part was measured. The total capacity of the stomach was measured, and afterwards the total capacity of the omasum and abomasum. The communication between the reticulum and omasum is narrow. The remained parts of the stomach communicate by big openings and their ligation must result in a change of capacity (fig. 1).

The results of the measurements are given in table I, II and III. The stags are placed in the tables according to their weights and ages, but not according to the dates of the experiments.

The material is to scanty yet to draw clear conclusions. The stags were at different age, of different weight, had different antlers, and received different

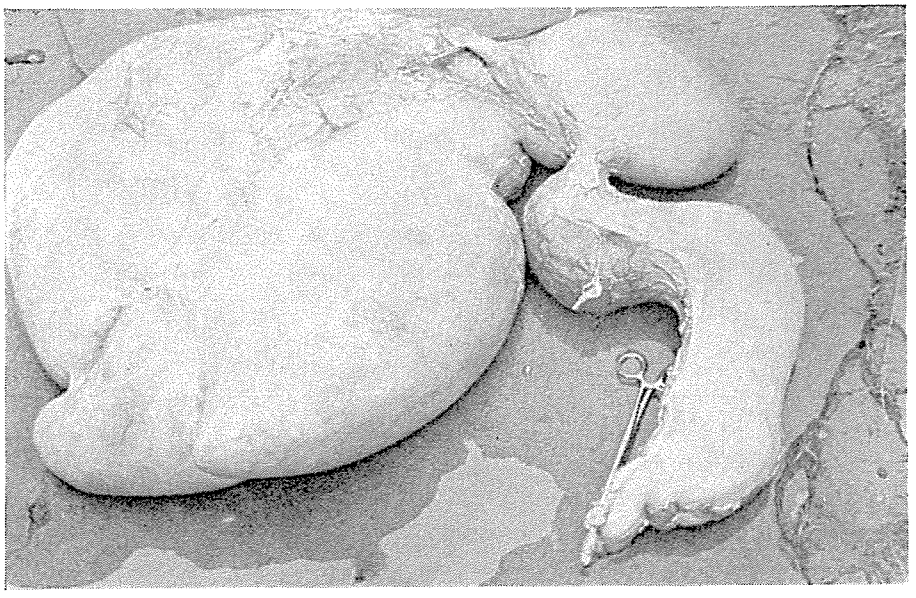


Fig. 1. Gaster of the Red-deer 3.

food (from April to June). All the stags fasted a short time before transportation and before the operations. On account of this, perhaps the capacities of stag No. 1 and No. 3 are nearly the same, in spite of difference in age (2 years) and weight (34 kg). Stag No. 1 had yet hard antlers, stag No. 3 had his antlers in velvet. The tissues of stag No. 3 were softer and weaker than these of No. 1, so were the walls of the digestive tract. It is possible that they were more stretched by the water. It is also possible that in period of antlers growing the digestive system is in a state of some kind of hyperactivity.

The dates contained in table I show, that the rumen and reticulum comprise $^2/_3$ of the total capacity of the digestive system. It is perhaps one more evidence, that the digesta must be already finely ground, when passing to the omasum (2).

The length of the active and nonactive sections of the intestine was not measured in these cases, as it was done before (3). It was on account of fastening that the relations are not physiological in these cases. It must be said, however, that these sections in the small intestine were distinctly marked, short; the bounderies between them were distinct. The active sections are contracted and do not let water pass during washing. Only after filling with water under pressure the relaxation ensue and the diameters of these sections were the same as of the

Table I.

Capacity of Different Parts of the Gastro-Intestinal Canal of three Red-deers (Cervus elaphus L.)

Part of Canal	Red-deer 3 "Raczy", 2 years, 94 kg			Red-deer 1 "Rogal", 4 years, 128 kg			Red-deer 2 "Stary", 7 years, 158 kg		
	Absolute Capacity (litres)	Relative Capacity (per cent)	Ratio of Capacity to Body Weight (litres to kg)	Absolute Capacity (litres)	Relative Capacity (per cent)	Ratio of Capacity to Body Weight (litres to kg)	Absolute Capacity (litres)	Relative Capacity (per cent)	Ratio of Capacity to Body Weight (litres to kg)
Rumen + Reticulum...	25,22	66,45	0,27:1	27,0	71,43	0,21:1	35,00	59,64	0,22:1
Omasus + Abomasus...	2,78	7,33	0,03:1	2,0	5,29	0,02:1	6,00	10,22	0,04:1
Jejunum.....	5,15	13,57	0,05:1	4,0	10,58	0,03:1	8,76	14,93	0,06:1
Caecum.....	1,48	3,90	0,01:1	1,3	3,44	0,01:1	3,22	5,48	0,02:1
Colon + Rectum.....	3,32	8,75	0,04:1	3,5	9,26	0,03:1	5,71	9,73	0,03:1
Total.....	37,95	100,0	0,40:1	37,8	100,0	0,30:1	58,69	100,0	0,37:1

non active ones. The active sections were also marked by colours, this difference remains also after filling with water.

In the large intestine these differences were less distinct.

Table III is only tentative one. Comparison of these dates and the preceding ones (3) indicates, that on account of fastening stags the digestive system of the latter ones has little contents.

Further study is in progress.

Table II.

Length of Different Parts of the Intestine of three Red-deers (Cervus elaphus L.)

Part of Intestine	Red deer 3 "Raczy", 2 years, 94 kg		Red-deer 1 "Rogal", 4 years, 128 kg		Red-deer 2 "Stary", 7 years, 158 kg	
	Absolute Length (metres)	Relative Length (per cent)	Absolute Length (metres)	Relative Length (per cent)	Absolute Length (metres)	Relative Length (per cent)
Jejunum	12,35	58,67	15,00	59,83	18,65	61,79
Caecum	0,35	1,66	0,37	1,48	0,53	1,76
Colon + Rectum	8,35	39,67	9,70	38,69	11,00	36,45
Total	21,05	100,00	25,07	100,0	30,18	100,0
Body Length	1,81		1,94		2,05	
Ratio of Body Length to the Length of Intestine.	1 : 11,63		1 : 12,92		1 : 14,72	

Table III.

Weight (in kg) of the Digesta and the Wall of the Gastro-Intestinal Canal of three Red-deers (Cervus elaphus L.)

	Red-deer 3 "Raczy", 2 years, 94 kg	Red-deer 1 "Rogal", 4 years, 128 kg	Red-deer 2 "Stary", 7 years, 158 kg
Wall of Total Gaster.....	9,150	3,250	6,650
Digesta of Total Gaster . .		7,250	9,200
Wall of Total Intestine...	2,130	2,250	2,900
Digesta of Total Intestine.	0,470	0,270	1,200
Total Gastro-Intestinal Canal with Digesta....	11,750	13,020	19,950
Ratio of the Weight of Total Canal with Digesta to the Body Weight . . .	0,12 : 1	0,10 : 1	0,13 : 1

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DISCUSSION:

VALENTINCIC: Ich habe beobachtet, daß die Rehe, die in Netze gefangen wurden, zugrunde gegangen sind ohne Verletzungen zu sehen oder ähnliches. Ich setze voraus, daß die nervösen Störungen der Sympathicus-parasympathicus daran schuldig waren.

JACZEWSKI: Es handelt sich wahrscheinlich in erster Linie um Reizung des Nervensystems im allgemeinen, nicht nur des Vegetativen Nervensystems. Dieses Problem ist schon seit langer Zeit

bekannt und besonders in den Arbeiten von Hediger gut beschrieben. Ich meine, daß der beste Weg Sedativa und Narcotica anzuwenden ist. Ich würde vorschlagen, die Tiere in kleine Gehege zu fangen, dann 1–2 Tage kein Wasser zu geben, darauf aber Wasser mit Chloralhydrat und Leinsamen zu bieten. Die Schwierigkeit ist, daß die Dosierung sehr schwer ist. Um die Dosierung genau festzustellen, habe ich intravenöse Injectionen angewandt. Zu praktischen Zwecken ist es aber besser Narcotica zum Trinken zu bieten. Es ist auch gut nach den Fangen Chloralhydrat per rectum anzuwenden.

WEBB: Does the digestive capacity of red deer vary with the kind of food eaten at different seasons of the year (i.e., with the bulk of cellulose in the diet)?

JACZEWSKI: Material of our experiments is yet too scanty to draw clear conclusions. But we suppose that such a possibility is existing. Of course we are speaking only of the post mortem capacity. There is a great difference, between the vital capacity and the post mortem capacity of the digestive system.

RIECK: Der Unterschied der Losung von männlichen und weiblichen Stücken des Rotwildes ist auffällig. Die Frage, ob man über die Entstehung der verschiedenen Form im Darmkanal Untersuchungen angestellt hat, wird verneint.

JACZEWSKI: Ich meine, daß der Unterschied der Losung bei männlichen und weiblichen Stücken von Cerviden wahrscheinlich vom Unterschied in den Darmkanalbewegungen abhängt. Wahrscheinlich müßte diese Frage auf dem Wege von Untersuchungen der Darmkanalbewegungen erforscht werden. Das ist aber nicht leicht. Wir haben zwei Hauptlinien solcher Untersuchungen: 1. Untersuchung von isolierten Stücken – diese Methode ist leicht durchzuführen, sie ist aber für diese Frage wahrscheinlich zu künstlich. 2. Untersuchungen durch eine Fistula am Darmkanal. Solche Experimente sind aber mit Wildtieren fast unmöglich. Diese Methode kann nicht bei Narkosie durchgeführt werden, weil Narkosie die Bewegungen des Darmkanals sehr ändert, oder ganz hemmt.

WHITEHEAD: 1. Have you done any work on the blood groups of deer; and if so do red, roe and fallow deer belong to the same blood groups.

JACZEWSKI: As far as I know, we have no investigations on the blood groups in the Cervidae. From a theoretical point of view it seems impossible, that the blood of the red, roe and fallow deer should have the same antigenic properties. Interspecific differences are certain. I suppose that also subspecific blood groups are existing here as in other mammalian species.

WHITEHEAD: 2. Does the volume of blood in a stag's system vary according to season? I have noticed that the volume of blood in the spleen increases considerably during the rut.

JACZEWSKI: The spleen becomes contracted—in healthy animals—during severe stress and then the volume of the spleen diminishes. I have no own opinion about the changes of the spleen volume during the different seasons of the year. In general it may be assumed, that rather the quality of the blood changes during the year, than its volume.

After severe losses of blood, the animal drinks much of water, and the volume of the circulating blood is restored rather quickly. The quality of the blood is restored very much slower. It is possible further, that the general blood volume does not vary very much during the season of the year. Our experiments are very scanty, but from our material there is no evidence in favour of changes of the blood volume during the seasons of the year.

THURSDAY, 17 OCTOBER

STOMACH CONTENTS OF DANISH RED DEER

P. Valentin Jensen
Zool. Museum, Copenhagen

Of 200 stomach samples from Danish, wild red deer 70 have been examined so far. The samples were received from 2 areas: 1) The dune plantations south of Ringkøbing Fjord (in the following called Oksbøl), a dune and heath area mostly planted with coniferous trees, predominantly Pinus mugo, and 2) The Rold Skov area (in the following called Rold), the largest Danish forest, harbouring an original red deer population. Two thirds of the area are now planted with coniferous trees, mainly Picea abies, the rest is hardwood with Fagus silvatica as a dominant.

Samples of about 200 cm^3 were taken from the stomach contents on the spot and preserved in formaldehyde solution for later examination in the Zoological Museum.

Exact determination of the proportions of different food items must be considered impossible for the following reasons: 1) the sample examined is a very small proportion of the stomach contents; 2) the proportion of the food items in the rumen does not correspond to the proportions actually eaten owing to the way of function of the ruminant stomach; 3) the great number of very small and often much decomposed plant fragments.

A method of examination which is believed to be sufficiently accurate for the purpose of the investigations and which can be completed within a reasonable time (6–8 hours) is as follows:

About one third of the sample is kept for possible check or later supplementary investigations. The remainder is washed and examined wet in small portions under a binocular microscope. In every portion the proportions of the individual food items are estimated in percentage of volume, the different portions are compared and the final percentage calculated. Attention is paid to the presence of larger amounts of food not easily digested and which have remained in the rumer for considerable time.

At present the following can be said about the preliminary result:

Bark (of conifers) is only found in inconsiderable quantities in a few stomachs.

Browse of conifers is important in winter. Picea abies up to 80 % in stomachs from Rold, on an average 25 %. Abies up to 20 % (Rold). Pinus mugo (and silvatica) only in samples from Oksbøl. Green needles in large quantity only in a few samples from the winter months (up to 20 %). Juniperus was found in a few stomachs from Rold. *Browse of hardwood trees:* only found in small quantities in summer and autumn. Species found: Quercus, Betula, Euonomys. *Browse of heath plants:* Calluna very important, occurs in all stomachs. Constitutes from September to March an essential part of the food (up to 95 %, average 30 %). Salix repens is found in stomachs from Oksbøl from the autumn months (up to 45 %, average 10 %). Further is found: Empetrum, Erica, Vaccinium vitis–idaea and V. myrtillus, Oxycoccus, Myrica and Sarothamnus.

Grasses and grasslike plants: Very important food; is found in all stomachs and may contribute up to 95 % of the contents (average 50 %). The dominant grass is Deschampsia flexuosa (up to 95 %, average 33 %). Other grasses found are Deschampsia caespitosa, Holcus lanatus, Festuca ovina. Several grasses not yet identified. Further is found Carex. Luzula pilosa is found in January stomachs from Rold (up to 80 %).

Herbs: A few species are found occasionally in greater quantities, thus Oxalis (Rold) and Melampyrum (Oksbøl). Further are found Spergula, Galium hercynicum, Veronica montana and a few species not yet identified.

Mushrooms often constitute an important part of the food in September–October (up to 30 %).

Lichens are found in all stomachs from Oksbøl (up to 75 %, average 10 %), important food in the winter months, species of Cladonia being the most important. Further Cetraria tenuissima and Parmélia.

Ferns: Polypodium is found in a few samples from autumn (Oksbøl).

Field crops: Avena sativa is found in great quantities in a few stomachs from Rold in February (up to 90 %, average 83 %). In a single Oksbøl sample from July is found 70 % green oats (field damage). Turnip occurs in a few stomachs (up to 2 %).

DISCUSSION:

HAGEN: Seeing that you (—at the slides you showed us—) make use of symbols (t'es) besides exact figures to describe the amount of several food elements, I would like to know the reasons for this. For instance, whether the volume (basis for percentages) could not be measured in such cases?

VALENTIN JENSEN: Symbols have been used in cases where a plant has only been found in a few small fragments. Specification in percentage has only been used when the plant-fragments have been found in such a great number that they are considered to form more than 1 volume percentage.

EYGENRAAM: As the proporation of the food items in the rumen does not correspond with the proportions actually eaten I would stress the importance of studying the possibility of finding a method for corrections.

It is much more worth-while to know in what proportions different food plants are eaten than to know in which proportions they are found in the rumen.

My question is whether our Danish colleagues are willing to consider further investigations to help us in solving the problems which we in Holland are dealing with too.

FRASER DARLING: Agreed with Mr. Jensen that a strict analysis by proportions would not be significant. Trends were all that could be expected. Such analysis helped to elucidate *habits*, and part of habit is its capacity to vary, not only from season to season, but day by day. F.D. suggested that if analyses could be linked with knowledge of densities of the animals on the ground, certain species in the stomach contents, such as coniferous leaves, do not necessarily indicate desired food; similarly with lichen, which happens to be an available winter food which would probably not be desired if something better were present. Stomach contents are not only reflections of choices but of pressures.

JACZEWSKI: I wish to say a few words on our investigations in Poland about the rate of passage of food through the digestive tube.

We find that the rate of passage depends on the time of the day, on the period of the year, and on the amount of food given.

On average we find that the first parts of special coloured food (with a special dye in a special manner) are in excrements often from 16–23 hours. The end of the passage was often 11 and more days. But the beginning and the end of food passage varies greatly.

Comments from THAMDRUP who asks Webb to answer: We have tried to put up a programme for investigating the habitat in which the deer live, for—if possible—to determine how much food is taken, e.g. of different wooded plants in a certain area, and if special preferences can be shown.

We should be greatful if some of the congress members could give information of methods of this sort. Would professor Webb be able to answer such a question?

TILGNER: Food habits of our game, and damages caused by game in forests and crop, are governed by instinct.

Consumer preference studies on rats, apes, and small children showed a surprisingly high correlation between food selection and food value (nutritive value).

Did the Californian biochemists approach or assess already the nutritive value of food selected by deer kept in cages (question for Dr. Webb)?

This research would lead to fundamental knowledge and damage control.

WEBB's answer to Thamdrup and Tilgner: In the USA food habits studies on Cervidae usually attempt to use 3 methods:

A. Studies of stomach contents.

B. Field studies to determine removal of woody material from the supply available (both quantity and quality).

C. Studies of preferance determined by measuring consumption when a variety of natural foods are given to animals in pens.

Probably the best method of expressing food habits is a combination of all three of these methods.

A. Start has been made in determining nutritive value of natural foods. Biochemical analyses have been made. However, we do not know enough about the physiology of the animals to properly interpret the results.

THURSDAY, 17 OCTOBER

DAS ROTWILD JUGOSLAVIJAS

Prof. dr. *Valentinčič Stane*
Ljubljana, Jugoslavia

Aus der Geschichte.

Im Laufe der Geschichte und bis zum vorgangenen Jahrhundert war das ganze Gebiet heutigen Jugoslavijas reich an dem Hirschwilde. Das bestätigen uns sowie die Historiker und Chronisten als auch zahlreiche und verschiedene Zeichnungen und Bas-reliefe mit Jagdmotiven und endlich zahlreiche Ortsnamen.

Im XIX. Jahrhundert ist aus politisch-militärischen und teilweise wirtschaftlichen Gründen im größeren Teile Jugoslavijas zu vollkommenen oder fast vollkommenen Ausrottungen des Rotwildes gekommen. In Serbien, Bosnien, Mazedonien und Montenegro — das ist südlich von der Linie, die die Flüsse Sava und Donau (von Beograd an) bilden-waren die Hauptursachen des Unterganges des Rotwildes: die Plünderung der Wälder, die mit der Entwicklung der Industrie begann, die Intensivierung des Verkehrs und der Verkehrsmitteln, die Wolfe, die Kriege und vor allem das regale System des Jagens. Das alles hatte zum Folge, daß bis zum Ende des XIX. Jahrhunderts das Rotwild, mit seltenen Ausnahmen, ganz ausgerottet war.

Auch in nord-westlichen Gegenden Jugoslavijas kam damals nahezu zur Ausrottung des Rotwildes. Die Ursache war die Revolution des 1848. In folgenden Jahrzehnten haben die befreiten Bauer das Rotwild, die vorher planmäßig bejagt wurde, planlos zu bejagen und zu verfolgen begonnen. Doch kam am Jahrhundertwende auf diesen Gebieten zu zahlreichen Einbürgerungen des Rotwildes, sei es in Gegenden, wo schon das Rotwild lebte, als auch in anderen. In den Gegenden nordlich von Sava—Donau, die unter Einfluß Oesterreich-Ungarns waren, war die Jagd schon früh organisiert und zwar meist nach dem dominalen System. Dieser Tatsache ist in erster Linie zuzuschreiben, daß sich in diesen Gegenden das Rotwild bis zu heutigen Tagen zahlreich aufbewahrt hat, trotz zwei Weltkriegen, die in erster Linie gerade dieser Wildart fühlbare Schaden

zugebracht haben. Heutige Jugoslavija kümmert sich viel um die Jagd und seine Fortschreitung. In dieser Zeit sind an drei Orten südlich von Sava-Donau die Ansiedlungen des Rotwildes ausgeführt.

Heutige Verbreitung des Rotwildes in Jugoslavija.

Südlich von Sava-Donau leben die letzten Reste des autochtonen Balkanhirsches *(Cervus elaphus subspecies Morihovo,* nach Martino) und zwar in Mazedonien auf Morihovske planine (Morihovo-Gebirge), einige Stücke auch in der Gegend Demir-kapija. Außerdem leben seit einigen Jahren südlich von Sava-Donau zwei Rotwildkolonien, die eine bei Biograder-See (Monte negro), die andere auf dem Gebirge Jastrebac (Serbien) und die dritte bei Lipovica (Serbien). Hieher sind sie nach dem Jahre 1950 aus Donau-Auen gebracht.

Nördlich von Sava-Donau Linie leben ungefähr 15.000 Stücke des Rotwildes (amtl. Statistik von 1954 gibt 12.350 an). Wir können oberflächlich die Hirschgebiete folgendermaßen einteilen: Donau-Drava-Gebiet (Haupthirschrevier Belje), Bosut-Spačva-Gebiet (Haupthirschrevier Bosuter Jagdrevier), Slawonien, Karstengebiet (Haupthirschrevier Schneeberg) und Alpengebiet (Revier Puterhof).

Was für Rotwild gibt es in Jugoslavija?

Unter anderem hat auch die Internationale Jagdausstellung in Düsseldorf gezeigt, daß Jugoslavija sehr gute Hirsche hat. Dabei sind hier die Hirsche sehr verschieden, sowie nach ihrem geschichtlichen Ursprunge, als auch mit Absicht auf ihr Standort, das sehr verschieden ist.

Morihovo-Hirsche und die Hirsche aus dem Bosut-Spačva-Gebiete gehören zum maraloiden Typus, die anderen aber zum hypelaphoiden Typus. Doch gibt es auch unter diesen Rassen beträchtliche und zahlreiche Nuancen.

THURSDAY, 17 OCTOBER

14,00 Chairman: R. Amon. Secretary: Johs. Andersen.

UNTERSUCHUNGEN AN 460 ZUGRUNDEGEGANGENEN REHEN

K. Borg

Statens veterinärmedicinska Anstalt, Stockholm, Sverige

Bei dem in den Jahren 1948-1956 gesammelten Obduktionsmaterial von 460 Rehen aus verschiedenen Gebieten Schwedens verteilen sich die Todesursachen auf folgende drei Hauptgruppen:

Unterernährung	58,7 %	(270/460)
Traumatische Schädigungen	23,5 %	(108/460)
Krankheiten u.a.m.	17,8 %	(82/460)

Die Unterernährung war in den meisten Fällen allein durch Hunger verursacht. Die an Entkräftung gestorbenen Rehe wurden während der Wintermonate untersucht, und zwar besonders in den Jahren, in denen der Winter ungewöhnlich hart und schneereich war, wie z.B. 1955-56. Aus dem Material ergibt sich, daß das Winterklima eine auslesende Einwirkung auf die Gattung der Rehe ausgeübt und die Ausmerzung schwächerer Stücke zur Folge gehabt hat.

Die traumatischen Schädigungen waren zum größten Teil durch Raubtiere verursacht, und zwar durch Hunde, Füchse, Luchse und Vielfraße. Der Unterschied in der Art, auf die die Raubtiere ein Reh reißen, ermöglicht es oft, durch Sektion festzustellen, welches Raubtier dem Reh Verletzungen zugefügt hat. Das Reißen erfolgte meistens im Winter und betraf vor allem kranke oder schwächliche Rehe. Andere traumatische Schädigungen waren durch Überfahren verursacht, durch Forkeln bei Kämpfen in der Brunft usw.

Die eigentlichen Krankheiten bestanden zum großen Teil in Infektionskrankheiten. Es handelte sich sowohl um Allgemeininfektionen (Clostridium septicum, C. perfringens, Streptokokken, Kolibakterien) als auch um lokale Prozesse in verschiedenen Organen wie etwa Lunge, Leber, Uterus (Pyogenesebakterien, Nekrosebazillen, Aktinomykose). Ferner fanden sich ziemlich viele Fälle eines Verdauungsleidens von nicht ganz klarer Ätiologie (Enteromykose?). Schließlich wurden in manchen Fällen Krebsgeschwülste und Arsenvergiftungen festgestellt.

DISCUSSION:

M.-K. LUND: Hat man auch Rehe, die von Adlern getötet worden waren, gefunden? Solche Fälle sind ja in Norwegen mehrere Male in Zeitungen beschrieben.

BORG: Es ist bekannt, daß in Schweden Rehe von Adlern angegriffen worden sind, im erwähnten Untersuchungsmaterial gibt es aber keine solche Tiere.

JACZEWSKI: Ich möchte fragen, ob Sie auf einige Fälle Maul- und Klaueseuche in Schweden beobachtet haben?

BORG: Maul- und Klauenseuche ist in Schweden beim Reh nicht nachgewiesen, ein Fall – obgleich nicht ganz sicher – ist aber beim Elch beschrieben worden (Svenska Jägareförbundets tidsskrift 1939, Deutsche tierärztl. Wschr. 1939).

RIECK: Dr. v. Braunschweig hat im extrem kalten Winter 1955/56 als Todesursache zahlreicher Rehe Kreislaufschädigungen festgestellt. Bei den verendeten Rehen fehlte Körperfettvorrat. Kitze und alte Rehe überwiegen bei dieser Kälteverlusten. Guter Ernährungszustand vor der Notzeit und Wärmeplätze können die Verluste voraussichtlich verringern.

THURSDAY, 17 OCTOBER

OBJEKTIVISIERTE QUALITÄTSBEWERTUNG DES POLNISCHEN REHWILDES (CAPREOLUS CAPREOLUS)

Prof. Dr. Ing. *Damazy J. Tilgner*
Politechnika Gdanska Polen.

Für die Wildkunde, Wildzucht und Wildverwertung ist eine möglichst objektiviserte Qualitätsbewertung von grundlegender Bedeutung. Die bisher übliche Qualitätsbewertung bei Rehwild stützt sich in der Praxis vorwiegend auf der Auswertung der Geweihform, der Qualität der Trophäe und der gefundenen Abwurfstangen und Feststellung des Gewichtes. An Hand dieser Qualitätsmerkmale werden Schlüsse über den Stand und Gang der Vererbung, Degeneration, Einfluß der Äsungsverhältnisse und dergleichen gezogen. Diese konventionelle Qualitätsmaßstäbe sind für die allgemeine Praxis wohl ausreichend, werden sich aber für künftige wissenschaftliche Vergleiche nicht als genügend erweisen.

Es ist anzunehmen, daß sich die vertiefende internationale Zusammenarbeit mit der Zeit zu einer weitgehenden zahlenmäßigen Erweiterung und qualitativen Auffrischung unserer wichtigsten Wildbestände führen kann. Es ist angebracht schon jetzt von der Jagdwissenschaft weit mehr objektive Gütemaßstäbe zu verlangen, insbesondere wenn es sich um zukünftige Wildumsiedelungen handeln wird. Es wäre zu begrüßen ein Übereinkommen zwecks Vereinheitlichung dieser wissenschaftlichen Güteprüfungsmethoden zu ermöglichen.

Polnisches Rehwild aus den nordöstlichen Jagdrevieren auf einer rund 400 km Länge des Weichselflusses ab Stromkilometer 600 beiderseits flußabwärts wurden erfaßt und folgende Qualitätsmerkmale festgestellt:

Körperform: im Liegen an 7 Körperstellen nach Auflösung des rigor mortis. Geringe Unterschiede zwischen den Geschlechtern. Es wurde nur Durchschnittswild analisiert und die Extremvarianten ausgeschlossen.

Gewichtsmerkmale: Über 50 % der analysierten 1097 Stück Rehwild hatten ein Abschußgewicht (ausgebrochen, mit Fell, Böcke ohne Kopf) zwischen 15—18 kg. Das Kaltgewicht (als Zweihälfteausbeute, ohne Fell, Kopf und Füßen) nach 48 Std. Kühlhauslagerung beträgt rund 59 % des Lebendgewichtes.

Teilstücke und Dissektionsanalyse: Der Kaltkörper wurde in 2 Kalthälften, diese in 5 Teilstücke geteilt und die Teilstücke in Fleisch, Fett und Knochen zerlegt. Hinzu kam die Messung der Rückenmuskelfläche.
Fleischanteil durchschnittlich 79 % im Verhältnis zum Kaltgewicht 18 kg als 100 %, mit Schwankungen von 74,7 bis 82,5 %. Negative Korrelation zwischen dem Fleisch- und Fettanteil. Die Keule beträgt 40,8 % des Kaltgewichts, das Schulterblatt mit Hals 30,4 %, die Lende 11,8 %.

Rückenmuskelfläche: Der Trennschnitt hinter der 12. Rippe zeigt die Tiefe und Breite des m. longissimus dorsi als Maßstab des individuellen Knochengerüstes und Heratabilität sowie der Äsungsverhältnisse.
Gesamtfläche rund 30 cm^2 mit einer Tiefe von rund 7 cm und Breite von 4,25 cm. Bei schlechten Äsungverhältnissen verringert sich die Breite des m. longiss. dorsi auf 3,5 cm und des "eye of loin" wird bedeutend kleiner. Die Rückenmuskelfläche sollte grundsätzlich immer ausgewertet werden.

Chemische Zusammensetzung: im Fleisch rund 21,61 % Eiweiß, 1,85 % Fett, 1,09 % Mineralstoffe und 73,68 % Wasser. Kein Unterschied zwischen Böcken und Ricken.
Die Konsistenz entspricht einem Penetrometerwert von 392—480 g und ist zartem, gekochtem Schweineschinken ähnlich.

Eine neuzeitliche Qualitätsbewertung bedingt die Erfassung anderer Faktoren, die unser Wild quantitativ und qualitativ beeinflussen. Außer den angeführten Qualitätskomponenten sollte noch das Fleischsaft-Bindungsvermögen geprüft werden, da es die biochemischen Verhältnisse des Fleischgewebes wiederspiegelt und sehr aufschlußreich ist.

DISCUSSION:

FRANK: 1) Die Bewertung verliert meiner Ansicht nach ihren Wert da wir bei ♂ keine Altersangaben haben.

2) Sind Untersuchungen angestellt, wie die Qualität bei einzelnen Schüssen ist. Blatt usw.

LEONHARD: Die Feststellungen sind von grosser Bedeutung für die Frage, ob bei Überhege eine Verschlechterung des Wildbestandes eintritt. Um Fehlerquellen auszuschalten muß das untersuchte Material aufgegliedert werden.

1) nach Geschlecht
2) nach Alter
3) auf Monaten in denen das Wild erlegt werden.

Sonst sind die Fehlerquellen zu groß.

TILGNER: (Antwort für beide Fragesteller.) Die Erfassung der vielseitigen Einzelheiten und die Aufteilung des Untersuchungsmaterials in Gruppen kann erst dann erwartet und angefordert werden, wenn erst eine grundsätzliche Arbeitsmethode ausgearbeitet worden ist, die eine derartige detaillierte Erfassung überhaupt ermöglicht.

Bisher bedienten sich die Jagdwissenschaften nur recht einfacher, überwiegend beschreibender und oft ziemlich subjektiver Untersuchungsmethoden, die überhaupt eine tiefgreifende Qualitätsbewertung nicht zulassen.

Andersen's Analyse einer dänischen Rehwildpopulation wäre gewiß noch weit aufschlußreicher, wenn zusätzliche Gütekomponente wie z.B. die »Rückenmuskelfläche« (eye of loin) der damaligen extermitierten Population festgestellt worden wäre, was einen Vergleich mit der jetzigen, neuen Population ermöglichen würde und weitere Aufschlüsse anbahnen könnte.

Das Ausmaß der Fehlerquellen kann durch statistische Analyse genau erfaßt werden. Vorerst handelt es sich darum, orientierende Werte für beide Geschlechter an Hand einer möglichst präzisen Untersuchungsmethodik zu erhalten. An Hand dieser kann dann erhofft werden, daß bei genügendem Untersuchungsmaterial, Zeit und Geld diese angeforderte, logische Aufteilungen durchanalysiert werden, vorausgesetzt daß eine derartige Zweckforschung als begründet angesehen werden kann und tragbar ist.

THURSDAY, 17 OCTOBER

SEX EQUATIONS IN ROEDEER

R. F. de Fremery
Amsterdam, Holland

Some of the theories on the optimum sex ratio in a roedeer population give this ratio as 1 : 1 because this would be the natural situation. Nature has to give us the facts and test-materials for our problem, but it does not need to give us its causal relations in obvious circumstances.

The European literature on this subject does not give a clear-cut answer on it either, because of its vague premises, its simplified conclusions and certain contradictions between its authors. This gave a Netherlands' mathematician D. Kruyswijk an opportunity to do some arithmetical research into the subject.

Kruyswijk takes an area in which a stable number of roe-buck (b) and of doe (g) is found in the spring. He supposes that the sex ratio b : g is approximately known.

Which will be the most appropriate shooting ratio in this area? By ,,shooting ratio" he means the ratio between the number of buck shot in summer and the number of doe shot in winter.

Game shooting is considered ,,appropriate" if one may except the sex ratio b : g to be re-established in the following spring in order that the roedeer population remains stable.

First he presumes, that the number of doe, which has to be killed, has been estimated by game management of the area and that this estimate proved reliable during a sequence of years.

Then the appropriate number of buck, available for game, must remain within the limits of the following formula:

$$\frac{d_b}{d_g} = C_1 + \left(\frac{C_2}{k} - C_3\right)\left(1 - \frac{b}{g}\right)$$

Here C_1, C_2, C_3 are numerical constants, whereas k is the number between 0 and 1 which denotes the fraction of doe, which is destined to be shot in the coming winter. d_b = number of buck shot; d_g = *idem* for doe.

The constants C_1, C_2, C_3 can be found by calculation for any area, on which the numerical data concerning roedeer-census and -shooting have been recorded for a sequence of years, e.g. from 1947 to 1957. If these data are sufficiently detailed, the appropriate value of k, which otherwise must be estimated, can also be computed.

The theory contains formulae, adapted for that aim.

But, even if such a scientific test is not undertaken, the simple laws on which the theory has been founded should be interesting to anyone who is concerned in the game-management of roedeer.

The most important laws are as follows:

I. (Second law in Kruyswijk's theory). The appropriate number of doe which must be killed, is independent of the number of buck which lives on the area. In other words: the factor k (see above) does not change its appropriate value, if the number of buck is diminished or increased.

II. (First law in Kruyswijk's theory). The absolute difference between the number of doe and the number of buck (in the underlying notation g — b) does not change its value when, in the month of May, the young buck and doe are born. It has a tendency, however, to diminish strongly during the season, which decrease is mainly due to the natural mortality of the deer.

Shooting more buck than doe is the only way to re-establish the original difference between the numbers b and g.

The further theory, emerging from these and some other laws, confirms the opinion that low sex ratios are undesirable. On the other hand, the theory does not provide any argument in favour of the sex ratio 1 : 1. It seems indicated, that certain reductions of the equilibrium between sexes have advantages against minor detriments. So far Kruyswijk.

We may find an illustration of Kruyswijk's second thesis in Leopold's population curve gathered from the maximum breeding potential for the American deer. Another derivation of Kruyswijk's theses may be found with Gruschwitz' arithmetical model of stable roedeer populations. Only for this purpose we added also the influence of other decimations than shooting in this life equation.

The theory and its formulae, if agreed upon, need practical completion with census reports from roedeer populations in differing environments. For the game warden it can give an indication of what he may expect from the development of the roedeer population in his territory.

DISCUSSION:

UECKERMANN: Es werden für die von Herrn de Fremery aufgestellten Formeln Zahlenwerte gegeben, die sich auf ein praktisches Beispiel beziehen sollen. Angenommen wird ein Rehwildbestand, bei dem der Zuwachs 100% der am 1. 4. vorhandenen Ricken und Schmalrehe beträgt. Das Zielalter soll 5 Jahre, das Geschlechterverhältnis 1:1 betragen, der Zuwachs soll voll genutzt werden. 6,25 weibliche Kitze und 6,25 Bockkitze bzw. Jährlinge sollen im Laufe des Jahres abgeschossen werden, so daß sich der Zuwachsfaktor entsprechend verkleinert. Δ g und Δ b sollen o sein, S soll o sein und d_b und d_g je 6,25.
In der Grundgleichung

$$b + \Delta b = (1-S). \quad (b-d_b) + \tfrac{1}{2}(1-\varsigma)\, p \,.\, g$$

ist ω dann 0,25.
Errechnet man für die obigen Werte ω aus der Formel

$$\omega = \frac{\frac{b}{g}(d_g + \Delta g) - d_b - \Delta b}{b - g + \mu d_g - d_b}$$

erhält ω den Wert o.

Daraus wird gefolgert, daß in der Ableitung noch Fehler sein müssen. Es erscheint danach notwendig, die Ableitung vor Veröffentlichung nochmals zu überarbeiten.

Das Vorhaben von Herrn de Fremery, durch Anwendung mathematischer Formeln Fragen einer optimalen Bestandesgliederung zu untersuchen, wird als notwendig und begrüßenswert angesehen.

THAMDRUP: It is always interesting to see attempts being made to use mathematics as a tool for solving biological problems.

Mr. Kruyswijk and Mr. de Fremery seem not only to intend giving a pure mathematical treatment but intend too—as it is mentioned at the end of the summary, to help the game warden to manage his roedeer population in practice.

To get a basis for calculating certain constants in the formula used it is supposed e.g. that sex ratio and other data can be obtained from certain census methods in a reliable form. If these data are sufficiently detailed—it is said—the appropriate value of e.g. K (in the formula) can be computed.

I find it necessary to stress this "if", because our experience from Kalö and other localities will show that ordinary observations and census methods do not seem satisfactory. Only through the extermination of the entire roedeer stock (or through very intensive capture-marking-release experiments) we have been able to get figures of that sort which are needed for your formula, and in practise—I believe—such measures cannot be taken. I therefore think your approach to the problems —until better and easier census methods can give you the figures wanted—will mainly have a theoretical aspect.

MÜLLER-USING: Die mathematische Behandlung der Wildbestandsschwangen ist auch in Deutschland schwer erfolgt. So ist mehrfach der Nachweis geführt, daß ein Wildbestand stets wider einem naturgegebenen Geschlechterverhältnis zustrebt, oder daß das Verhältnis von Alttieren zu Schmaltieren beim Rotwild keineswegs beliebig variiert werden kann.

Einfacher und sinnfälliger scheint aber doch das Hofmannsche Darstellungsschema, nach dem in Deutschland überwiegend verfahren wird – insbesondere für die Praxis.

FRIDAY, 18 OCTOBER

9,00 Chairman: H. M. Thamdrup. Secretary: Johs. Andersen.

WILDLIFE RESEARCH ON THE HUNTINGTON WILDLIFE FOREST

William L. Webb

Dept. of Forest Zoology, State University of N.Y., Syracuse, N.Y., U.S.A.

The Huntington Wildlife Forest is a 15.000 acre (6.000 ha) area in the Adirondack Mountains of New York State. This forest is used primarily for research on the ecology and management of forest wildlife. The term wildlife is used in its broadest sense to include not only the game animals but also other vertebrate animals which live in the biotic community of the forest. Major emphasis is given to the game species, but research is also being conducted on fur-bearing animals, small rodents and insectivores, song- and insectivorous birds, and fish of the lakes and streams.

The majority of this research work is of a long-term nature. Many agencies in the U.S.A. are studying current wildlife problems, but relatively little research is being done on the problems which take many years of study before conclusions can be drawn. On the Huntington Wildlife Forest we are attempting to anticipate the wildlife management problems of the future, and to initiate research which will form the basis for wildlife management practices of future generations. Most of our research plans call for continued work over many years, rather than projects conducted on a year-to-year basis.

One of our important research efforts deals with the effects of forest management practices on wildlife populations. Five rather large segments of the Huntington Wildlife Forest have been dedicated to this project. On each area a different intensity of forest management has been established. In the most intensively managed area the cutting cycle will be from 5 to 10 years, while on the least intensively managed area the cutting cycle will be 40 to 50 years. An unmanaged "control" or "natural" area has also been established.

On each of these areas the animal populations will be measured for many years. Populations of whitetailed deer (*Odocoileus virginianus*) are determined by deer drives, by pellet counts, and by track counts; ruffed grouse (*Bonasa*

umbellus) numbers are determined by the King census method; squirrels (*Sciurus hudsonicus*) are counted by a time-area census; song- and insectivorous birds numbers are measured by singing bird counts; and small mammal population levels are measured by trap-sampling by the N.A.C.S.M. technique.

Vegetation of these five areas is determined at regular intervals by study of permanent sample plots. As the forest management work continues, we hope to evaluate the changes in the dominant tree canopy and in the sub-dominant vegetation. Eventually we hope to be able to correlate changes in the animal populations with changes in the vegetation so it may be possible to know which of the environmental components influences the animal numbers.

Work on the whitetailed deer is especially important in this research program because this species is the most important game species of the region. Population levels are determined by deer drives, pellet counts, and track counts. Seasonal variations in food habits have been investigated. Mobility of individual animals has been studied by trapping, marking, and release. We have made some progress with determining longevity and mortality based on marked animals. Seasonal selection of habitat and relation of animals to food and shelter is being investigated by direct observation and by sampling procedures.

DISCUSSION:

FRASER DARLING: Appreciating the fact of the research of professor Webb's Institute not being biassed by the origins of its funds. One of the needs in wild-life research is for more fundamental studies. Answers to many game problems cannot be answered at the game level, because they involve geology + physiography + plant + invertebrate animal ecology. Particular attention was called to the work of the Danish school of invertebrate animal ecology in revealing the nature of conversion cycles, on which agriculture + game-cropping depend.

HAGEN: Are you trying to make a census of the beaver, and can you give us an idea of the census methods used?

WEBB: Two types of beaver censuses are in current use in the U.S.A.: (1) On extensive or remote areas the airplane is often used to determine the number of occupied beaver colony sites on an entire stream drainage area. Dr. John L. Buckley of the University of Alaska at Fairbanks, Alaska has used such a procedure for determining beaver numbers of large areas that are very difficult to get to on foot. (2) On smaller areas the usual procedure is to visit each colony site in the fall of the year to determine which sites are occupied. An experienced biologist can determine the beaver numbers at each site with fair accuracy. Of course all potential sites must be visited each year to determine if new areas are occupied. This is the technique we are using on the Huntington Wildlife Forest. In 1957 we had 37 sites; 19 of these sites were occupied; and there were 115 beavers on the area.

VALENTINCIC: May I ask Dr. Webb to tell us a few words more about census methods used, especially about the pellet census method and about the King census method?

WEBB: Our census methods can be grouped into four types:

A) Direct counts. For some animal species the total population may be observed and counted. For example the Antelope (*Antilocapra americana*) is frequently counted from an airplane in their grassland habitat, and the Elk (*Cervus canadensis*) in some cases are counted in special areas where they are fed in the winter time.

B) Direct counts on sample areas. The King method of censusing Ruffed Grouse (Bonasa umbellis) is of this type. Here the biologist walks along lines which are laid out to give an accurate sample of the forest area to be censused. When he flushes a Ruffed Grouse he measures the distance from him to the point where the bird flushed. The average of these flushing distances is used as a measure of grouse behavior in this particular forest area and under the existing weather conditions for that day and season. The length of the line walked multiplied by twice the average flushing distance is the area on which the grouses were flushed. This gives the grouse density per acre of ground and this may be applied to the entire area.

C) Ratio Censuses. This type requires the marking of a part of the population so that they may be recognized as a component of the entire population. Following the marking period there is a period of observation or trapping to determine the ratio between marked and unmarked animals. This type is quite widely used in U.S.A., and is especially well known because of its use for waterfowl where it is called the Lincoln Index.

D) Indexes to Animal Populations. In an index type of census something is measured which is related to the animal population. On the Huntington Wildlife Forest we are counting the number of white-tailed deer pellets deposited on sample areas. The number of pellets per acre of sample per unit of time is used as an index to the population level. If the number of pellets per acre increases by 30 per cent. from one year to the next, we believe this means a 30 per cent. increase in the deer population.

TILGNER: Are you using general or specific statistical formulas in your work?

WEBB: We are using both. Most of our statistical analysis uses general formulas. However, in some cases specific formula's have been developed and are being tested.

TILGNER: Who approves your research projects from the scientific and community point of view before you get started?

WEBB: The officials of my own College review research proposals from many different points of view. These men are outstanding scientists in their own right and also are aware of the scope of research possibilities in the biological sciences. These men review the proposals submitted to them, and usually we have detailed conferences on purposes of the research, experimental design, and expected costs. These conferences are always pleasant contacts as they give the research man the opportunity to profit by the experience and the keen mind of the College staff.

FRIDAY, 18 OCTOBER

PREVENTING GAME DAMAGE TO CROPS BY USING IMPREGNATED CORD

J. A. Eygenraam
Institute for Biol. Field Research, Arnhem, Holland

A preliminary report is given about an investigation regarding the protection of agricultural, horticultural and forest crops from damage by hares, red deer, roe deer and rabbits.

Such protection could be obtained by putting a $^1/_8$" string impregnated with bone tar oil (Oleum animale foetidum) round the field concerned. The most effective height varied with the size of the game species: 15-20 cm for rabbits and hares, 70 cm for roe deer and 120 cm for red deer. The results of observations are summarised in Table 1. Cases in which no damage occured within one month are marked with the symbol +; less favourable results with —.

The method proved to be more effective against hare and red deer than against roe deer and rabbits.

The costs amounted to about D. fl. 5.— per 100 m. for the first application. The material could be used more than once. Protection lasted for at least one or two months. The investigations are being continued in order to obtain more precise information on the factors which cause the animals to stay away from the protected fields.

Tabel I.

Exp. area Proefveld	Hare Haas	Exp. area Proefveld	Roe deer Ree	Exp. area Proefveld	Red deer Edelhert	Exp. area Proefveld	Rabbit Konijn.
1	+	4	+	5	+	9	+
2	+	5	+	6	+	10	—
3	+	6	+	7	+	11	—
5	+	8	+	8	+	12	+
6	+	16	+	27	+	19a.	+
13	+	17	+	38	+	19b.	+
14	+	18	+	39	+	28	+
15	+	20	+	40	+	29	+
21	+	27	+	42	+	32	—
22	+	30	—[1]	44	+	34	+
23	+	31	+	45	+	35	—
24	+	33	+	60	—	41	+
25	+	35	+		92 %	51	—
26	+	36	—[2]				62,5 %
27	+	37	—[2]				
41	+	43	—[2]				
50	+	44	+				
52	+	45	+				
53	+	48	+				
54	+	49	+				
55	+		80 %				
56	+						
57	+						
58	+						
59	+						
	100 %						

[1]) Tamme Reebok.
Tame Roebuck.

[2]) Alleen veegschade.
Rubbing damage only.

DISCUSSION:

VALENTINCIC: How were the results on the control-areas?

EYGENRAAM: When on the same flower-field one part was circled by the impregnated string, the other not, the damages only happened on the unsurrounded areas. However, we have not yet the quantity dates.

UECKERMANN: In Deutschland wird Tieröl (Oleum animale foetidum) seit vielen Jahrzehnten als Verwitterungsmittel verwandt. Es wurden aber getränkte Lappen oder Schwämme in kurzen Abständen aufgehängt. Der Abwehrerfolg war dabei nicht immer befriedigend.

In Verbißmittel wird Tieröl t.T. seit 50 Jahren eingebaut. Es gab in neuerer Zeit sogar ein Verbißmittel, das zu über 90% aus Tieröl besteht. Dieses Mittel entspricht heute wegen zu geringer Sicherheit in der Abwehrwirkung nicht mehr den in Deutschland gestellten Anforderungen.

Typisch für unsere Ergebnisse waren sehr unterschiedliche Wirkungen in der Abwehr. Die Ergebnisse streuten auch für die einzelnen Wildarten stark.

Wir verwenden auch Verwitterungsmittel zum Schutz gegen Fegen, u.a. wurden Versuchen mit Bindfäden durchgeführt, die mit Fettsäure getränkt waren. Es trat dabei keine Abwehrwirkung hervor, da etwa die gleiche Zahl von geschützten und ungeschützten Pflanzen gefegt wurde. Schälschutzmittel mit Tierölzusatz versagten ebenfalls teilweise.

EYGENRAAM: Gerade weil viele Verwitterungsmittel in ihre Abwehrwirkung stark schwanken, ist es wichtig zu wissen, worauf die Wirkung basiert ist. Dann ist es leichter, die Ursachen der Mißerfolgen zu finden.

TILGNER: The sense of smell regenerates very fast. Most probably anosmia is hardly found among wild animals. Different smells evoke different degrees of pleasantness and unpleasantness in the receptor and psycho-physiological reactions which could be measured by different physiological means, for instance the increase in body waves, blood pressure etc. By analysing the changes in physiological behaviour caused by different smells in game we could obtain fundamental data for future field repellent work.

EYGENRAAM: Our institute is not suitable for such experiments as you suggest here. But we are working in close contact with the Laboratory for Sensorial Physiology at Utrecht and there these experiments could be undertaken.

FRIDAY, 18 OCTOBER

TECHNISCHE SCHUTZMASSNAHMEN ZUR VERHÜTUNG VON ROTWILDSCHÄLSCHÄDEN IM WALDE

von Dr. *Erhard Ueckermann*
Meckelfeld über Harburg 1, D. B. R.

Nach den Untersuchungen der letzten Jahre wird der Umfang des Schälschadens durch Schalenwild in Waldrevieren maßgeblich von der Wilddichte und den Ernährungsgrundlagen im Revier beeinflußt (2, 3, 4). Zur Verminderung der Schälschäden muß nach diesen Untersuchungsergebnissen

1.) Die Herstellung einer wirtschaftlich tragbaren Wilddichte und

2.) Die Verbesserung der Ernährungsgrundlage in den Revieren

angestrebt werden. Beide Maßnahmen reichen aber für einen den wirtschaftenden Forstmann voll befriedigenden Schutz der Bäume nicht aus, so daß auf die *Vornahme technischer Schutzmaßnahmen* gegenwärtig nicht verzichtet werden kann. Bei einer Rangordnung der möglichen Abwehrmaßnahmen stehen die Herstellung der wirtschaftlich tragbaren Wilddichte und die Vornahme technischer Schutzmaßnahmen als gleichwertige und gleichzeitige vorzunehmende Maßnahmen an erster Stelle. Die Verbesserung der Äsungsgrundlage in den Revieren als weniger betriebssichere und teure Verhütungsmaßnahme tritt an die zweite Stelle.

Technische Schutzmaßnahmen werden begrifflich unterteilt in den *Flächenschutz* und *Einzelschutz*. Ein Flächenschutz ist mit Hilfe von Einzäunungen möglich. Diese versperren aber wegen der langen Schälgefährdung der meisten Baumarten größere Waldteile sehr lange. Zur Abwehr von Schälschäden bleibt die Gatterung daher auf Ausnahmefälle beschränkt. Außerdem ist zum Flächenschutz die Verwitterung zu rechnen, die sich aber in der Mehrzahl der Fälle bei neueren Untersuchungen als nicht genügend wirksam erwiesen hat. Angewandt wird zur Abwehr der Schälschäden vornehmlich der Einzelschutz. Nach HEUELL (1) werden als Einzelschutzmaßnahmen der chemische Schälschutz, der mechanisch-biologische Schälschutz und der mechanische Schälschutz unterschieden. Diese Aufteilung kann auch nach neueren Untersuchungen beibehalten werden.

Beim *chemischen Schälschutz* werden die Stämme in ihrem schälgefährdeten Teil mit chemischen Präparaten bestrichen oder bespritzt. Die Schutzwirkung der in neuerer Zeit entwickelten Präparate ist fast 100 %ig. Die Wirkungsdauer ist je nach Baumart und Alter der zu schützenden Stämme auf 4 bis 8 Jahre begrenzt. Die Anwendung des chemischen Schälschutzes ist ohne Gefahr von Pflanzenschäden bei allen Baumarten möglich. Bei dem gegenwärtigen Lohnniveau entstehen Schutzkosten je Stamm zwischen 0,20—0,70 DM.

Bei der Vornahme des *mechanisch-biologischen Schälschutzes* wird die Rinde der Bäume oberflächlich mit Hilfe von Kratz-, Hobel- oder Punktiergeräten verletzt. Durch eine vom Korkkambium (Phellogen) ausgehende Wundkorkbildung wird die Rindenoberfläche rauh. Bei den Nadelholzbäumen wird die Schutzwirkung anfänglich durch Harzaustritt unterstützt. Günstigster Zeitraum für die Vornahme des Schutzes sind die Monate Mai bis Juni, möglich ist die Behandlung von Mitte März bis Mitte September. Die zu erzielende Schutzwirkung lag bei bisherigen Versuchen im Bereich von 95 %. Voll erprobt und anwendbar ist der mechanisch-bilogische Schälschutz für die Baumarten Fichte, Douglasie und Tanne. Für Buche kann das Verfahren nur unter bestimmten Vorbehalten empfohlen werden. Für die Baumarten Lärche und Kiefer sind die Versuche noch nicht abgeschlossen. Die Schutzkosten liegen mit 0,02 bis 0,12 DM je Stamm sehr niedrig.

Von den *mechanischen Schälschutzverfahren* hat sich der Grüneinband als sicherster und wirtschaftlichster Schutz für die jüngsten Altersstufen der Baumarten Fichte, Douglasie und Lärche bewährt. Die Schutzwirkung erwies sich bei umfangreichen Versuchen als 100 %ig. Die Schutzkosten je Stamm liegen im Bereich von 0,15 bis 0,25 DM.

Gute Schutzwirkung ergibt auch der Trockeneinband. Wirtschaftlich ist das Verfahren aber nur, wenn die zu behandelnden Stämme gleichzeitig aufgeastet werden.

Nicht bewährt hat sich die Verwendung von Glasfaserstreifen.

LITERATURHINWEISE

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FRIDAY, 18 OCTOBER

14.00 Charmain: H. M. Thamdrup.

SYMPOSIUM ON DEER-PROBLEMS

The discussion called forth by Dr. Ueckermann's paper assumed the form of a well attended symposium on deer problems. The main items of the discussion are summarized here.

Population changes.

Although the Red Deer populations have increased at a somewhat different rate in different countries a perceptible increase would seem to have taken place over the last 15–25 years in certain countries, e.g. in Austria, Germany, Holland, England, Scotland, Denmark and Norway. Everywhere in these countries deer damage to woods has become a problem. In most places also the Roe Deer populations have increased.

Estimation of Red Deer damage.

In certain places in Germany Red Deer damage to mature spruce stands has been estimated to cause a depreciation in value of 7 per cent.

In one Danish forest district the barking activity of an unfenced Red Deer herd reduced the returns from Norway spruce plantings by close on 10 per cent.

The difficulties encountered in the estimation of Red Deer damage to forests are considerable but in several countries the more obvious forms of damage have called forth more or less outspoken claims that measures should be taken against Red Deer. In order to counter too drastic claims of this kind research work is being done to shed light on the biology of Red Deer, the carrying capacity for Red Deer of different habitats and on means of averting or minimizing the damage.

Census methods.

A necessary basis for estimating deer damage must be correct information on the absolute size of the population causing it. Likewise game plantings, forage fields and supplementary feeding of the herd have only a rational meaning when a detailed knowledge of the population size serves as a background. The same applies when control of the population size is used as a tool in game management and in this case such factors as reproductive biology and population turnover must also be known.

The current census methods for Red Deer are based upon more or less intensive observations on the herds. Tracks left in the snow often furnish a basis for taking stock of the population of a certain area.

It is the experience in Denmark that in censuses of Roe Deer made in the usual way the population estimate is about three times too low. (cf. Johs. Andersen: Analysis of a Danish Roe-Deer Population. Danish Review of Game Biology, vol. 2., pp. 127–155, 1953). Recent studies on certain Danish Red Deer populations (not yet published) seem to confirm, that direct observation leads to an underestimate of the population size.

In any case it is certainly desirable to subject the census methods for European deer population to critical examination with a view to possible improvement of methods, especially for herds living in woodland.

The possibilities for direct observation are particularly good in the low treeless mountains of Scotland. F. Darling informed us that reliable population estimates had been obtained there by counting the hinds and adding 50 per cent to allow for the bucks. During the greater part of the year the sexes live separately. Incidentally, the Red Deer has proved to be more stationary than previously assumed.

The Scottish Red Deer population is estimated at 100,000–110,000.

Problems connected with population density.

The Scottish investigations led to the conclusion that the maximum population density was 8 deer per 100 ha. Higher density would lead to emigration irrespective of the quality of the habitat.

If it is desired to grow forests in Scotland the density of Red Deer should not exceed 4 per 100 ha. or, in other words, the total population should be reduced to 60,000.

F. Darling points out that at present the Scottish population of Red Deer is located on the upper, flat part of the sigmoid curve of population growth. A reduction should be aimed at which would bring the population down the curve to a point where the reproductive potential is given a chance to unfold and where the herd is of tolerable size. On the other hand it will necessitate considerable labour to maintain the population at this level.

In German and Austrian forest districts a density of 1–3 Red Deer per 100 ha. is considered ideal when damage is to be avoided. Examples are known from France that damage is absent at densities of 1–2 per 100 ha.

Means of reducing Red Deer damage.

General support was given to the means of reducing deer damage mentioned in Dr. Ueckermann's paper aiming at a reasonable balance between game and habitat.

The chief feature of such a programme would seem to be:

1. Control of game density to make it compatible with sound economy,
2. improvement of the food situation for the game,
3. use of mechanical, chemical or biological means of protecting a reasonable proportion of the trees against deer damage in particularly exposed places.

Several contributors pointed out that much of what had been said about Red Deer would also apply, on no smaller scale, to Roe Deer.

Other topics for research on deer.

Intensive studies on the biology of deer species are much called for. Particular interest is associated with studies on reproduction, population turnover, food preferences and other aspects of their feeding biology.

Alongside with studies on the game it is also desirable to study their habitats. In several places study is being made of the carrying capacity (Äsungskapazität) for Red Deer of certain areas. The possibility of increasing the carrying capacity through planting, through the introduction of forage fields or through changes in forest practices forms a special facet of this complex problem.

CONTENTS

SOME RESULTS OF MARKING EXPERIMENTS ON PHEASANTS FROM A DANISH ESTATE (KALØ)

BY

KNUD PALUDAN

COMMUNICATION NO. 22
FROM VILDTBIOLOGISK STATION
KALØ

SOME RESULTS OF MARKING EXPERIMENTS ON PHEASANTS FROM A DANISH ESTATE (KALØ)

By *Knud Paludan*

Introduction.

The marking experiments on pheasant and partridge carried out by the Danish Game Biology Station began in 1949. It has been considered appropriate to take stock of the results obtained since then. The data on partridge have already been published in the series "Danske Vildtundersøgelser" (No. 7, 1957) issued by the Station.

The data on pheasants fall into two natural groups, one comprising pheasants from the Estate of Kalø, in which the fate of rings and wing tags is fairly well under control, and the other group consisting of marking experiments carried out in other places. In the latter group the recovery of marks was to a larger extent subject to chance. During the years 1950–55 a little more than 14.000 individuals were marked outside Kalø among which 996, or 7 per cent, recoveries were obtained. In what follows I shall, however, deal exclusively with the results from Kalø.

The Estate of Kalø (Fig. 1) covers an area of about 1000 ha, of which two woods contribute a total of 340 ha. Beech is the predominant tree but coniferous plantations are important also. The two woods are appr. ½ km apart. The remainder of the estate is farm land. Kalø is bounded on the South by the sea while in all other directions it is surrounded by farm land except for part of the northern boundary where it touches upon the village Rønde. The immediate surroundings of the estate are presumably less attractive to pheasants than is Kalø itself; it would therefore seem that emigration is relatively unimportant, a feature which also appears to be confirmed by the marking experiments.

During the years 1950–53 pheasants were reared at Kalø by the Game Manager according to principles used on many other estates in this country. Pheasants were trapped during the winter and some of them kept in pens during the subsequent breeding period while others were sent away for stocking purposes. During the first three years the reared chicks were released in the wood with foster-mothers at an age of 5–6 weeks. The last year the chicks were reared in artificial

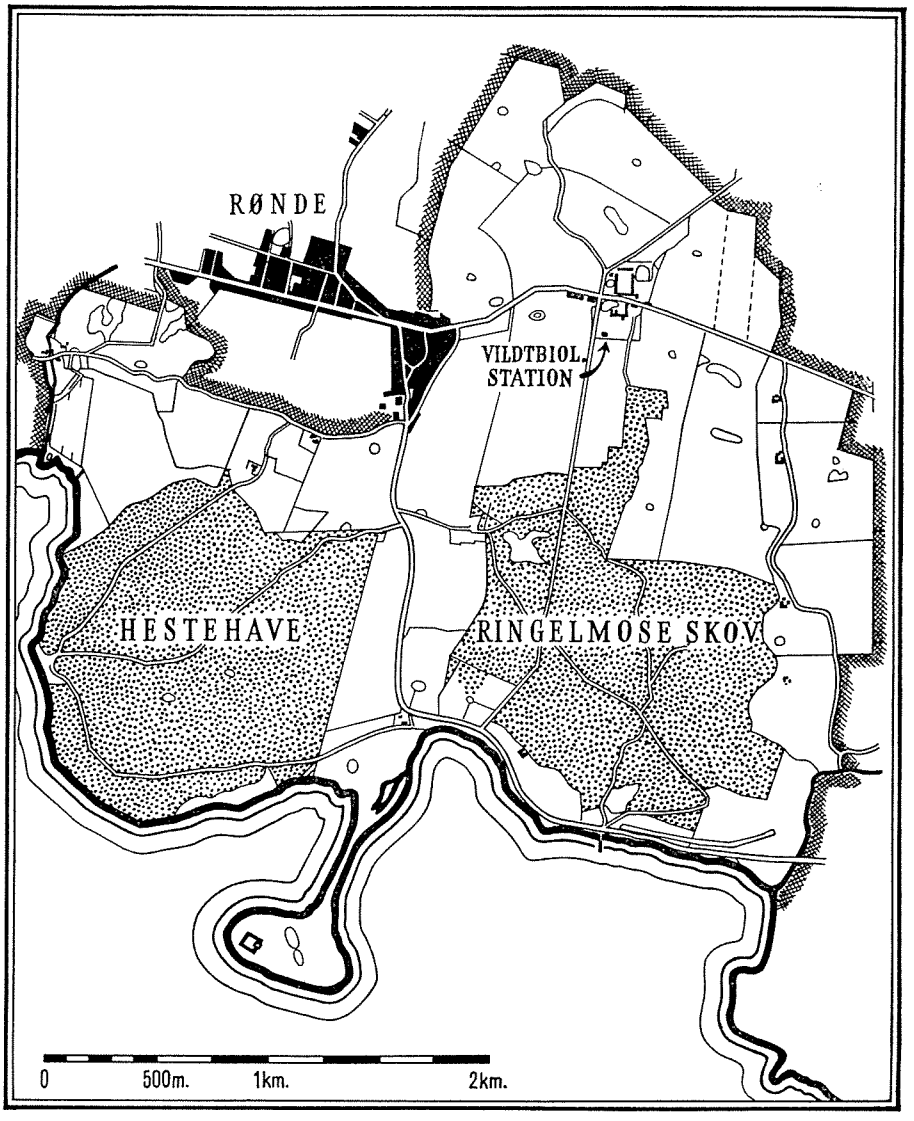

Fig. 1. Map of the Estate of Kalö. The area of the two woods is dotted.
(After Andersen 1953.)

brooders within a fenced area which they could freely leave as soon as their flying ability and general development would enable them to do so.

All these birds were marked prior to release, to some extent it is therefore possible to give an account of their further life.

The adult birds.

Laying birds were released in early June. During the four years 1950–53 a total of 151 cocks and 1077 hens were released, the numbers being distributed among the four years as shown in Table 1. The table also sets out the number of recaptures at the subsequent winter trappings beginning 6–8 months after release and repeated subsequent winters. Unfortunately some data are missing

Table 1.

151 adult males and 1 077 adult females released at Kalø 1950–53, and recaptures of these birds during subsequent years. The releases took place in June and the captures during the winters.

Year of release	Number released	Recaptures: No. of individuals 1.	2.	3.	4.	% of released 1.	2.	3.	4.
MALES									
1950	45	?	1	0	0	?	2	0	0
1951	44	15	2	2		35	5	5	
1952	32	12	8			38	25		
1953	30	8				27			
Total	151	35	11	2	0	33	9	2	0
FEMALES									
1950	266	?	53	15	8	?	20	6	3
1951	337	106	40	31		31	12	9	
1952	246	81	49			33	20		
1953	228	128				56			
Total	1 077	315	142	46	8	38	17	8	3

as regards the winter capture of 1951, hence this year must be omitted in the calculations. Furthermore the pheasant rearing was reorganized in 1954 and continued as fenced rearing not based upon the capture of wild birds. Therefore comparable data are not available for the period after the winter capture of 1954.

It should be noted, however, that the winter captures were not made with a view to population analysis but merely to obtain the required number of birds for laying and for release elsewhere. The trapping intensity can therefore be

expected to vary a good deal between years which also appears from the trapping records and more so from the right hand part of the table where recaptures are expressed in percentages of the birds released. For example it will be seen that whilst the percentage of first recaptures of 1951– and 1952–hens amounts to 31 and 33 respectively it is 56 among the 1953-hens. This discrepancy is probably not caused by a better survival among the latter group but more probably by an increased trapping intensity, this was also confirmed by an estimate of the population size on the completion of the trapping.

Real censuses of the pheasant population within the experimental area were never established but the winter catch of about 1000 birds in each of the three years 1952–54 may give some impression of the population size.

To some extent this variation between different captures will cancel out on adding the five years' results. When pooling all released birds which could theoretically contribute to the respective recoveries it will be seen that out of 100 cocks released on an average 33 were recovered during the first year, 9 during the second, 2 during the third while the fourth year recovery was nil. Among the hens the recoveries are respectively 38, 17, 8, and 3.

The figures quoted must provide a reasonably good picture of the average population decline, although of course, less accurately so for the cocks due to the smaller figures. When the recovery percentage is taken to represent the residual population (Table 2) the cocks show an annual loss of 73 per cent between 1st and 2nd capture, 78 between 2nd and 3rd, and a mean annual loss of 75 per cent. Among the hens the losses between first and second, second and third and

Table 2.

Life table based on release and recapture of adult birds at Kalø (cf. Table 1).

Recaptures (years)	Recaptures in percentages of released	Number surviving out of 100 (l_x)	Number dying out of 100 (d_x)	Mortality rate in each group	Mean annual mortality rate for the entire population
MALES					
1.	33	100	73	73	75.0
2.	9	27	21	78	
3.	2	6	6	(100)	
4.	0	0			
FEMALES					
1.	38	100	55	55	57.6
2.	17	45	24	53	
3.	8	21	13	62	
4.	3	8	8	(100)	

between third and fourth captures are 55, 53, and 62 per cent respectively or, as an annual mean, 57.6.

The population studies made on birds so far agree on the fact that, except for the first age class, the mortality is practically identical throughout life. Notwithstanding the rather small body of data available here, especially for cocks, and the possible sampling bias (trapping intensity), the variation in loss seems rather small, it would therefore seem that the calculated mean annual decline is a close approximation to the true value.

In the material obtained from other places in Denmark, and already mentioned, the mean annual mortality among adult cocks is appr. 80 per cent and among hens appr. 67–68 per cent, i.e. in either case somewhat higher than in the Kalø material and particularly so among the hens.

Since in a population of sexually mature pheasants there is a distinct excess of hens although at hatching the sex ratio is unity, the annual loss of males must exceed that of females. The excess of hens is not an artificially created situation in as much as it also occurs among pheasants living wild within their natural area of distribution. Under the conditions to which pheasants are exposed in this country the selective and varying shooting pressure will to a greater or smaller extent increase the mean annual mortality among the cocks. Consequently the excess of males is likely to vary in size between places. Hence the 75 per cent mortality found in the Kalø material cannot be expected to apply precisely in a material collected elsewhere.

Although the mean annual mortality among the Kalø hens was found to be as high as 58 per cent it is nevertheless considerably lower than in the material from other parts of this country and also low as compared with previous estimates for pheasant and most other gallinaceous birds. An explanation of this may be offered by the fact that several Kalø hens were recaptured and penned one or more times after their initial release and thereby protected from the dangers lying in wait for them in Nature.

Notwithstanding this extra protection the marking experiments confirm the very quick turnover which has been demonstrated repeatedly by population studies of the last decades, and which always appears to be much pronounced among game birds. Our particular example shows that the birds released had virtually disappeared within 3–4 years. This fact should be borne in mind when we consider problems concerning pheasant populations and the feasability of releasing birds for stocking purposes.

Another problem of immediate interest to game management is the extent to which the released birds were exploited. A summary of this is given in Table 3, left half, where all birds (1) killed, (2) trapped and removed from the estate,

Table 3.

Yield of adult males and females released at Kalø 1950–53, and the theoretical yield had all captured birds been removed from the population immediately. (Birds released in 1950 omitted because it is unknown how many of the birds from captures 2, 3 and 4 had already been captured during the first season.)

Year of release	Nos. released	Actual yield Nos. per season 1.	2.	3.	4.	total	Nos. released	Theoretical yield Nos. per season 1.	2.	3.	total
MALES											
1950	45	?	3	1	0	4					
1951	44	10	3	2		15	44	17	1	1	19
1952	32	10	7			17	32	15	6		21
1953	30	12				12	30	13			13
Total	151	32	13	3	0	48	106	45	7	1	53
Per cent of released		30	11	3	0	*44*		42	9	2	53
FEMALES											
1950	266	?	16	3	1	20					
1951	337	48	15	19		82	337	107	24	10	141
1952	246	21	36			57	246	84	21		105
1953	228	73				73	228	132			132
Total	1 077	142	67	22	1	232	811	323	45	10	378
Per cent of released		16	8	4	0	*28*		40	8	3	51

(3) killed during trapping, and (4) dying while penned are to be found among the crop taken from the birds released initially. Since comparable data relating to the years below the stepped line are not available it is not possible to obtain primary data on the total yield. However, if we take the actual recaptures above the line to represent the annual percentage recovery it can be seen that the crop of males would have been 30 + 11 + 3 + 0, or a total of 44 per cent, and of females 16 + 8 + 4 + 0, or 28 per cent. The remainder of the population has died from all other causes not easily traceable except for 5 per cent in the males and 3 per cent in the females. Thus the total loss which can be accounted for amounts to 49 and 31 per cent respectively.

It can be added that when the percentage utilization rises to as much as 44 among the cocks this is to a large extent an effect caused by the intensive winter captures. Shooting alone only accounted for 14 out of 44 per cent.

In what has been said so far only those birds were considered which have been entirely removed from the population whereas birds which have been captured and released later on have been left out. Had all birds captured been removed

and thereby included in the harvest the utilization of the birds would have been considerably better for the hens, namely 51 per cent as against 28, whereas the harvest of cocks would only increase from 44 to 53 per cent (Table 3, right half). Therefore, under the prevailing conditions one half of the marked population could have been exploited.

This, however, does not imply that a population could stand a hunting pressure of this order and still be able to reproduce vigorously enough to maintain the initial population level. Of this the data tell nothing. Nor do they give us any information on what else could have happened had this potential harvest actually been taken. Thus it cannot be rejected that it might have improved the conditions for the residual population to an extent that might have reduced the losses among this residual population and led to recovery of a still larger number of marked birds.

The chicks released.

Table 4 summarizes the recaptures among 2034 chicks reared at Kalø during the years 1950–52. During the first winter capture, immediately after the release, 305 birds were caught, next year 127, the third year 45, and the last 5. For the last two years data from below the stepped line are not available. Therefore, a better idea is conveyed by considering a percentage recapture based upon the birds which actually contributed to the recaptures. In this case we obtain the sequence 15–6–3–2 which, provided the trapping intensity has been reasonably constant, reflects the relative decline in the initial population between first and fourth capture.

Table 4.

2 034 + 999 pheasant chicks reared at Kalø 1950–52 and 1953 and the resulting recaptures during subsequent winters.

Year class	Nos.	Age at marking (weeks)	Recaptures (1st–4th year) Nos. 1.	2.	3.	4.	Per cent of marked 1.	2.	3.	4.
1950	332	8	59	29	9	5	18	9	3	2
1951	1 068	1	152	47	36		14	4	3	
1952	634	1	94	51			15	8		
Total	2 034		305	127	45	5	15	6	3	2
Mean annual mortality of adults: $\frac{(15)\ (100)}{15 + 6 + 3 + 2} = 57.7\%$										
1953	999	4–6	308				31			

A population decline of the order just mentioned is equivalent to a mean annual mortality of 57.7 per cent which is in close agreement with the mortality among hens in the material of released adults (57.6). Undoubtedly it must be ascribed to chance that the agreement is so close; although a large number of individuals is common to either group studied, a large number occur in only one of them and as the data on released chicks comprise cocks as well as hens one might rather have expected a somewhat higher mortality.

An estimate of the mean annual mortality is, naturally enough, of prime interest to the game biologist when he wants to consider the balance and turnover in a population. On the other hand the practical sportsman is more likely to ask for the size of harvest he can expect from the chicks released. As regards this question the Kalø material can also supply some information. It has already been shown that the harvest resulting from a release of adult birds amounted to 44 per cent of the cocks and 28 per cent of the hens under the given conditions of shooting and capturing but that, on the other hand, about fifty per cent of either sex could have been obtained.

Table 5.

Actual yield from 2 034 pheasant chicks marked at Kalø during 1950–52, and the theoretical harvest had all captured birds been removed from the population immediately.

Year class	Nos.	Age at marking (weeks)	Actual yield: Nos. obtained in successive seasons 1.	2.	3.	4.	Total	Per cent of marked	Theoretical yield: Nos. obtained in successive seasons 1.	2.	3.	4.	Total	Per cent of marked
1950	332	8	44	16	5	2	67	20.2	61	26	6	3	96	28.9
1951	1 068	1	112	12	22		146	13.7	175	16	5		196	18.4
1952	634	1	39	40			79	12.4	100	23			123	19.4
Total	2 034		195	68	27	2	292		336	65	11	3	415	
Percentage marked birds recorded			9.6	3.3	1.9	0.6		*15.4*	16.5	3.2	0.8	0.9		*21.4*

Table 5 sets out the actual harvest obtained from the chicks released during 1950–52 and the harvest which could theoretically have been obtained had all the captured birds been removed from the population immediately. From among the three year-classes the actual harvest was 20.2, 13.7 and 12.4 per cent respectively. The two last year-classes would have contributed a little more had the harvest below the stepped line not been missing; on the other hand this additional crop would hardly exceed 2–3 per cent, thus it would still have been

far below year-class 1950. On further thought this is not so very odd since the 1950-chicks were not marked until they had reached an age of 8 weeks whereas the two other classes were only appr. one week old when marked, thus the loss incurred over the intervening 7 weeks has been disregarded. On an average the yield from among the three year-class is 15.4 per cent of the birds released and of this percentage only 2.6 per cent, or roughly one sixth, was obtained by shooting. It will, however, appear from the right half of the table that on an average at least 21.4 per cent of the birds could have been utilized (varying between a little less than 30 per cent among the chicks marked at 8 weeks of age and about 20 per cent among those marked one week old).

It seems appropriate also to consider the mortality among chicks between the time of marking and the first shooting or capturing season. This mortality is, of course, very important for considerations on the harvest that can be hoped to result from a release of birds. Using the ringing technique it is ordinarily possible only to estimate the mortality of adult birds because the percentage of dead adult birds recovered can be assumed fairly constant and identical for different age classes while, on the other hand, this percentage is entirely different among subadults where the frequency distribution of mortality factors is different.

Table 6.

No. of chicks theoretically capable of producing same possible yield during first and second season as 100 adult birds (♂♂ + ♀♀) released in June, and the probable no. of survivors at beginning of 1st season, viz. no. of survivors among the adults (since at this time the young are likely to have same expectancy of further life as adults). Calculations based first on assumption I, next on assumption II (i.e. resp. 100 and 75 per cent. survival of adults between release and beginning of first season).

Year of marking	Age at marking	Nos. of birds producing identical crops of shot + trapped individuals	Assumption I: all adults survive from release to beginning of first season			Assumption II: 75 per cent. of the adults survive		
			Survivors at beginning of first season	Nos. died prior to first season	Mortality rate during period prior to first season	Survivors at beginning of first season	Nos. died prior to first season	Mortality rate during period prior to first season
1951/52	ad.	100	100	0	0	75	25	25
1950	8 weeks	153	100	53	*35*	75	78	*51*
1951	1 week	223	100	123	*55*	75	148	*66*
1952	1 week	207	100	107	*52*	75	132	*64*

The material presented here enables us, however, to make a rough estimate of the chick mortality. On comparing the "possible harvest" of adult and sub-adult birds it shows up (Table 6) that 153, 223, and 207 chicks released in 1950, 51, and 52 produced the same harvest as did 100 adults released in June. For the comparison use has been made of the number of individuals caught and shot during first and second season from among adult cocks and hens released in 1951–52 and chicks released in 1950–52. On using this procedure a maximum of actual and no calculated data are included.

It must be assumed that in the late autumn the nearly adult young birds possess the same expectancy of further life as do the adults, and hence that they must be present in the same number as this latter category in order to produce, during the first and subsequent seasons, the same crop as these. But what is the number of survivors among 100 adults released in June when the season starts? Unfortunately we do not know but let us consider two hypothetical examples. In the first we assume 100 per cent survival which, of course, is unrealistic. However, suppose this was the case then also there would be 100 survivors among each group of chicks which gives a mortality of 35, 55 and 52 per cent respectively. I believe it is fully justified to consider these percentages as minima.

However, it is improbable that all the adults would survive until the first shooting—and capturing season after the release. As has already been shown the annual loss was 75 per cent among cocks and 58 per cent among hens. Undoubtedly the greater part of this loss occurs during the winter months; but assuming a loss of 25 per cent of either sex during the period of almost six months preceding the first season we have, after all we know, kept the estimate on the low side. The one hundred adults would then become reduced to 75, and the chicks would be reduced to the same number. In this case (Table 6, right) the three batches would suffer losses of 51, 66 and 64 per cent respectively.

Bearing in mind these considerations it would therefore seem that one is justified in estimating that between one third and one half of 8 week-old chicks and between one half and two thirds of one week old chicks disappeared from the population before the first shooting season began.

Returning now to more practical problems the value of different methods of release can also be discussed on the basis of Kalø material. In 1950–52 the chicks were released with foster-mothers in the wood whereas in 1953 they were reared in artificial brooders within fence. At an age of 8–9 weeks they were at will to leave the pen and, if they so desired, to return to it. 999 chicks were marked at 4–6 weeks' age and during the first season 308 were recaptured, i.e. 31 per cent as opposed to 14–18 per cent among the chicks of the three previous years in

the corresponding season (Table 4). Therefore, when the rearing ground is conveniently located within the shoot it is advantageous to use this method.

With the advent of modern rearing methods, based on incubators and artificial brooders, the question of the most suitable method of release acquires new interest. In most cases, where the method just mentioned cannot be used, the birds have to be released directly into unfamiliar surroundings. What is then the most favourable age at release, and how do the birds get on? In order to shed light on this problem 308 12-week-old brooder reared chicks were released on 4 September 1952. They were released in the wood without further ado. Admittedly, our first experience was most discouraging, a fox finished off at least 18 birds during the first or second night, presumably because their instinct of roosting in trees had not yet developed, or perhaps it had not developed in all individuals. It is therefore suggested that everything be done to call forth this instinct prior to release; but it seems doubtful that one can do much more about it than provide perches in the pen; on the other hand this seems to have little effect.

Table 7.

Comparison between 634 hen-reared chicks marked one week old and 308 artificially reared chicks released 12 weeks old at Kalø, 1952.

	Nos.	Shot and trapped during first season	Nos. recovered through shooting or trapping during 3 years
Hen-reared	634	100 (= 16%)	124 (= 19%)
Artificially reared .	308	128 (= 42%)	136 (= 44%)

As can be seen from Table 7 later experience was, after all, quite satisfactory in comparison with other releases, namely the earlier mentioned 634 chicks marked at one week of age and later on released in the wood with foster-mothers. Among this batch of chicks 6 were shot and 94 caught during the first season, i.e. a total of 100, or 16 per cent. From among the brooder-reared 20 were shot and 108 caught, a total of 128 or 42 per cent. During the subsequent two years another 24 hen-reared and 8 brooder-reared individuals were shot or caught; this causes the theoretical percentage utilization to reach 19 and 44 respectively. If the value of the birds is to be measured by shooting and capturing, and no other yardstick is available, it appears that in spite of the fox, 308 brooder-reared birds released at twelve weeks' age would correspond in value to 700 one week old, hen-reared chicks released with foster-mothers. It must be stressed that the two experiments were carried out simultaneously within the same shoot, and therefore under quite similar circumstances.

Table 8.

Experimental release of brooder-reared chicks of different ages at Kalø, 1956.

	♂♂				♀♀		
Age at release (weeks)	8½	11	13	20	8½	11	13
Date of release	4.ix.	4.ix.	4.ix.	25.x.	4.ix.	4.ix.	4.ix.
Nos. released	71	58	79	32	71	63	71
Shot during first season	19	29	40	17			
Captured during first winter	4	3	6	3	5	10	10
Total	23	32	46	20	5	10	10
Percentage of released	32	55	58	63	7	16	14

In 1956 a small experiment was made in order to get information on the optimum age at release of brooder-reared birds. Three batches of chicks were released at the ages 8½, 11 and 13 weeks (Table 8). Each batch consisted of appr. 150 birds, the sex ratio being almost unity. In order to eliminate environmental interference (habitat, climate) all birds were released simultaneously (4 Sept.) and in the same place. The release area had a feeding space but within one week the birds stopped visiting it and feeding was discontinued. The 1956-shooting season at Kalø began on 25 Oct., a little more than 1½ months after the release. Table 8 shows the numbers killed during the first season and captured during the following winter. Among the 8½-weeks-old cocks 32 per cent were recovered as opposed to 55 and 58 per cent of the chicks 11 and 13 weeks old. Hens were not shot, therefore only capture data are available but although the figures are low they show exactly the same, poor survival of 8½ week chicks since only 7 per cent of these were caught in contrast with 16 and 14 per cent of the other groups.

This experiment emphatically stresses that 8½ week old chicks are too young for release whilst 11 and 13 week old chicks get on satisfactorily.

By way of supplement 32 cocks, 20 weeks old, were released in the early morning of the first day in the season. Their recovery proved slightly better, 63 per cent, but a higher percentage had been expected in view of their age and their release immediately prior to the shoot.

Conclusions.

The practical conclusions to be drawn from these experiments at Kalø can, perhaps, best be expressed as follows:

1. The rapid population turnover in conjunction with the large discrepancy between actual and theoretical utilization show that the population increment must be harvested as soon as possible.

2. Release of chicks with foster-mothers gave very poor returns.

3. Since improved results were obtained by brooder-reared chicks this method is recommended.

4. Brooder-reared chicks to be released in a new environment should be at least 11–12 weeks old on release.

5. In view of the rather low percentage utilization of released birds the price per bird harvested will necessarily remain fairly high.

Since the present investigation was made on a single estate it is to some extent debatable whether the results can be considered universally valid. On the other hand, the quick population turnover and the conclusions to be drawn therefrom as well as the experience as to the appropriate age at release of brooder-reared chicks would seem to be so fundamental that the universal validity can hardly be doubted. The higher or lower degree of utilization of adults as well as the various categories of chicks may quite well vary considerably between estates, this will cause the price per harvested bird to vary also. On the whole we do not yet know much about the varying degree of utilization of the birds between estates but we hope to be able to complete current investigations which are likely to shed light on this particular problem.

INVESTIGATIONS ON THE FOOD OF PARTRIDGES, PHEASANTS AND BLACK GROUSE IN DENMARK

BY

MARIE HAMMER, M. KØIE

AND

R. SPÄRCK

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INTRODUCTION

When in the autumn of 1936 systematic investigations on the food of wild birds in Denmark were commenced it was quite natural to start with partridges and pheasants since these two species are of special importance to Danish sportsmen. Later on also the third Danish gallinaceous bird, the black grouse, was included in the investigation. The main part of the investigation was carried through in the course of 1936 and 1937, and the principal results were presented at the Bellahøj Exhibition in Copenhagen 1938, and later in a series of smaller publications in Dansk Jagtleksikon, Håndbog for Jægere, etc. The reason why a special account of these investigations was not published until now is, among other things, the difficulty of procuring material in spring and early summer, which difficulties have only recently been practically overcome.

The nutrition of the said gallinaceous birds has not previously been subjected to detailed investigations in Denmark, nor have any works of importance on this subject been published in other countries apart from a single British investigation. It is true that quite a number of scattered observations exist which form the basis of the often very brief and summary information found in ornithological handbooks. In particular, there has been no possibility of judging how much the food of these our most important species of game birds varies in the course of the year, from one place to another, and particularly it has not been possible, on basis of the present knowledge, to form a well-founded opinion of the mutal significance of the different food items. Therefore, erroneous views based on a single observation are not seldom met with, e.g. the fairly widespread opinion that partridges feed mainly on insects, or the assertion that pheasants feed partly on mice. Although it cannot be denied that an omnivorous bird as the pheasant, quite exceptionally, may eat a mouse (most probably a young), this is at any rate an absolute exception and does not justify the opinion that pheasants feed on mice.

Altogether the investigated material comprises 181 adult partridges, 56 chicks; 232 adult pheasants, 69 chicks; 37 adult black grouse and 15 chicks. The investigation was made in the way that the crops and gizzards of the birds sent in

were examined, and the different food remains identified, counted and weighed. It soon appeared however that the crop content gives the best picture of the diet of a bird, since the food in the crop occurs in quite the same condition as when it was eaten; while as regards the gizzard part of the food passes on at once, while part of it remains there for a shorter or longer time, thereby distorting the picture of the composition of the food. The investigation was therefore based on the crop content. The results for each single bird were entered on an index card which, in addition, gives information of the weight and sex of the bird, the locality and time of killing. Simultaneously with the analysis of the stomach content an examination of the parasites was made. This examination was carried out by Dr. Holger Madsen, who also—partly together with mag. sc. F. Jensenius Madsen—carried out the weighing and sex determination, while the analysis and working up of the stomach content were undertaken by Dr. Marie Hammer (animal food) and Dr. Mogens Køie (vegetable food).

1. PARTRIDGES

Table 1 contains a survey of the different food items found in the crops of adult partridges and pheasants taken together for the whole year and calculated in percentage of occurence, i.e. the figure indicates the percentage of the examined partridges—which had any crop content at all—in which the said food item was found. Of the 181 examined adult partridges 22 had no crop content, so that the material listed in table 1 comprises 159 partridges. The main result is that leaves and flower buds—briefly expressed greenfood—occur in 75% of all the partridges, seeds of weeds in 61%, cereals in 37% and animal food only in 9%, roots and tubers in 1%. Thus it can be laid down at once that animal food plays inferior role in the diet of Danish partridges, for not only does animal food occur only in very few partridges, but it is found in very small quantities, and it is mostly a question of ants and ant pupae, beetles, caterpillars and snails and slugs.

If we look more closely at the vegetable food we find that there is grain in a little more than one-third of all the examined partridges. It is however evident from the table that the four cereals do not play an equally great role, since the spring corn occurs much more frequently than the winter corn. In 26% of the partridges barley was found, in 18% oat, in 7% wheat, while rye was found only in a single partridge and only a single grain. The greatest number of grains found in a single crop is 131 or 4.5 g.

As mentioned above seeds of weeds were found in almost two-thirds of the partridges. A closer study of the table shows that in reality only very few species are of particular importance. More important than all seed species together is Polygonum. Of most common occurrence is black bindweed which was found in 21% of the crops, often even in considerable quantities (up to 130 in a single crop). There can be no doubt that this plant whose seeds are very big plays an important part in the diet of the Danish partridges. Black bindweed is a very common weed which notably occurs in great quantities in cornfields on sandy soil, but also the other species of Polygonum: pale Persicaria and Polygonum persicaria which are especially abundant in root crops, and common knot-grass occur in a considerable number. Pale Persicaria in 14% of the examined crops, P. persicaria in 7%, and common knot-grass in 10%, the reason why pale Persicaria occurs in greater quantities than P. persicaria is presumably that this species is more common.

Of other seeds of weeds could especially be mentioned heath stitchwort which is found in 18%; spurrey which is found in 13%, goose-foot in 8% and field chickweed in 6%; in addition, grass seeds, especially annual meadow grass, in 9%. The other seeds of weeds and grass occur only in a single crop and only in small quantities. It is striking that seeds of plant species which do not grow on cultivated soil are only seldom eaten by partridges. The plants found are nearly all annual and grow mainly on soil which has just been prepared. Grain and seeds of Polygonum are picked up singly, while the seeds of heath stitchwort, spurrey, and field chickweed are eaten in the way that the complete ripe pod is swallowed whole. Of meadow grass part of the top is taken in each bit.

Quantitatively green food plays major part in the diet of the partridges, since leaves and buds were found in three-fourths of the crops. Grass plays the most important rôle. In no less than 63% of the crops grass leaves were found, often in a considerable quantity, in a single crop up to 40 g. The partridges bite the grass leaves to small pieces of about 1 cm; they eat different species of grass; also winter corn, but only rather broad and flexible leaves. Besides leaves of grass, leaves of clover, alfalfa or other species of medic are of fairly common occurence, viz. in 30% of the crops and in quantities of up to 24 g. The small leaves are picked off singly, and the partridges eat only fairly small leaves. Leaves of buttercups have been found in a few per cent; what has otherwise been found of leaves is quite insignificant and was probably eaten quite accidentally.

The results clearly show that partridges are far from omnivorous, but that, on the contrary, they select certain plants for their diet. In addition, it is evident that the diet of the partridges consists almost exclusively of seeds and

green leaves. It is striking that they seem clearly to prefer the glume covered barley and oat, while wheat is of comparatively inferior importance, and they seem to avoid rye completely. Still more striking is their discriminating taste in choice of seeds of weeds. On the whole, the number of species of seeds found is small, and only ten species of seeds of weeds occur fairly frequently in the partridges—of these the four are species of willow weeds. All the ten species are common weeds in beet and corn fields throughout the country, but they are especially abundant on poor, lime-deficient soil, where the soil is not so intensively cultivated as in the more fertile areas. We have many common weeds, as for instance crucifers and composites which a priori might be expected among the food items of the partridges—just as in the pheasants. There is no doubt that the partridge, in contrast to the pheasant, selects seeds of definite plants. Almost the same holds good of green leaves where grass, clover and buttercups are almost solely predominant, although many other plants would be just as accessible.

In order to find out to what extent the partridge is associated to the cultivated soil a number of partridges was procured from outlying stretches of dunes. Some partridges which were shot in the North Sea dunes near Blåvand and on Holmsland Klit had the usual crop content of cereals and seeds of weeds, while a few contained very small amounts of dune plants. This means that the partridges in these dune areas seek the main part of their food in the few cultivated fields. A similar result was obtained by an investigation of a number of partridges from Saltholm; only a very small quantity of their crop content originated from the plants predominant on the littoral meadows of Saltholm, the majority was the usual plants which they had found on the very few and small cultivated areas existing on Saltholm. Four partridges from Skallingen and four from Læsø, on the other hand, appeared to have fed exclusively on parts of plants from the natural plant communities. On Skallingen lime-grass and marram-grass had replaced the cereals, and in addition, all had eaten bulbs of arrow grass; furthermore were found different beach and dune plants, i.a. seeds and leaves of sea milkwort, rush, Lady's bedstraw, cat's-ear, and bent-grass. The partridges from Læsø had leaves of grass, clover and buttercups, in addition crowberries, and seeds of sedge, orache and goose-foot—thus exclusively plants which may occur outside cultivated soil. It looks as if partridges can subsist without cereals and field weeds, but they are however so strongly associated with these latter that they always seem to visit cultivated fields and feed on these provided that they occur within a reasonable distance.

If we compare the results of this investigation with a corresponding British investigation carried out by A. D. Middleton and Helen Chitty who had the

opportunity to analyse the crop content of 429 partridges we find fairly good agreement. It is the same plant species which dominate in the food of the partridges in England as here, though there are certain differences which may partly be explained by the fact that the said plants occur in different quantities in England and here. There are, however, differences which must have other causes, e.g. wheat is far more common in English partridges than in Danish since it plays an almost equally important part as barley; field chickweed is more common in England than heath stitchwort and pale Persicaria is more rare than Polygonum convolvulus and common knotgrass, just the opposite of what holds good here. Seeds of grass, and here especially annual meadow grass, are more common in English partridges than in Danish; finally, buckwheat has been found in a number of English partridges. The green food found in the English partridges is quite the same and occurs in almost the same ratio as in Danish partridges. The only point where there is some discrepancy between the English and the Danish results is as to the occurence of beets. In winter the English partridges contained beets, almost exclusively sugar beets, in a rather considerable degree (more than one-fourth) whereas beets were found in only 2% of the Danish partridges; the difference may, to some extent, be due to the fact that comparatively few of the examined Danish partridges derived from pronounced sugar beet areas. The partridges examined from Lolland, however, did not appear to contain sugar beets in any high degree, so presumably there is a real difference between Danish and English partridges as regards food. To the English as well as to the Danish partridges animal food plays an inferior rôle and occurs only in 2 or 3 per cent of the examined birds. In England as well as in Denmark the diet consists principally of ants and pupae. Strange enough, an older English investigation made by Collinge has given quite different results, since he states that upwards of 40 volume per cent of the food of the partridges were insects. It is however not clear from his publication whether chicks or adults are involved, from which season they derive etc. After having become acquainted with the more recent English investigations Collinge has set forth the supposition that the English partridges may have changed their diet in the course of the 20 years which have elapsed between the two investigations. Taking into consideration the good agreement between the new English investigations and our results and further the fact that the food instincts of the partridge seem to be unusually fixed it seems to be highly improbable that there should have been such a change. The discrepancy is rather due to the fact that Collinge's material mainly consisted of quite young partridges which had retained some of the food choice of the chicks.

If we then look at the composition of the food at the different seasons it

appears—as is evident from table 2—that there is a very distinct change in the composition. The winter (December–February) from which there are 25 partridges, and the spring (March–April) from which 38 partridges exist are characterized by the complete predominance of green leaves in the food. Green leaves are absent in only 6 partridges from these periods, while cereal occur only in 4% in winter and in 13% in spring, and seeds of weeds in 20% and 42 %. This difference is further underlined when instead of looking at the occurence percentage we look at the quantity. Leaves of clover occur in the stomachs of the partridges all the year round, but it is especially in winter and spring that the quantity is considerable, and corresponding conditions exist as far as the leaves of grass are concerned, as is evident from table 2, bottom column. In winter and spring more than one half of the examined partridges had more than 10 leaves of grass in the crop, in summer and autumn only one-tenth had more than 10 leaves of grass. All crops which contained more than 2 g of grass leaves in a single crop belonged to partridges which were shot in winter or spring. On the contrary, summer and autumn are characterized by the presence of cereals (in 35% and 63% resp. of the investigated birds) and seeds of weeds (in 73% and 82% resp. of the examined birds). In the summer months animal food occurs in a somewhat greater quantity (in about one-fourth of the examined partridges). Also flowers and buds seem to play a somewhat greater rôle in summer. These results agree completely with those obtained in England where there is a corresponding rhythm in the choice of food of the partridges.

It is a question whether this change in the food choice throughout the year is a natural rhythm or whether it is only due to the fact that the said food items are most easily accessible to the partridges during the seasons in question. Middleton and Chitty are inclined to adopt the latter view being of the opinion that it is only the absence of other food which makes the partridges eat green leaves. They support this view on the fact that partridges kept in captivity or rulich fed during the winter willingly eat grain and seeds. Since feeding as a rule is only made in unfavourable circumstances when the partridges starve, this is however no evidence. In favour of a natural rhythm speaks in the first place that it has been possible in other gallinaceous birds—e.g. the ptarmigan in Greenland—to demonstrate a corresponding change in the food choice. Most of the seeds on which the partridges feed do not sprout until late in spring and are thus accessible in winter and early spring without the partridges seemingly taking any interest in them. Nor do they in spring feed on the newly sown corn although this is apparently easily accessible to them. They feed almost exclusively on grain from stubble-fields late in summer and in the autumn. Compared with the pheasant it appears that they eat a good deal of seeds in winter; there-

fore, there is every reason to assume that the change in food choice at the different seasons like the food choice proper is a natural rhythm governed by the fixed instincts of the animals.

It will appear from table 3 that the material of partridges is fairly evenly distributed throughout the country, though the southern islands are a little less represented. As already mentioned, there is on the whole no essential variation in the food choice in the different regions. Even in those parts of the country where the cultivated soil occupies only a small area compared to dunes and heaths the partridges seek the cultivated fields for food. Only in places very far from cultivated soil has it been demonstrated that the partridges may replace the usual food items by seeds from dune plants etc. It may also be possible that they take sugar beets in sugar beet areas although not to the same extent as in England. Taking it all in all it may however be said that while the difference in the choice of food is great between the green-leaves-period from December to April and the seeds-period from June to November there is only a slight difference in the choice of food in the different parts of the country. Finally, it should be mentioned that there does not seem to be any indication of variation from one year to another. It is true that the majority of the material was collected in 1936–37, but in the following years it has been augmented now and then by single partridges, especially in the autumn months and in these no variation from one year to another has been traceable.

As regards the chicks the investigation included 56 crop contents of chicks which however varied much in size, from 15–370 g. Only 12 of the 56 chicks weighed less than 100 g, while the rest were larger. The 56 chicks, of which ten were without food in the crop, and therefore are left out of consideration, are distributed with 13 in July, 24 in August and 9 in September. It appears from table 4 that the youngest chicks, i.e. the 13 from July, fed almost exclusively on animal food, since nearly all of them (92%) contain animal food, whereas a great number of them in addition contains plant food (77%). A closer examination of the animal food reveals that aphids seem to play the greatest rôle (in 62% of the examined chicks); in addition occur ants and beetles in a considerable number of the chicks, spiders and wood-lice were found in 23% of the crops. The number of aphids in a single crop may be very considerable; in three of the examined chicks there were about 250, about 350, and about 500 resp. Also ants occur in great quantities; three of the chicks had 194, 234 and 383 ants resp. in the crop. These two food items must no doubt be said to be absolutely preferred by the chicks; it is true that beetles occur in no less than 54% of the examined crops of the chicks from July, but they do not occur in equally great quantities and seem to have been eaten more accidentally.

In August only half the chicks have animal food in the crop, only 17% have aphids and only 13% ants, so that these insects no longer seem to play the greatest rôle. Larger-sized insects, beetles etc., now occur in 38% of the examined chicks. While only three-fourths of the chicks from July had plant material in the crop all the examined chicks in August had eaten vegetable food, in the main of the same nature as that of the adults at this season, namely grains, especially of barley and oat (71%), and seeds of different weeds, notably heath stitchwort (63%). Also grass and clover occur in a considerable quantity in the crops in August (in 58%).

Finally, 44% of the chicks in September still had animal food in the crop, but aphids as well as ants had now completely disappeared from the diet and only largesized insects as beetles etc. are eaten. In 88% of the September chicks we found plants of almost the same kind as in the chicks from August.

If we compare these results with the English investigations from 1938 made by Ford, Chitty and Middleton there is clear agreement in the main features. However, the change from animal food to vegetable food seems to take place more evenly in the Danish chicks than in the English, since in England the food in the three first weeks of their life was almost exclusively animal, whereupon it changed rather suddenly into vegetable matter of a composition very similar to that of the adults. In England the food of the tiny chicks was found to consist of springtails, aphids and a species of a small weevil, while ants were the predominant food in the 2nd and 3rd weeks of life.

2. PHEASANTS

The material of pheasants altogether comprises 232, of which however only 161 had any crop content. Of these 161 birds 57 derive from a special locality, viz. the isle of Vorsø in Horsens fjord, and they are therefore treated separately. The remaining 104 are listed in table 1 together with the partridges. A comparison of these two species as regards food shows both a conspicuous similarity and a clear difference. Also for the pheasants grains and seeds as well as leaves play a great rôle, but besides, roots, tubers and animal food occur to a much greater extent than in the partridges, and many more species of plants are of importance to the pheasant than is the case for the partridge. A common feature is that pheasants as well as partridges seem clearly to prefer barley and oat which constitutes an essential part of the diet, since no less than 38% had grains of barley and 21% oat in the crop, often in considerable quantities. Not seldom 1000

grains were found in a single crop, in some crops still more. The maximum weight of grain in a single crop was 60 g. Spring corn has nearly never been found in spring and thus must have been taken either in stubble-fields or from food laid out. Similarly wheat and rye—which obviously is of slight importance—has almost never been found in the autumn. As regards the seeds of weeds eaten by the pheasants it appears that also in these Polygonum is of great importance; it occurs in almost half of the examined pheasants, up to 4500 seeds in a single crop (about 15 g). But, as already mentioned, seeds of a considerable number of other weeds occurred, especially heath stitchwort, field chickweed, goose-foot, scarlet pimpernel, charlock, ivy speedwell, hemp-nettle, buttercup, clover, medic and vetch; in addition, grass seeds, notably annual meadow grass, play a very important rôle for the pheasants. Also grass and leaves of clover occur—as in the partridges—in great quantity, but besides these the pheasants, in a higher degree than the partridges, take leaves and flowers of other plants. It seems as if the pheasants also take a number of berries, though berries have been found in the crop only in very few cases. On the other hand, the gizzards have been found to contain seeds of fairly many berries and the like: elderberries, blackberries, sloe, hip, haw, and Siberian crab. Finally, the pheasants eat a number of tubers and root pieces, especially the tuberous roots of pile-wort play a significant rôle, but beets and potatoes may also occur. As already mentioned, animal food is much more important, since it has been found in 16 % of the crops, although as a rule not in great quantities. In a few instances larvae of crane-flies have been found in considerable numbers; on the whole, the pheasants do not seem to feed on definite insects, different larvae, beetles and also wood-lice and common slugs occur in the crops.

The result of these investigations is quite clear: the pheasant is much more omnivorous than the partridge. It is not a pronounced field-feeder, although the majority of the food derives from cultivated soil, it also eats vegetable matter in woods, heaths and on lake shores. Its feeding instincts do not seem to be nearly as fixed as those of the partridge, and its power of adaptation must therefore be considered much greater than that of the partridge. It is in good agreement herewith that the introduction of the pheasant in great parts of the world has turned out successfully. Comparatively few investigations on the food of the pheasant have been made elsewhere. Of considerable interest is a survey published in The Field 1939 p. 1288, on the stomach content of a few hundred white-winged pheasants (Phasianus colchicus pallasi) in its home in northern Manchuria. The pheasants live especially in river valleys and on shrub-covered slopes, where dwarf hazel and the 2–3 m high Mongol dwarf oak dominate. In the summer months the pheasants live here mainly on insects, among others

grasshoppers, whereas the food in the autumn and winter consists almost exclusively of plants, notably acorn, nuts, berries of hawthorn, Siberian crab, bulbs, seeds etc. Where they live near cultivated fields, they eat Indian corn, millet, rice and soya beans. An investigation from Michigan in North America made by P. L. Dalke in 1937 shows that vegetable food here represents 94 weight per cent of the total amount of food; here mainly cultivated plants, notably Indian corn and wheat, play the major rôle. Also black-bindweed is rather common in the diet of the American pheasants together with other com-com weeds. A small Swedish investigation from 1940 by G. Lundberg shows on the whole agreement with the Danish results, however that in Sweden wheat plays a greater rôle than in Denmark. As here rye is without any importance at all.

As already mentioned a fairly considerable part of the material, viz. 57 pheasants, derive from the isle of Vorsø in Horsens fjord, and it has therefore been considered most reasonable to treat these separately. The result is given in table 5 which shows the stomach content of these pheasants so that winter and spring birds and summer and autumn birds have been kept separate. These results bear out how the pheasants adapt their diet to the prevailing conditions. In good agreement with the fact that the cultivated soil on Vorsø is of small extension and that, in addition, it contains very few weeds, seeds of weed are almost completely absent in the Vorsø pheasants; nor do grains play any considerable part. By far the greater part of the food was fetched outside the cultivated fields, notably in wood and shrub. Thus the crops may in spring and summer be filled with tubers of pile-wort and rootstocks of anemone, and leaves of this plant and buttercup in the Vorsø pheasant represent the majority of the green food, while grass and notably clover play an inferior rôle. Also buds of anemone and buttercup are eaten in spring. Among tree fruits those of the ash are the most common in winter, while acorn which are often picked to pieces, but also may be swallowed whole, and hazel nuts are found in the crops in October. The seeds are from different species from wood and meadow. In the column insects are included galls from the gall wasps of the district with which the crops could be almost completely filled. The food of the pheasants on Vorsø seems to correspond fairly well to what is known from England, but it differs a good deal from the food in other parts of Denmark. The reason is surely that the English pheasants originate from estates where cultivated fields, as on Vorsø, occupy only small areas.

As to the variations of the diet throughout the year it is evident from table 6 that here too is a rhythm reminding of the rhythm in partridges though it is less pronounced. In summer insects seem to be more predominant (60 %) than

at the other seasons of the year, grass and clover leaves have a distinct maximum from November to February when the occurrence percentage is from 50 to 90, while in March and June it rules between 17 and 33. Grains and seeds of Polygonum dominate in the autumn, but are also fairly abundant in winter and spring, on the other hand they are almost completely absent in summer. Roots and rootstocks also seem especially to be autumn and winter food. Thus we have here the usual change between seeds in the autumn and green leaves in winter which we know from other gallinaceous birds, although—in good agreement with the slightly fixed feeding instincts of the pheasants—it seems less pronounced.

Finally, we shall look at the food of the chicks; we had a material of 69 chicks at disposal of which 14 had empty crops. Of the remaining 55 chicks there are 10 which had an average weight of 49 g, shot in June, 17 of an average weight of 192 g, killed in July, while finally 28 of an average weight of 471 g, shot in August–September. Tabel 7 shows that the chicks from June feed exclusively on animal food; but in contrast to partridge chicks the pheasant chicks do not seem to prefer definite species of insects. While aphids and ants completely dominate the diet of young partridge chicks they were only found in 10 % of the examined pheasant chicks, various other insects in 80 %, and spiders, snails and slugs and wood-lice in 70 %. The number of bigger animals may be fairly considerable, a few pheasant chicks had for instance eaten 14–15 snails and slugs, a single chick contained 12 wood-lice, and the number of spiders in the single crops could be as high as 10–12. In July the chicks take more varied food, since now only 71 % contain animal food, while 95 % had eaten vegetable matter. As to the distribution of the animal food of the larger chicks it appears that 35 % had eaten aphids, 6 % ants, 53 % beetles of which up to 20 were found in a single chick, 65 % contained other insects, and 24 % spiders. Also the vegetable food in the larger chicks is very mixed; 12 % contained grains, 6 % seeds of Polygonum, 24 % seeds of heath stitchwort, 35 % grass seeds, 47 % various other seeds, and 24 % leaves of grass and clover. Finally, as regards the quite large chicks from August–September the composition of the food is still more dominated by vegetables. Now all the chicks had vegetable matter in the crop, while only 68 % also contained animal food, more particularly larger insects, snails, slugs and wood-lice. In 32 % of the examined crops we found seeds of Polygonum, in 64 % grains especially of barley and oat with up to about 250 grains in the individual crops, 36 % had seeds of heath stitch wort, which might occur in a number upwards of 2000; in 11 % were found grass seeds, in 43 % various other seeds, and, finally, 18 % had grass and clover leaves in the crop. It is seen that the pheasant chicks stand in the same relation to the partridge chicks as the adult pheasants to the adult partridges.

They have a much more varied diet, and they seem in a lesser degree than the partridges to be bound to definite food items, but are apparently, to a rather great extent, able to make use of the prevailing food sources.

3. BLACK GROUSE

The material comprises 37 adult black grouse, of which however 4 had no content in the crop, and 13 chicks. Table 8 shows the ratios of the most important food items in the examined birds. It is conspicuous that berries play an important part in the diet of the black grouse. Only very few crops did not contain berries. Among berries crowberries dominate, they occur in 69 % of the examined black grouse, in several crops in a considerable number (up to about 225 = 35 g); after crowberries come crane-berries, which were found in about one-fourth of the crops. Besides these also cowberries and bearberries—of which two a single crop contained almost 300 berries—a fairly important rôle; also juniper berries in single cases occurred in a considerable number (upwards of 200).

Next to berries different seeds and dry fruits are however also of some importance, first and foremost deer-grass (Scirpus caespitosus) which occurs in one-fourth of the examined black grouse. The spikes are eaten whole, and up to 600 have been found in a single crop. Spikes of sedge were likewise found in several black grouse, here too the spike or the top is eaten whole. In addition, a number of other seeds and grains, notably of barley, have been found; furthermore buds and flowers of various plants (buttercup, tormentil and notably various composites as cat's ear, hawkbit, hawkweed etc.) are of importance. While flowers, buds and the like in partridges and pheasants mainly occurred in the summer months proper these food items are found in the black grouse late in the autumn. The black grouse also eat green leaves like the partridges and pheasants grass and clover leaves, but, in addition, leaves and fragments of shoots of different heath plants, notably creeping willow which was found in more than one-fourth of the examined black grouse and which may often be present in great quantities (up to 200 leaves).

It is evident from the above that, in contrast to the partridge and to some extent also to the pheasant, the black grouse is a pronounced berry eater; it is further seen that although certain food items as crowberries, cranberries, willow leaves and flower buds as well as deer-grass dominate, the diet of the black grouse is very varied, since it eats berries, seeds and leaves of the plants of heaths and raised bogs. On the other hand, food from cultivated soil seems to be of inferior importance to the black grouse, only in a few crops in late autumn

did we find grains and seeds of Polygonum in any considerable quantity. Animal food occurs only in comparatively few of the examined birds and in small quantities only, notably ants and a few caterpillars, spiders etc.

It has not been possible to form an estimate of the diet of the adult black grouse in winter, since it has not been feasible to procure a sufficiently big material, only four individuals having been available, one from November, two from December and one from March. This material may however give a slight indication of the diet of the black grouse in winter. One of the December birds contained exclusively roots of cat's-ear in pieces of 2–5 cm length—altogether no less than 55 g; the other contained roots, although in smaller quantity, and leaves of clover and grass and bits of stems of creeping willow and bog myrtle. Also the black grouse from November contained stems of willow and bog myrtle and different leaves. The black grouse from March had eaten leaves of cowberries and shoots of bedstraw and juniper. If we compare this with the available investigations, e.g. on the ptarmigan in Greenland, it is reasonable to presume that the diet of the black grouse in winter consists of roots, leaves and shoots of willow, bog myrtle and the like. In the black grouse, too, there seems thus to be a rhythm in the food choice between berries, seeds and buds in summer and autumn, and roots, leaves and stems in winter.

The total material of chicks comprised 15, two of which however had empty crops. The chicks were as a whole fairly big, weighing 200–300 g. As is the case of the other gallinaceous birds, the chicks feed on insects in a much higher degree than do the adults. While only 21% of the adults had eaten insects, 83% of the chicks had animal food in the crop. As found for the pheasants there seems to be preference for definite insects; caterpillars, saw-fly larvae, flies, midges, bugs, cicads, beetles and, in addition, spiders. Furthermore, the chicks also contained vegetable food as is seen from the table, of a somewhat similar composition as that of the adults, however that buds and anthocarps play a relatively greater rôle than berries.

4. THE GALLINACEOUS BIRDS AS DISTRIBUTORS OF SEEDS OF WEED

As it is a wellknown fact that some seeds may pass the intestine of birds without losing their germination capacity it has been suggested that pheasants may be injurious by spreading weeds. In order to further elucidate this some experiments were made in the Zoological Garden, where a number of pheasants in a period were fed exclusively with seeds of weeds. It appeared that seeds of the following plants found in the excrement had retained their germination capacity: Polygonum, ribwort, clover, medic, sorrel, sheep sorrel,heath stitchwort, and possibly also buttercup which, however, will only sprout after a certain period of rest. These experiments however showed that only a very small part of the seeds pass the intestine without being injured, and it further appeared that it only happened if the birds had eaten very large quantities. Therefore, it is not reasonable to believe that our gallinaceous birds do any essential damage by spreading weeds. They rather are beneficial since they eat considerable quantities of seeds which are destructed in their intestine.

5. SOME GENERAL RESULTS OF THE FOOD INVESTIGATIONS

What general conclusions can be drawn from these investigations? Primarily, that our three species of gallinaceous birds are rather different in their nutrition biology. They are all three mainly plant eaters, and this applies especially to the partridge, although the tiny chicks almost exclusively feed on insects. The food investigations also clearly show that the partridge is a pronounced field bird, which can hardly be believed to have lived in this country before the deforestation and thus must be supposed to have immigrated simultaneously with the beginning of agriculture about 5000 years ago. Its place of origin no doubt was the steppe. The black grouse is just as pronouncedly associated with heath bogs and heaths, and it certainly immigrated very early together with the open pine wood to the bogs and vegetation of which it is associated. The black grouse is supposed to be one of our oldest species of game which may have lived in this country in 10–11.000 years. Gradually as the wood and the cultivation spread it was forced back to the heath districts in West Jutland, a distribution which is well understandable considering its nutrition biology. The third species, the pheasant, is a much younger element in our fauna than the other two. It was introduced artificially in recent time and it is in a far less

degree attached to a definite plant community than the other two. As will appear from its variable diet the pheasant has a much greater ability to subsist under different conditions than the partridge and the black grouse, and as said above, this may explain why the pheasant has been able to acclimatise in great parts of the world. As regards the nutrition biology of our three gallinaceous species there can thus hardly be any doubt that the ability of the pheasant to compete far exceeds that of the other two. This should be borne in mind in the districts where an effort is made to protect the natural population of partridges and black grouse so that measures to increase the pheasant population should not be made simultaneously.

It is furthermore evident from the investigation that the partridge in this country practically everywhere depends on weeds in the cultivated fields, actually on very few species which mainly occur in lime-deficient soil. This explains why the partridge population thrives better in areas with a meagre soil than on richer soil with weedless and well marled fields. The development in the sanctuary on the isle of Vorsø has just plainly shown that the partridges cannot thrive if their food plants disappear. Until 1928 the greater part of this island was cultivated (the island is of well over 136 acres, of which a minor part is occupied by a few small woods). At that time there were a few flocks of partridges; when the cultivation of the greater part of the island was given up, the soil became gradually grown with a dense cover af grasses and perennials, 34 acres which are still cultivated are treated so intensively that they are almost devoid of weeds. The result has been that although there has been almost no hunting, the partridges disappeared very quickly, while the pheasants thrived well; in spite of the fact that they were not fed and no form of control of prey animals was carried out (fox, ermine, owl, kestrel, crow, and magpie occurred on the island), the pheasants thrived well through many years, and attempts exterminating them by hunting were unsuccessful. This is just a good example showing that the partridges succumb when the food conditions deteriorate, whereas the pheasants are able to subsist.

The causes of the fluctuations in the partridge population—as on the whole fluctuations in all animal stocks—are complicate, and as a rule we cannot expect to find a single cause of such fluctuations. Increase of an animal stock will often be due to a simultaneous occurrence of a series of favourable circumstances (favourable climatic conditions in the breeding season, good nutrition conditions etc.), while a decrease is often ascribable to a simultaneous occurrence of unfavourable circumstances (poor food conditions, mass occurrence of enemies, diseases, etc.). Therefore, it is presumably not justified to maintain that the decrease in the population of partridges observed in many districts is solely due

to the deterioration of the nutrition conditions of the partridges involved by the improved methods of agriculture, although there is hardly any doubt that the weeds in the field have decreased in many regions and the food conditions of the partridges thereby have deteriorated. It goes without saying that the soil cannot be less intensively cultivated for the sake of the partridges, but the results obtained on Saltholm show that even relatively small cultivated areas rich in weeds may be of importance for the partridges. It would therefore no doubt be of importance to sow small stretches with Polygonum, buck-wheat or other food plants of value to the partridges.

Nor can there, according to the investigations, be any doubt that seeds of Polygonum when they are present are preferred by the partridges which should, of course, be borne in mind in case of feeding and rearing, and likewise that grains of barley are preferred among our cereals.

Table 1.

The occurrence of different food items in the crops of adult partridges and pheasants for the whole year indicated in per cent of crops examined.

	Partridges	Pheasants
Barley	26	38
Oat	18	21
Wheat	7	8
Rye	1	1
Seeds of Polygonum convolvulus, Black bindweed	21	18
— - P. tomentosum, Pale persicaria	14	20
— - P. persicaria, Persicaria	7	8
— - P. aviculare, Knotgrass	10	8
— - Stellaria media, Chickweed (Heath stitchwort)	18	19
— - Spergula album, Corn spurrey	13	0
— - Chenopodium arvensis, Goose foot	8	9
— - grass (mostly Poa annua), Annual meadow grass	9	22
— - Cerastium sp., Mouse-ear chickweed	6	6
— - Atriplex sp., Orache	3	3
— - Anagallis arvensis, Scarlet pimpernel	1	7
— - Sinapis arvensis, Charlock (Wild mustard)	–	12
Grains total	37	44
Seeds of weed total	61	50
Leaves and flower buds	75	59
Roots and tubers	1	16
Animal food	9	16

Table 2.

Survey of the most common food items of adult partridges.

	Winter	Spring	Summer	Autumn
Number of crops	25	38	29	67
Barley	4	13	28	39
Oat	–	8	10	32
Wheat	–	3	7	13
Seeds of Polygonum	16	24	38	46
Seeds of Stellaria media	–	5	17	32
Other seeds of weeds	4	16	71	58
Leaves of grass	88	76	17	55
Leaves of clover and alfalfa	24	23	24	37
Other leaves	12	–	14	12
Grains total	4	13	35	63
Seeds of weeds	20	42	73	82
Leaves total	100	84	38	72
Animal food	–	8	24	7
More than 10 leaves of grass	56	53	10	12
Less than 10 leaves of grass	32	23	7	43

Figures indicate per cent of occurrence within the different seasons: December–February, March–May, June–August, September–November.

Table 3.

Distribution of the examined partridges during the months and in the different districts.

206 patridges	Number per month													
Locality	January	February	March	April	May	June	July	August	September	October	November	December	Without date	Number per locality
Jylland														
Løjt							1							1
Tinglev							1	4						5
Holmskov, Als						1								1
Rødding										2				2
Haderslev (Højer, Farris, Sommersted)		1	2	2			2	1		5				13
Jerne, Esbjerg	1	3	2	6					5	5	3	5		30
Skallingen										4				4
Holmsland Klit										8				8
Fromsejer		3	3	2					2					10
Rønholt									4					4
Lindholm Høje						3								3
Aalborg	2													2
Venø		2	2	2						4				10
Fur										10				10
Fyn														
Brahetrolleborg	2	2						1	4	3		2		14
Lyø	1		2					4						7
Fjellebro						1								1
Broholm, Gudme							2	1						3
Bojden, Faaborg								1		5				6
Horne								1						1
Schelenborg						3								3
Sjælland														
Høve, Asnæs					1									1
Haarlev, Stensved, Svinø										8				8
Taarnborg, Korsør	2													2
Krusesminde, Korsør			2											2
Sofienholm, Uggerløse					2									2
Gaunø							2							2
Benzonsdal, Thorslunde, Taastrup						2								2
Lundby							3							3
Snertinge					3									3
Amager							1			6				7
Saltholm			10			4			5					19
Lolland														
Rødby												1		1
Lungholm							1	1	1					3
Without locality										3			10	13
Total per month	8	11	23	12	6	14	13	14	21	63	3	8		

Table 4.

Occurrence of different food items in the crops of chicks of partridges.

Number of crops examined	July 13		August 24		September 9	
	Number of crops	Occurrence per cent	Number of crops	Occurrence per cent	Number of crops	Occurrence per cent
Plant lice	8	62	4	17	–	–
Ants	5	38	3	13	–	–
Beetles	7	54	9	38	3	33
Other insects	9	69	8	33	1	11
Spiders						
Wood lice etc.	3	23	2	8	2	22
Total animal food	12	92	12	50	4	44
Polygonum, Rumex	1	8	8	33	3	33
Barley, oat, wheat	3	23	17	71	5	55
Stellaria media	3	23	15	63	2	22
Other seeds	7	54	15	63	3	33
Grass, clover etc.	1	8	14	58	6	66
Total vegetable food	10	77	24	100	8	88

Table 5.

Occurrence of different food items in pheasants from Vorsø indicated in per cent of total amount of pheasants with food in the crop within the said months.

	February March	June	October
Number of crops	36	6	15
Barley	6	–	7
Oat	–	–	13
Wheat	–	–	40
Tubers of pile-wort	44	83	–
Roots and rootstocks	31	–	7
Leaves of grass	33	17	7
Other leaves	64	17	13
Flowers and buds	33	–	7
Fruits of oak, hazel and ash	33	–	40
Various seeds	36	83	33
Insects etc.	36	50	47

Table 6.

Occurrence of different food items in adult pheasants in per cent of total number of examined pheasants in the said months.

(only pheasants with food in the crop are included).

	January	February	March	April-May	June	July-August	November	December
Number of crops	9	9	9	12	15	14	10	27
Barley	22	44	38	17	–	7	90	70
Oat	22	56	13	8	–	–	10	11
Wheat	–	11	13	–	–	14	10	11
Seeds of Polygonum	44	56	50	25	–	29	60	37
Seeds of Stellaria media	11	–	13	17	53	29	10	11
Seeds of grass	11	22	50	–	53	64	–	19
Various other seeds	56	78	63	17	40	50	60	78
Leaves of grass and clover	89	67	25	17	33	–	50	44
Leaves and shoots of other plants	11	67	–	42	27	29	20	26
Flowers and flower buds	–	22	13	8	7	29	10	4
Roots and rootstocks	–	44	13	17	13	–	30	26
Insects etc.	33	22	13	17	60	21	10	30

Table 7.

Occurrence of the different food items in the crops of pheasant chicks.

Number of examined crops	June 10		July 17		Aug.-Sept. 28	
	Number of crops	Occurrence per cent	Number of crops	Occurrence per cent	Number of crops	Occurrence per cent
Plant lice	1	10	6	35	1	4
Ants	1	10	1	6	–	–
Beetles	3	30	9	53	8	29
Other insects	8	80	11	65	16	57
Spiders, snails and slugs, wood lice etc.	7	70	4	24	8	29
Total animal food	10	100	12	71	19	68
Polygonum, Rumex	–	–	1	6	9	32
Barley, oat, wheat, rye	–	–	2	12	18	64
Stellaria media	–	–	4	24	10	36
Grass seeds	–	–	6	35	3	11
Other seeds	–	–	8	47	12	43
Grass, clover, berries etc.	–	–	4	24	5	18
Total vegetable food	–	–	14	95	28	100

Table 8.
Black Grouse
Survey of the most important food items.

	Adults	Juveniles
Berries of Empetrum nigrum	69	23
— - Oxycoccus quadripetalus	27	8
— - Vaccinium vitis-idaea	15	–
— - Arctostaphylus uva-ursi	15	–
— - Juniperus communis	6	–
Grains of oat	15	–
— - barley	9	–
Seeds of Scirpus caespitosus	25	23
— - Juncus squarrosus	12	15
— - Sieglingia deccumbens	12	–
— - Carex, several species	15	8
Buds and anthocarps of Ranunculus	6	38
Buds of Hypochoeris radicata and Leontodon	21	30
Top with flowers and seeds of Rumex acetosa and R. acetosella	21	8
Anthocarp of Potentilla tormentilla	9	8
Leaves of Salix repens	40	–
— - grass	18	8
— - clover	27	38
— - Andromeda polyfolia	12	–
Stems of Calluna vulgaris	18	–
— - Genista pilosa	12	
Insects etc.	21	83

Occurrence per cent in the crops of adult (totally 33) and juvenile (totally 13) black grouse in the summer and autumn months. In addition were found in one or at most two adult black grouse: seeds of Viola, Pedicularis, Spergula and wheat, Flowers of Andromeda, clover, Erica. Shoots with leaves of Thymus and Galium harcynicum. Leaves of Arctostaphylus, Vaccinium vitis-idaea, Plantago, Leontodon autumnalis, Luzula, Hieracium pilosella. In addition, Cladonia rangeferina, galls from willow leaves and root fragments of Hypochoeris. In the chicks were found seeds of Luzula and Melandrium dioecum, shoots with buds of Narthecium, bud of Knautia and flowers of Andromeda.