ANALYSIS

OF

A DANISH ROE-DEER POPULATION

(CAPREOLUS CAPREOLUS (L.))

BASED UPON THE EXTERMINATION
OF THE TOTAL STOCK

BY

JOHS. ANDERSEN

REPRINTED FROM THE »DANISH REVIEW OF GAME BIOLOGY«
VOL. 2 PP. 127—155.

COPENHAGEN 1953

Printed in Denmark · J. H. Schultz A/S · Universitets-Bogtrykkeri

ANALYSIS

OF

A DANISH ROE-DEER POPULATION

(CAPREOLUS CAPREOLUS (L.))

BASED UPON THE EXTERMINATION
OF THE TOTAL STOCK

BY

JOHS. ANDERSEN

COMMUNICATION NO. 8
FROM VILDTBIOLOGISK STATION,
KALØ

COPENHAGEN

1953

CONTENTS

1. INTRODUCTION

In the year of 1948 the Estate of Kalø was taken over by the Game Fund with the purpose of establishing a game research farm and associated game biology station.

Various problems of game biology have here been subjected to study, in particular problems relating to the density of game populations, feeding biology migrations &c.

The roe-deer (Capreolus capreolus (L.)) is an important game species in Denmark—on an average about 17000 are killed per year—and shortly after the establishment of the game research farm a good opportunity occurred for studying the age distribution of an entire roe-deer population.

The woods of the estate supported a large stock of roe-deer, however, from the hunters' point of view it was not satisfactory because of the poor heads.

After the estate had become a game research farm it was desired to remedy this by introducing a completely new stock from a place where the types of roe-deer were in conformity with the wants of the sportsmen.

It was decided to eliminate the old stock before fresh deer were released and the kill was carried out in 1950 by the staff of the game farm conducted by the head keeper, Mr. BJERG-THOMSEN.

2. DESCRIPTION OF THE AREA

Kalø is situated on the North coast of Århus Bay and covers an area of about 1000 ha. There are 340 ha of woodland forming two separate woods, 'Hestehaven' (176 ha) and 'Ringelmoseskoven' (164 ha) that are about 500 m apart (see fig. 1).

Surrounding and in between the two woods is arable land. As regards topography it is rolling country sloping towards the sea. In most places the soil is a fertile boulder clay, and the woods as well as the arable land are intensively cultivated.

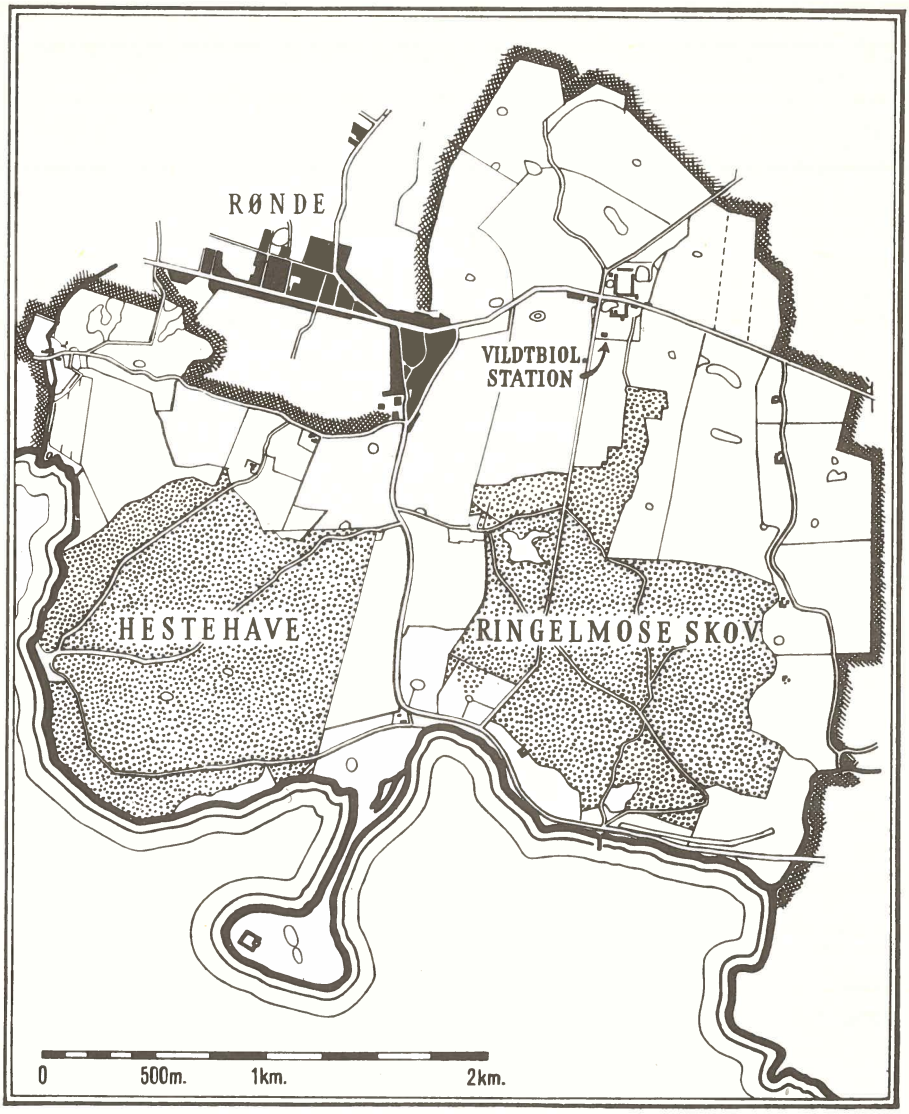

Fig. 1. Map of the Danish Game Research Farm, Kalø, on the North coast of Århus Bay. The position of the two woods »Hestehaven« and »Ringelmoseskoven« is shown with the surrounding arable land. At the point of the arrow is the Game Biology Station. Top left is the village Rønde.

The woods are mixed, more than one half consisting of beech (52 per cent), oak contributes 6 per cent, various other deciduous trees (alder, poplar, ash) 5 per cent, and conifers (various species of spruce, larch and a little thuja) 35 per cent.

It is noteworthy and of interest for what follows that a large part of the wood consists of young, dense plantings.

As a consequence of a change in the management plans in 1930 and the compulsory thinning during World War II several of the old sections have been replaced by young plantings.

Not less than 43 per cent of the total woodland area carry plantings less than twenty years old. So the present picture of the wood is that of many dense plantings scattered throughout the old and more open wood.

As a habitat for roe-deer the wood is particularly favourable. Other larger mammals present are hares, a small stock of foxes and badgers but no other species of deer.

3. SIZE OF THE ROE-DEER POPULATION

Before the shooting was started it was tried to estimate the number of roe-deer living in the wood.

It is a well known fact that roe-deer are very stationary which is also supported by the marking experiments in Germany (BIEGER 1941 I, p. 208), and hunters and foresters who spend much of their time in the wood throughout the year get an idea of the number of deer living in the different sections of the wood. Also a good opportunity of counting the deer occurs when they are feeding in the fields outside the wood in the mornings and evenings.

The total roe-deer population of the Estate of Kalø was estimated at about 70. It was a great surprise to all concerned that there turned out to be very many more.

The day when the kill was stopped 213 roe-deer had been shot. A very small number, perhaps four or five, escaped which could be seen from the tracks in the snow during the last days of the shooting.

This means that the population density has been 60–65 deer per 100 ha of woodland or one per 1.6 ha. If the entire area used by the deer is considered, the wood and the adjacent fields, the area increases to about double the size which corresponds to an average area per deer of 3.2 ha (or 8 acres).

LEOPOLD quotes (1947, p. 54) some figures for the area per deer (white-tailed deer) and in one particular fenced locality he finds that saturation of the area

occurs at one deer per 7.5 acres. In non-fenced areas the maximum density of white-tailed deer is considerably less.

BIEGER (1941 I, p. 206) gives the density of roe-deer as 10–20 per 100 ha in suitable areas in Germany, that is in areas with more than 50 per cent of woodland.

However, this does not exclude the possibility of still higher density in some populations in Germany.

So on the whole the density found on the Estate of Kalø is considerably higher than those recorded from other places.

Even if the density on the area with which we are concerned here is high for Denmark there are probably several other Danish localities with similar densities.

The question arises whether the density found at Kalø is too high because of immigration during the shooting period. For the persons who know the local conditions and who had the opportunity of following the kill in details all the time an immigration seems highly improbable, although it can neither be proved nor disproved.

The two nearest districts with a permanent though small roe-deer population are 4–5 km East and West of Kalø. In these districts no changes were noticed in the roe-deer populations during the period when the shooting took place at Kalø.

In other places where the area has been efficiently fenced one has also experienced that the roe-deer population is far greater than found by estimates in the field. This applies e. g. to the two Funen estates of Egeskov and Fjellebro where similar complete exterminations were carried out in 1938 and 1939 inside efficient deer fences.

In addition there is a similar example of an underestimate of the population of *fallow deer* on a small Danish island.

Mr. I. SPORON-FIEDLER has described the interesting case in an article in 'Dansk Jagttidende' vol. 47 p. 39–43, 1930.

In this case the area was a small island of 250 ha with a good deal of wood and shrub. It was wanted to get rid of the stock of fallow deer. Mr. SPORON-FIEDLER carried out the shooting from 12/9 1929 to 26/2 1930.

As in this case the area was an island the question of immigration or emigration during the shooting period can be ruled out.

The estimated size of the stock was 30 (5 bucks and 25 does and fawns). However, there turned out to be 44 (8 bucks and 36 does and fawns) i. e. 50 per cent above the estimate.

When the estimate of such a relatively small herd in a restricted and small

area is so far of the mark it cannot surprise that the estimate of the Kalø herd of roe-deer, living in woods with plenty of dense young plantings, resulted in a vast underestimate, especially because the roe-deer are smaller than the fallow deer and much better at hiding themselves.

These cases show how cautious one has to be when drawing conclusions concerning population densities from field estimates.

4. THE SHOOTING PROCEDURE

According to the Danish Game Law roebucks may be killed between 15 May and 15 July and roe-deer in general from 1 October to 31 December.

During the first period—15/5–15/7—18 bucks were shot (nos. 1–18 in the list on p. 153). The rest was shot during the autumn season.

During the summer hunting period and in October the deer were stalked using rifle usually morning and evening when they came out into the open fields to feed.

From the beginning of November the shooting was very intensive and dogs (spaniels) were used for the drive in all the thickets of the wood. The deer were killed with shot-guns by the shooters posted outside—usually 6–8 men.

The deer that appeared first were shot irrespective of age and sex—this is important for what follows.

They were often extremely difficult to get out either because they went on moving about inside the thickets or lay concealed.

The shooting was particularly intensive towards the end of the period when it had become apparent that the size of the herd had been underestimated. During the last days the shooting was facilitated by several falls of snow, which made it possible to trace the remaining roe-deer to their hiding-places.

5. COLLECTION OF THE MATERIAL

Immediately after a deer had been shot it was numbered, and when the viscera had been removed the body was weighed. The lower jaw was kept for the age determination. The genital organs and the stomach were kept in 10 per cent formalin. In addition notes were taken on the sex, date of shooting, & c. In the list on p. 153 all the individuals are entered in the order they were shot.

6. AGE AND SEX DISTRIBUTION OF THE POPULATION

The degree of wear of the molars is the only feasible indicator of the age of a deer so far known.

Some authors consider the method useless or at least not very reliable (WEISMAN 1939, p. 171). It has been argued that the degree of wear of the molars can vary with the type of food, however, it has never been demonstrated. BIEGER (1939, p. 19 and 51–74) has tested the method on a large number of marked deer, and he concludes that the degree of wear varies to such an extent that the method cannot be used for the age determination of roe-deer more than three years old if an accuracy of less than $\pm$ 1 year is wanted, and that the accuracy decreases with increasing age of the deer. The age of old deer can only be estimated within wide limits.

All the individuals of the present material come from one locality and the food was probably much the same in all cases so that the variation in the degree of tooth wear caused by differences in the food can probably be neglected.

In addition we are concerned with a large collection of jaws of a uniform character from a herd with common genetical background. Probably this will also tend to produce a uniform degree of wear in relation to age.

Accordingly the tooth wear method was considered reliable in this particular case, and to make the analysis as objective as possible the grouping of the jaws with reference to tooth wear was carried out independently by two persons. However, the result was exactly the same.

As a basis for comparison BIEGER's description was used in conjunction with a series of jaws collected by the Danish expert on roe-deer, Chief Game Warden, G. Count AHLEFELDT-LAURVIG-BILLE. The series consists of jaws from marked individuals of known age (fig. 2).

No difficulties were met with in grouping the fawns, as the milk-teeth were still present at the time of the kill.

The result of the age determinations of 213 individuals is presented in fig. 3. Of course, the few individuals that escaped could not be taken into consideration but that cannot change the picture appreciably.

In spite of the possible inaccuracies inherent in the tooth wear method of age determination when applied to old individuals it is probably justified to think that the diagram depicts fairly well the age distribution in the herd.

It appears that by far the greater part of the population consists of young individuals. Only about 14 per cent of the deer are more than 3–4 years old, the number of individuals in each age class decreases rapidly with the age, and

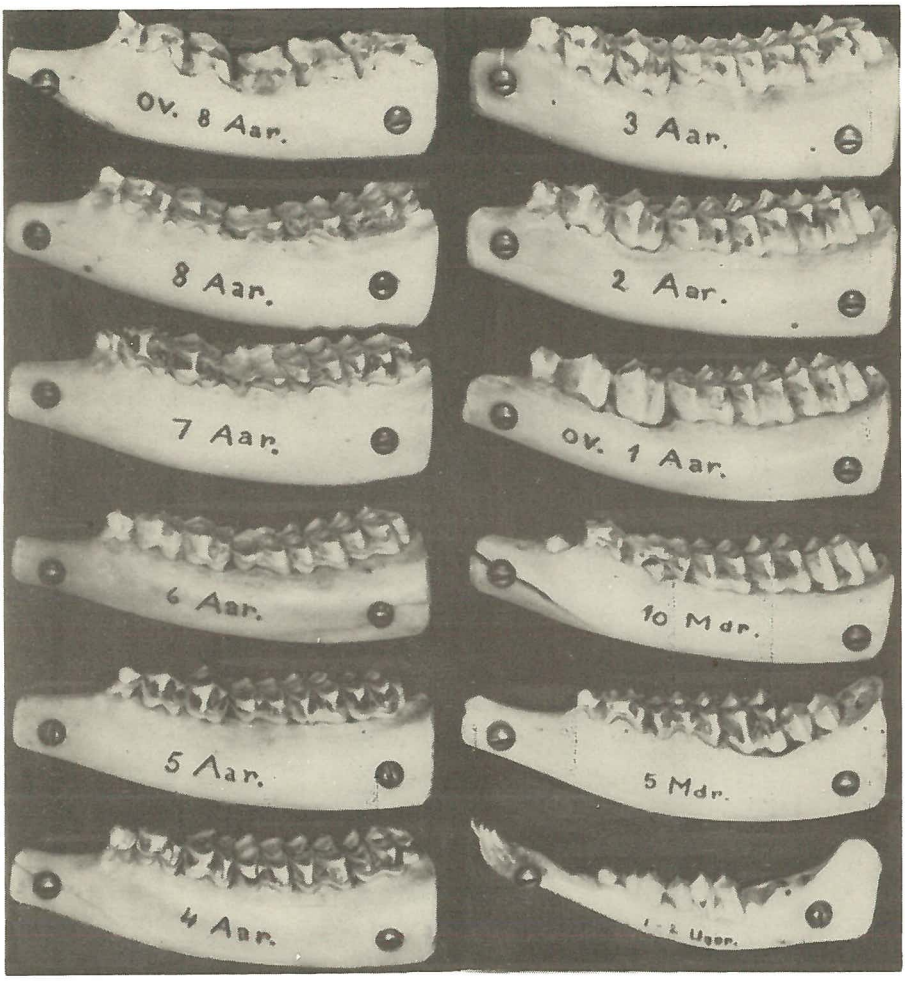

Fig. 2. Series of jaws from roe-deer of known age, showing the increasing degree of tooth wear. Ages, left column: > 8, 8, 7, 6, 5 and 4 years; right column: 3,2 years, > 1 year, 10 months, 5 months, 1-2 weeks. - Collected by Chief Game Warden, Count Ahlefeldt-Laurvig-Bille.

particularly striking is the large number of fawns as compared with the older age classes.

When the age of the fawns is assumed to be six months, a mean age of all the individuals killed of only 2.0 years is obtained. It is a curious fact that SKUNCKE (1949, p. 338) arrives at an arithmetical mean age of 1.9 years for protected herds of elk in Sweden.

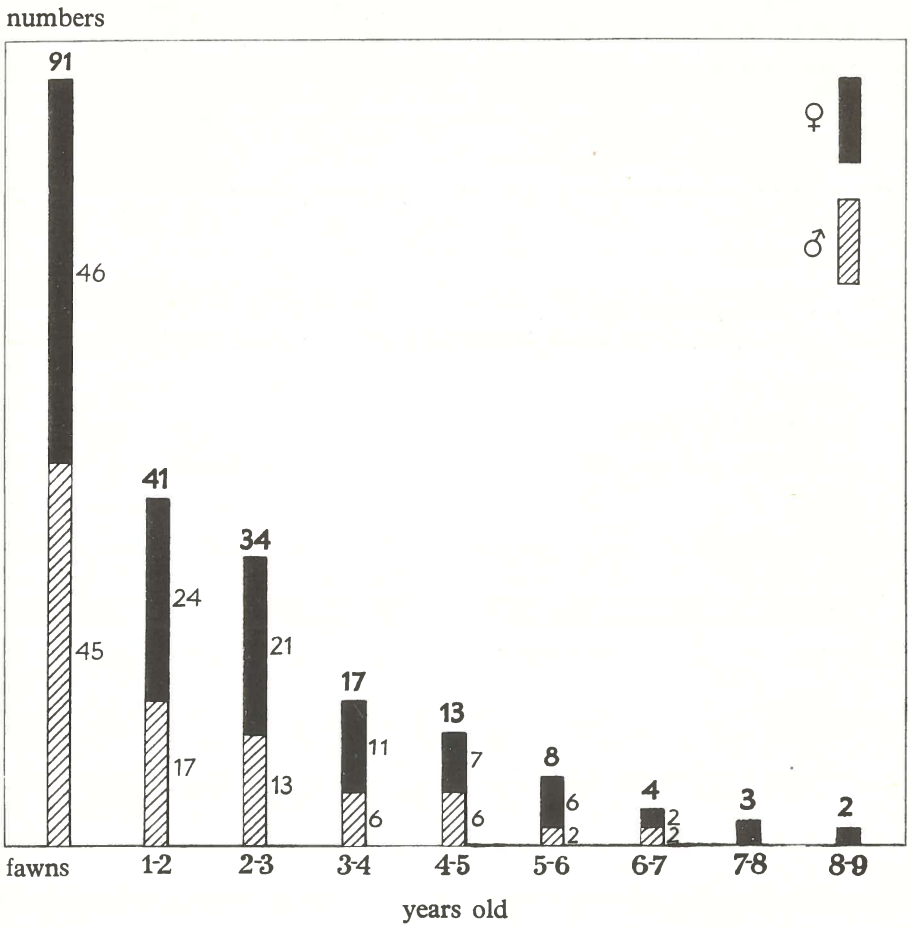

Fig. 3. Diagram of the age and sex distribution in the total population of 213 roe-deer killed at Kalø in 1950.

Excluding the fawns the mean age of the Kalø herd is calculated at 3.1 years. Following the same procedure SKUNCKE calculated the mean age of elks killed in Sweden and arrived at a mean age of 3.5–3.8 years.

There is a striking coincidence between the mean ages of herds of these widely different species of deer, and in another place it will be shown that there is a similar agreement between the reproductive capacity of the two species.

The older age groups only contribute a small proportion of the herd, and the potential longevity seems to be rarely attained in actual practice. Only few individuals of roe-deer and elk become more than four to five years old,

and the bulk of the herd consists of quite young individuals. Probably this rule holds true in several other species.

On the Kalø Estate only few roe-deer have been killed during the years preceeding the kill (on an average 16 per year), and dead individuals being rarely found a certain measure of emigration must have taken place.

It is a general experience that an emigration of young bucks from densely populated areas takes place during the summer.

They settle in plantings and small woods (where they are usually shot by the holder of the shooting rights). However, this emigration must comprise young does too.

Under all circumstances a certain amount of emigration from crowded areas is to be expected because there is a limit to the number of deer a district can support.

Several authors mention the saturation density of an area with regard to some animal species. That such a density exists is a practical experience which has been explained in several ways. It is also known to vary in size between different places and at different times, however, almost nothing is known with certainty about the underlying mechanism.

LEOPOLD (1947, p. 54) says 'in hoofed mammals there is so far no visible evidence of any density limit except the carrying capacity of the food...'

In the case treated here there is no doubt that the saturation density of the Kalø area had been attained. However, it is not possible to discern any factor that could possibly cause this limit. It is highly improbable that shortage of food could be the operative factor.

POUL HANSEN (1943, p. 66) quotes several characteristic statements by Danish sportsmen, e. g. by Mr. POULSEN, Chief Forester of Foussingø:

'The local roe-deer herd has always been thinned very lightly, such that the addition of young individuals has always exceeded the number of older individuals that have been killed.

Therefore, when the herd has not increased in size it is probably due to the fact that the roe-deer emigrate to adjacent woods and plantings when a certain 'pressure' has been reached, and on the Estate of Foussingø this seems to take place at about 130 individuals. The 'pressure' is not solely dependent upon the possibility of finding food because food is administered so liberally during the winter that the emigration cannot possibly be caused by starvation. Already during the autumn emigration takes place, before the onset of the winter, so the reason for the emigration must be the need for a certain distance between the individuals as a condition for feeling comfortable.'

This passage is quoted here because it is characteristic of the practical experience of several sportsmen.

The maximum density of an animal species—or the saturation point—varies from one locality to another, and in the same locality there is variation between years (fluctuations).

One important problem to deal with in the future will be to determine the saturation densities in various habitats.

It appears from the diagram in fig. 3 that 91 males and 122 females were killed in all, i. e. 43 per cent of males and 57 per cent of females, so the sex ratio is 1:1.3.

Further the sex ratio in the youngest generation, fawns about six months old, is seen to be very nearly unity (45:46).

In the older generations there is a constant excess of does.

As bucks and does were killed at approximately the same rate during the years preceding 1950 there is hardly any other explanation that the density limit on the Kalø Estate is lower for bucks than for does (perhaps due to fighting during the season) with the consequence that relatively more bucks will emigrate from the area.

7. THE SIZE OF THE REPRODUCTION IN THE YEAR OF THE KILL

An analysis of the ratio of the number of (surviving) fawns over the number of sexually mature does, i. e. does more than two years old, gives an idea of the rate of reproduction.

Among 213 individuals 52 were does more than two years old, and 91 were fawns, i. e. 1.8 fawns per doe on an average. This ratio would be obtained if ¾ of the does had two fawns and ¼ one fawn, disregarding the rare occurrence of triplets. Even if the figures are only approximate the reproductive rate is likely to be fairly high.

The ratio of 1.8 fawns per mature doe cannot be assumed to have general validity as an average reproductive capacity of does. It only applies to the Kalø Estate during 1950. This year may have been particularly favourable, at least this was the case in the other important Danish game species.

It is interesting to note that Skuncke (1949, p. 332) arrives at exactly the

same figure for what he calls the net mean production of elk in Sweden, 1.75 fawns per year per mature female elk.

Let us assume Kalø to be totally isolated and the exterminated herd to remain. In that case the 76 pregnant does (52 more than two years old + 24 yearlings) would bring the herd up to 346 individuals in 1951, in other words the population would increase by 62 per cent. A similar growth of the population during the subsequent years seems impossible in practice. There would not be sufficient space for it.

Therefore emigration is necessary if the surplus is not killed every year.

On several Danish estates the areas are fenced to keep the roe-deer. However, in many places dead animals in varying numbers are found every winter, a higher number being found in severe winters. This phenomenon is hardly known at Kalø.

It is highly probable that the occurrence of dead animals can be related to a supersaturation of the area.

This should probably be considered when efficient deer fences are being used.

8. PREGNANCY OF THE DOES

The expression ‚infertile does' is often used to designate does which have lost the power of reproduction due to old age or for other reasons. In the highly developed Danish wildlife management it is often recommended to kill deer with a poor appearance, e. g. bucks with poor antlers, exceptionally small fawns and does not followed by fawns. However, it is doubtful if the category of infertile does exists at all. A doe without fawns may have lost them and need not necessarily be infertile. In the following year it may be as fertile as the others.

In order to get an idea of the position at Kalø the reproductive organs were removed from the does killed.

The roe-deer are in rut in July and August. After fertilization the embryos enter a resting period in the uteri (prolonged pregnancy) lasting until January when the further development continues (cf. SAKURAI 1906).

This implies that the does killed during the autumn contain extremely small embryos that are difficult to find.

However pregnancy can be diagnosed through the presence of the corpora lutea that have developed in the ovaries subsequent to the ovulation. The presence of corpora lutea during the autumn, i. e. 2–4 months after fertilization must necessarily indicate pregnancy.

If fertilization has not taken place the corpora lutea degenerate fairly soon; CHEATUM (1949) among others mentions that in the white-tailed deer *(Odocoileus virginianus borealis)* the degeneration commences within a fortnight after the ovulation if fertilization has not taken place.

Similar conditions must be assumed to prevail in the roe-deer, such that the presence of non degenerated corpora lutea in October–December must indicate the presence of embryos.

It appears from the list on p. 153 that 76 sexually mature does were killed (52 more than two years old does + 24 yearlings). They constitute the does that could theoretically be pregnant. Unfortunately, by a mistake the ovaries were not kept in all cases. When the does were opened after the kill the reproductive organs were removed by the game assistants and placed in formalin. However, during the examination later on it was found that the ovaries had in several cases been torn away from the uteri and thus were missing. The ovaries

Doe no.	Age in years	No. of corpora lutea	Doe no.	Age in years	No. of corpora lutea
23	7–8	1 + 1	103	6–7	1 + 1
25	1–2	2 + 0	106	3–4	2 + 0
26	2–3	2 + 0	109	2–3	2 + 0
27	5–6	2 + 0	116	3–4	2 + 0
28	7–8	3 + 0	123	2–3	2 + 0
29	2–3	1 + 1	137	1–2	1 + 0
33	1–2	2 + 0	139	2–3	1 + 1
34	4–5	1 + 1	145	3–4	1 + 1
35	2–3	1 + 1	157	8–9	1 + 1
36	1–2	1 + 1	160	1–2	1 + 0
40	2–3	2 + 0	163	1–2	1 + 0
43	4–5	1 + 1	164	1–2	2 + 0
47	7–8	2 + 1	166	2–3	1 + 1
57	3–4	2 + 0	175	4–5	2 + 0
60	3–4	1 + 1	180	5–6	2 + 0
62	2–3	2 + 0	186	1–2	1 + 1
73	7–8	1 + 1	187	2–3	3 + 0
77	2–3	2 + 0	199	2–3	2 + 0
80	4–5	1 + 1	200	3–4	2 + 0
82	3–4	1 + 1	204	3–4	2 + 0
89	3–4	1 + 1	205	6–7	1 + 1
94	1–2	1 + 0	208	2–3	2 + 0
100	4–5	1 + 1	209	4–5	2 + 0

and oviducts were often embedded in fat and the very small ovaries (only 7–10 mm in diameter) were not at all easy to see.

Two ovaries were obtained from each of 46 does, i. e. from 60 per cent of the total number of mature does. The percentage is probably sufficiently high to be representative of the herd.

The ovaries were studied by making several parallel sections through the organ and counting the number of corpora lutea.

In the list above the number of corpora lutea in the ovaries of each individual is given. The age of the doe is also stated, and the numbers are given in such a way that e. g. 1 + 1 means 1 corpus luteum in either ovary, 2 + 0 means 2 corpora lutea in one ovary and none in the other and so on.

In all the does examined there were thus 1–3 corpora lutea which must mean that they have all been pregnant in 1950, and the occurrence of infertile does could not be substantiated.

Of course, the number of corpora lutea need not coincide with the number of embryos present, it only provides a mean of determining the number of eggs that have been liberated and it is thus an indicator of the maximum number of embryos that can be present.

It is seen that

3 does had a total of 3 corpora lutea,
39 – – – – – 2 – –
4 – – – – – 1 corpus luteum

This indicates that at most 3 among 46 does, or approximately 6 per cent, had the possibility of being pregnant with three embryos.

That is in agreement with the fact that triplets are of rare occurrence.

To some extent the number of fawns must be determined already about one year before they are born by the number of ripe follicles present at the time of copulation. By far the greater part of the does, 39 individuals, i. e. about 85 per cent have only two corpora lutea in the ovaries. Thus there is a good agreement between the number of corpora lutea and the number of fawns born. The data presented here agree fairly well with the experience of BIEGER (1941, p. 210), however, with the difference that BIEGER normally found one egg to be liberated from either ovary. In the list above the corpora lutea are seen to occur just as often in one ovary.

It is interesting that the four does with only one corpus luteum are only 1–2 years old and pregnant for the first time. This is probably not mere chance. Although five of the yearlings had two corpora lutea there is undoubtedly a tendency for young does to give birth to only one fawn.

The total number of corpora lutea in the cases examined corresponds to about two per doe which must be the theoretical maximum of fawns in a herd. In actual practice there will hardly ever be so many as there are several possibilities for a prenatal loss in connection with fertilization and pregnancy.

In addition mortality among the newly born fawns will reduce the number of survivors. If in 1949 the does had the same number of eggs and conditions on the whole were similar to those examined in 1950, where there were 1.8 surviving fawns per doe, then the total loss during the period from ovulation in the summer of 1949 to the autumn of 1950 when the fawns were 3–6 months old has been approximately 12 per cent.

The loss seems small but it is likely to vary considerably with external conditions.

It is concluded from the present material that infertile does, i. e. non pregnant does did not occur in the herd, and it is probable that the category of infertile does does not occur at all or at least very rarely.

The theoretical maximum of embryos per doe is approximately two. In the year 1950 the number of surviving fawns at 3–6 months' age is only 12 per cent below the number of corpora lutea, if the number of corpora lutea is assumed to be the same per individual in the years 1949 and 1950.

Not more than 6 per cent of the does killed could theoretically be pregnant with three fawns.

Cases with the possibility of only one embryo per doe were restricted to young does in their first pregnancy.

9. CHANGE IN THE SEX AND AGE DISTRIBUTION OF THE POPULATION DURING THE SHOOTING PERIOD

Among the 213 deer 18 bucks were killed already during the summer, therefore, at the beginning of the general extermination on 1 October 195 deer remained (disregarding the few individuals that escaped).

The changes that took place in the sex ratio of the herd during the shooting period were as follows:

On 1 October the herd consisted of { 73 males = *37 per cent.* / 122 females = 63 per cent.

On 1 November – – – – { 46 males = *32 per cent.* / 96 females = 68 per cent.

On 1 December the herd consisted of { 9 males = *22.5 per cent.*; 31 females = 77.5 per cent.

On 15 December – – – – { 4 males = *17 per cent.*; 19 females = 83 per cent.

In fig. 4 the same data are shown diagrammatically.

It is apparent that the percentage of males decreases steadily while the percentage of females increases correspondingly during intensive shooting.

It is also possible to analyse how the fawns survived the shooting as compared with the adults:

On 1 October	there were	91	fawns	among	195	deer	=	46.7 per cent.
On 1 November	– –	66	–	–	142	–	=	46.5 per cent.
On 1 December	– –	19	–	–	40	–	=	47.5 per cent.
On 15 December	– –	10	–	–	23	–	=	43.5 per cent.

This indicates that throughout the period the fawns were killed at the same rate as the adults. Although the percentage of fawns on 15 December is slightly lower there is no statistically significant difference.

When the survival of the two sexes among the fawns is analyzed the result is similar to that obtained for the entire herd.

On 1 October	there were	45 males	among	91	fawns	=	*49 per cent.*
		46 females	–	91	–	=	51 per cent.
On 1 November	– –	27 males	–	66	–	=	*41 per cent.*
		39 females	–	66	–	=	59 per cent.
On 1 December	– –	6 males	–	19	–	=	*32 per cents.*
		13 females	–	19	–	=	68 per cent.
On 15 December	– –	1 male	–	10	–	=	*10 per cent.*
		9 females	–	10	–	=	90 per cent.

The same data are shown diagrammatically in fig. 5.

Also among the fawns the males have a greater chance of being shot. The same picture is obtained if the calculations are carried out for deer more than one year old. Towards the end of the shooting period only very few bucks remain.

When it is analyzed how the old deer, e. g. those more than 5–6 years old survive it appears that they too are killed at the same rate as the younger ones.

Apparently the chance of escaping is much the same in the older, young and quite young age groups.

The above findings may be of some interest from point of view of shooting technique. By an intensive shooting regardless of age and sex an excess of females results while there is apparently no changes in the age composition.

Probably this implies that a herd which is exposed to intensive shooting and thus having a large percentage of does, must have a higher reproductive capacity than a herd of the same size but exposed to light shooting pressure.

In several places in the literature on roe-deer it is recommended through selective shooting to aim at a sex ratio about unity in herds of roe-deer (e. g. RAESFELD 1923, p. 478 and BRUNS & SARTORIUS 1950, p. 7).

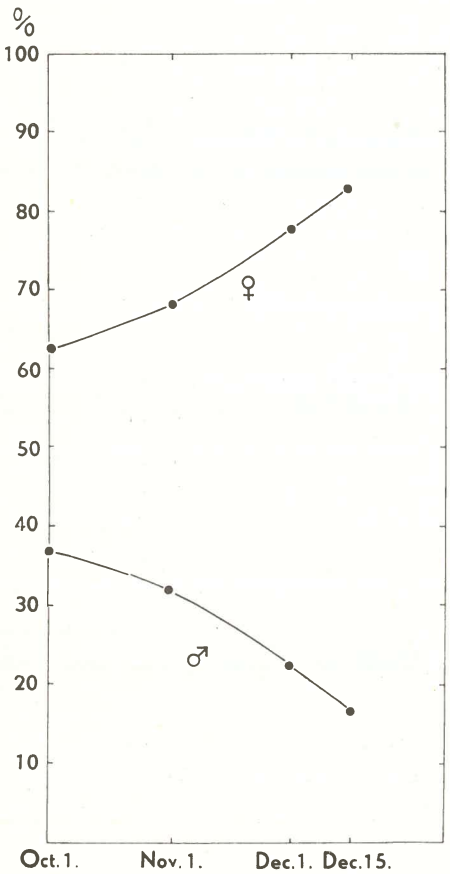

Fig. 4. Diagram showing the percentage distribution of sexes in the remaining herd of roe-deer at different times during the shooting period in the autumn of 1950.

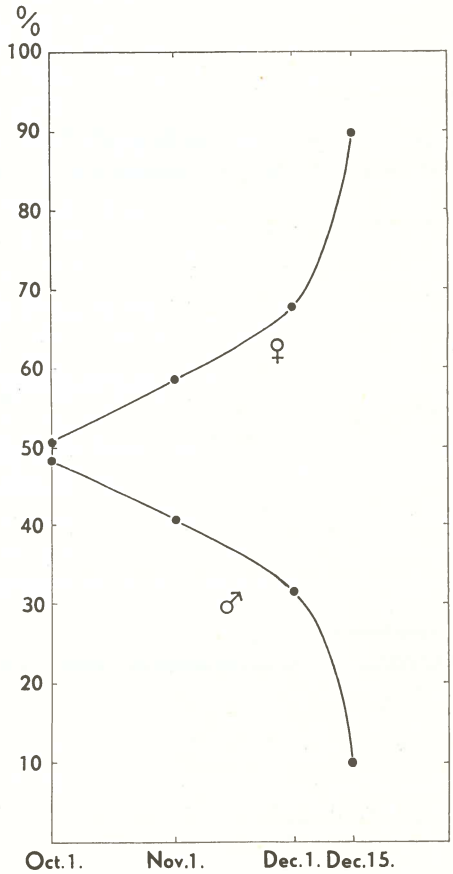

Fig. 5. Diagram showing the percentage distribution of sexes among the fawns in the remaining herd of roe-deer at different times during the shooting period in the autumn of 1950.

However, the argumentation is weak mainly being that overcrowding can be avoided in this way with the effect that the deer should become more vigorous and the heads better.

If a large number of deer is wanted on an area the general recommendation seems to be the establishment of a surplus of does over bucks (cf. e. g. BRUNS & SARTORIUS 1950, p. 7). However, this is a truism as roe-deer are polygamic.

On the other hand it is unknown how many does can be fertilized by one buck but in actual practice the reproductive rate seems to be solely dependent upon the number of does unless the number of bucks is extremely small.

While it has been mentioned above that the entire herd—now exterminated—would have a rate of increase of 62 per cent, the herd left over on 1 December (40 deer among which 18 were sexually mature does) would have a rate of increase of 79 per cent calculated in the same way.

The surplus of does which results from an intensive shooting gives the remaining herd a relatively high power of regeneration, relatively higher than would be expected from the absolute size of the herd.

Perhaps this is the explanation why herds of roe-deer can endure the intensive shooting to which they are subjected in many places.

10. BODY WEIGHTS

The deer were weighed after removal of the viscera. This is the usual way of stating body weights, and for the sake of comparison it was preferred here too. On the whole that is probably the most satisfactory basis for comparison as variations in the loss of blood and amount of food in the stomach are ruled out.

When comparisons are made it must be remembered that the weights apply to deer killed during the autumn. The bucks killed during the summer weighed usually about one kg less.

The individual body weights are listed p. 153.

In the summary below the average weights are given for the different age and sex groups.

Among the fawns the mean weight of the males exceeds the mean weight of the females by 800 gs. Among the adults there is a similar difference in the weights between the two sexes, on an average the males are 700 gs heavier than the females. Exactly the same difference in weight among adult roe-deer was

Age group	Females		Males	
	Number of individuals	Mean weight kgs.	Number of individuals	Mean weight kgs.
c. ½ yr (fawns)	46	*9.8*	45	*10.6*
1–2 years	24	*15.1*	9	*14.1*
2–3 years	21	15.8	9	16.3
3–4 years	11	16.4	4	16.1
4–5 years	7	16.9	4	17.8
5–6 years	6	16.5	1	19.5
6–7 years	2	13.3	1	16.0
>7 years	5	16.3	–	–
all above two years of age	52	*16.0*	19	*16.7*

found in Germany by BIEGER (I, 1941, p. 207). His material consisted of several thousands of deer.

The yearlings are exceptional in that the females are heavier than the males. The quicker rate of growth in the females may be induced by the pregnancy.

On the whole the number of individuals is too small to provide a satisfactory basis for calculating the mean weights of the remaining age groups. Among the does the maximum weight seems to be attained at 4–5 years' of age.

The adult mean weight of 16.0 kgs. in the does and 16.7 kgs. in the bucks may seem rather low. POUL HANSEN (1943) gives some weights of roe-deer from various Danish districts among these also some from deciduous woods. They are somewhat heavier. However, these weights do not refer to entire herds killed in one year, and it is not stated whether fawns and yearlings were included, so it is hardly possible to compare with the data given here. Possibly the weights can vary from one year to another. From several districts, however, mean weights of 16–17 kgs. are known and thus showing good agreement with the data from Kalø.

The question whether the body weights of the Kalø herd are low compared with other Danish herds cannot yet be settled.

The body weights given by BIEGER (1941, p. 207) of a large number of individuals from Germany cannot either be used for comparison as the ages are not stated, nor is it recorded at what time of the year the animals were killed.

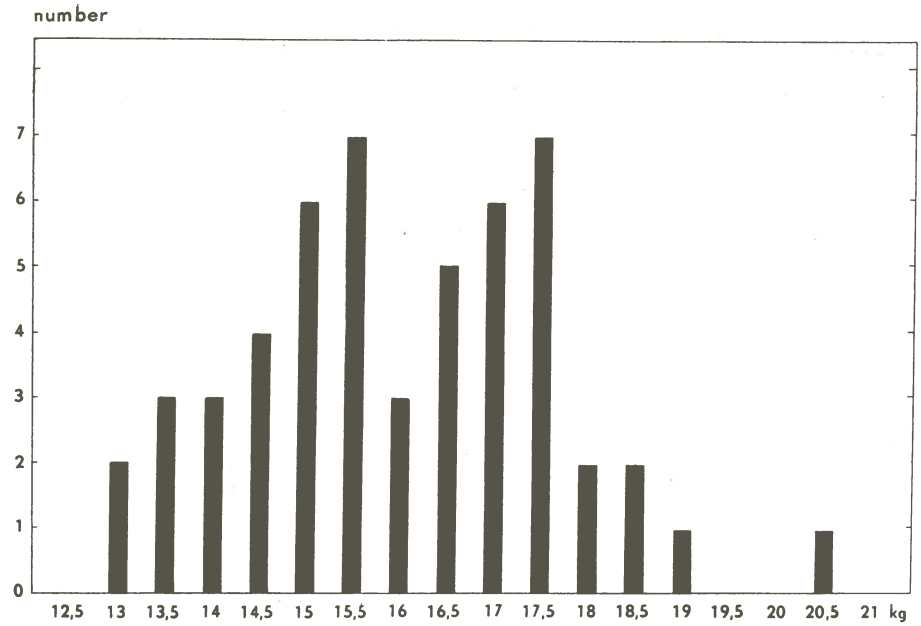

Fig. 6. The distribution on weight classes of 52 adult does killed at Kalø during the autumn of 1950.

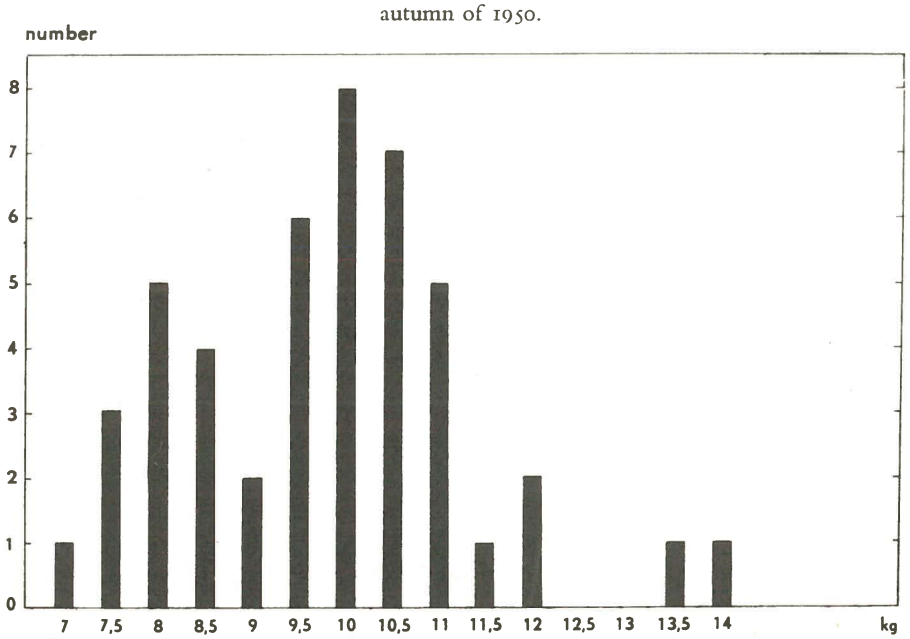

Fig. 7. The distribution on weight classes of 46 female fawns killed at Kalø during the autumn of 1950.

Within the single age groups there is a wide range of variation in body weights, usually amounting to about 5 kgs.

In fig. 6 is shown the distribution of body weights of all the adult does (more than 2 years old).

Fig. 7 shows diagrammatically the distribution of body weights of all the fawns, and a similar range of variation is seen.

An analysis of the body weights of the males leads to similar results.

SUMMARY

During the total extermination of the roe-deer population of the Danish Game Research Farm at Kalø in 1950 data were obtained that throw some light on the composition of an entire population living in a particularly good roe-deer habitat. 213 roe-deer were killed corresponding to 60–65 individuals per 100 ha of woodland. The population proved to be approximately three times as large as estimated beforehand. The herd showed a very large surplus of young individuals, only 14 per cent were more than 3–4 years old.

Among the fawns the sex ratio was unity, and in the entire herd it was 1 male: 1.3 females.

A considerable emigration must necessarily take place each year, and it must comprise more bucks than does. If the stock has been nearly stationary in size the annual emigration must amount to 60–80 individuals. It is concluded that bucks require more space than does, and that the saturation density of bucks is lower than that of does.

There was found to be 1.8 surviving fawns per mature doe, this would give the—now exterminated—herd a rate of increase of 62 per cent per year.

The ovaries of all the mature does contained non-degenerated corpora lutea. This indicates that they have been pregnant this year, and the presence of sterile does could be excluded.

The number of corpora lutea per doe was found to agree rather well with the number of fawns ordinarily occurring, and the number was not much higher than the number of surviving fawns actually found in the exterminated herd.

During the shooting period the sex ratio changed such that an increasing percentage of females resulted. The age class composition did not change.

The body weights (after removal of the viscera) were almost one kg higher in the males. The range of variation in body weights within the age groups amounts to about 5 kg, the maximum was found to be 7.5 kg.

LITERATURE

Bieger, W. (1941): Handbuch der deutschen Jagd I–II. Berlin.

Bieger, W. (1935): Anleitung zur Alterschätzung des Wildes. Berlin.

Bruns, Hans & Otto Sartorius (1950): Das Ansprechen des Rehwildes. 6. Aufl. Hannover.

Bræstrup, F. W. (1949): Vort Lands Dyreliv, p. 112. København.

Bræstrup, F. W. (1944): Lidt om Raadyrenes Liv Aaret rundt. Dyr i Natur og Museum 1943–44. København.

Bræstrup, F. W. & G. Ahlefeldt-Laurvig-Bille (1944): Dansk Jagtleksikon, bd. II, p. 1022.

Cheatum, E. L. (1949): The use of corpora lutea for determining ovulation incidence and variations in the fertility of White-Tailed Deer. The Cornell Veterinarian, 39 (3), p. 282.

Hansen, Poul (1943): Den store Vildtvandring mod Vest. København.

Leopold, Aldo (1947): Game Management, New York, London.

Marienfrid, S. Schumacher von (1939): Jagd und Biologie. Berlin.

Raesfeld, F. v. (1923): Das Rehwild. Berlin.

Skuncke, Folke (1949): Älgen. Stockholm.

Sakurai, Tsunejiro (1906): Normentafel zur Entwicklungsgeschichte des Rehes (Cervus capreolus). Jena.

Sporon-Fiedler, I. (1930–31): Da Daavildtbestanden paa -øen skulde bort. Dansk Jagttidende 47, p. 39.

Weismann, C. (1939): Haandbog i Jagt. København.

LIST OF ALL THE ROE-DEER KILLED AT KALØ IN 1950.

No.	Date	Sex	Age years	Weight kg*)	No.	Date	Sex	Age years	Weight kg*)
1	20/5	♂	1–2	11.0	42	13/10	♀	fawn	11.0
2	23/5	♂	1–2	14.0	43	13/10	♀	4–5	17.5
3	28/5	♂	2–3	14.0	44	14/10	♂	1–2	16.5
4	29/5	♂	2–3	14.5	45	14/10	♂	1–2	12.0
5	9/6	♂	5–6	16.5	46	14/10	♂	fawn	10.5
6	9/6	♂	4–5	17.0	47	16/10	♀	7–8	17.5
7	9/6	♂	2–3	16.0	48	16/10	♂	4–5	14.5
8	12/6	♂	1–2	12.0	49	18/10	♂	fawn	11.0
9	12/6	♂	1–2	14.0	50	19/10	♂	fawn	12.0
10	13/6	♂	3–4	16.0	51	19/10	♂	fawn	13.0
11	15/6	♂	1–2	13.5	52	20/10	♂	2–3	17.0
12	16/6	♂	3–4	19.0	53	19/10	♂	fawn	11.0
13	16/6	♂	4–5	16.0	54	23/10	♂	2–3	17.5
14	18/6	♂	2–3	16.0	55	23/10	♀	fawn	10.5
15	21/6	♂	1–2	12.0	56	25/10	♂	2–3	16.5
16	24/6	♂	6–7	15.0	57	25/10	♀	3–4	15.5
17	3/7	♂	1–2	15.0	58	25/10	♀	fawn	10.5
18	3/7	♂	1–2	13.5	59	26/10	♂	fawn	10.5
19	3/10	♂	4–5	16.5	60	26/10	♀	3–4	15.0
20	8/10	♂	fawn	8.7	61	26/10	♂	fawn	11.0
21	9/10	♀	5–6	17.0	62	28/10	♀	2–3	15.0
22	10/10	♂	fawn	8.0	63	28/10	♂	3–4	16.5
23	10/10	♀	7–8	14.0	64	28/10	♀	fawn	10.0
24	10/10	♂	fawn	9.0	65	29/10	♂	2–3	14.0
25	10/10	♀	1–2	15.0	66	29/10	♀	1–2	15.0
26	10/10	♀	2–3	15.5	67	29/10	♂	fawn	9.5
27	11/10	♀	5–6	18.0	68	29/10	♀	fawn	10.0
28	11/10	♀	7–8	17.5	69	29/10	♂	fawn	10.0
29	12/10	♀	2–3	20.5	70	29/10	♂	fawn	9.5
30	12/10	♀	1–2	14.5	71	29/10	♀	fawn	9.5
31	12/10	♂	fawn	11.5	72	2/11	♀	1–2	13.0
32	12/10	♂	fawn	8.5	73	3/11	♀	5–6	14.5
33	12/10	♀	1–2	14.0	74	3/11	♂	4–5	20.5
34	12/10	♀	4–5	16.0	75	3/11	♂	fawn	12.0
35	12/10	♀	2–3	17.5	76	4/11	♀	8–9	17.0
36	12/10	♀	1–2	16.0	77	4/11	♀	2–3	14.5
37	12/10	♂	fawn	11.5	78	4/11	♂	fawn	9.0
38	12/10	♂	fawn	11.5	79	6/11	♀	fawn	11.0
39	12/10	♀	fawn	9.5	80	7/11	♀	4–5	17.5
40	13/10	♀	2–3	15.0	81	9/11	♂	fawn	10.0
41	13/10	♂	fawn	12.0	82	9/11	♀	3–4	14.0

*) After removal of the viscera.

No.	Date	Sex	Age years	Weight kg*)	No.	Date	Sex	Age years	Weight kg*)
83	9/11	♀	fawn	11.0	124	19/11	♀	fawn	8.5
84	9/11	♀	fawn	10.0	125	19/11	♀	5–6	16.5
85	9/11	♂	fawn	11.5	126	19/11	♂	fawn	12.0
86	9/11	♀	4–5	16.5	127	19/11	♀	fawn	8.5
87	9/11	♀	fawn	10.5	128	19/11	♂	fawn	12.0
88	9/11	♂	fawn	12.0	129	19/11	♀	2–3	17.5
89	9/11	♀	3–4	17.0	130	19/11	♂	fawn	11.0
90	10/11	♀	fawn	8.0	131	19/11	♀	fawn	9.5
91	9/11	♂	1–2	15.0	132	19/11	♂	2–3	18.0
92	11/11	♀	fawn	10.0	133	19/11	♂	fawn	11.0
93	11/11	♀	fawn	11.0	134	19/11	♀	fawn	10.0
94	11/11	♀	1–2	13.0	135	19/11	♀	3–4	18.5
95	11/11	♀	fawn	12.0	136	19/11	♂	1–2	16.5
96	11/11	♂	fawn	11.5	137	19/11	♀	1–2	15.0
97	11/11	♀	fawn	14.0	138	19/11	♂	fawn	7.0
98	12/11	♂	3–4	15.5	139	21/11	♀	2–3	17.0
99	12/11	♂	1–2	14.0	140	22/11	♀	1–2	12.0
100	12/11	♀	4–5	15.0	141	22/11	♀	fawn	12.0
101	12/11	♀	fawn	9.0	142	22/11	♀	1–2	15.5
102	12/11	♂	fawn	10.5	143	22/11	♂	2–3	17.0
103	12/11	♀	6–7	13.5	144	22/11	♂	fawn	9.0
104	12/11	♀	fawn	8.0	145	22/11	♀	3–4	13.5
105	14/11	♂	fawn	11.0	146	22/11	♂	1–2	12.0
106	15/11	♀	3–4	19.0	147	23/11	♀	fawn	9.0
107	15/11	♀	fawn	13.5	148	23/11	♂	1–2	14.5
108	15/11	♂	1–2	12.5	149	25/11	♂	fawn	10.5
109	15/11	♀	2–3	14.0	150	25/11	♂	4–5	19.5
110	15/11	♂	3–4	15.0	151	25/11	♀	1–2	15.0
111	15/11	♀	fawn	10.0	152	25/11	♂	5–6	19.0
112	15/11	♀	5–6	15.5	153	25/11	♀	2–3	13.0
113	15/11	♀	fawn	8.0	154	26/11	♀	1–2	17.0
114	15/11	♂	fawn	10.5	155	26/11	♂	fawn	10.5
115	15/11	♀	2–3	15.5	156	26/11	♂	1–2	13.5
116	15/11	♀	3–4	15.5	157	26/11	♀	8–9	15.5
117	17/11	♂	fawn	10.5	158	26/11	♀	1–2	11.5
118	19/11	♂	fawn	10.0	159	26/11	♀	fawn	7.0
119	19/11	♀	fawn	11.0	160	26/11	♀	1–2	14.0
120	19/11	♀	fawn	10.0	161	26/11	♂	fawn	10.5
121	19/11	♂	2–3	16.5	162	26/11	♀	1–2	15.5
122	19/11	♀	1–2	16.5	163	26/11	♀	1–2	16.0
123	19/11	♀	2–3	16.5	164	26/11	♀	1–2	15.0

*) After removal of the viscera.

No.	Date	Sex	Age years	Weight kg*)	No.	Date	Sex	Age years	Weight kg*)
165	26/11	♀	2–3	14.5	190	13/12	♀	fawn	10.0
166	26/11	♀	2–3	17.0	191	17/12	♂	6–7	16.0
167	26/11	♂	2–3	14.0	192	17/12	♀	fawn	8.0
168	26/11	♀	1–2	16.0	193	17/12	♀	1–2	15.0
169	27/11	♂	fawn	12.0	194	17/12	♀	1–2	16.0
170	27/11	♀	fawn	9.5	195	20/12	♀	fawn	10.5
171	27/11	♀	3–4	17.0	196	23/12	♀	fawn	7.5
172	29/11	♀	fawn	10.5	197	27/12	♀	fawn	8.5
173	29/11	♀	fawn	10.5	198	28/12	♀	fawn	7.5
174	2/12	♀	fawn	8.5	199	29/12	♀	2–3	16.0
175	3/12	♀	4–5	16.5	200	29/12	♀	3–4	16.5
176	3/12	♀	fawn	10.5	201	29/12	♀	fawn	9.5
177	3/12	♂	fawn	11.0	202	29/12	♂	3–4	17.0
178	3/12	♀	2–3	15.0	203	30/12	♂	fawn	10.0
179	3/12	♀	2–3	14.5	204	30/12	♀	3–4	15.5
180	3/12	♀	5–6	17.5	205	30/12	♀	6–7	13.0
181	3/12	♀	2–3	16.0	206	30/12	♂	2–3	16.5
182	6/12	♀	2–3	13.5	207	30/12	♀	fawn	7.5
183	6/12	♀	fawn	11.5	208	30/12	♀	2–3	18.0
184	10/12	♂	fawn	10.5	209	30/12	♀	4–5	18.5
185	10/12	♂	fawn	10.5	210	30/12	♀	fawn	9.5
186	10/12	♀	1–2	17.0	211	30/12	♀	1–2	17.5
187	10/12	♀	2–3	15.0	212	31/12	♀	1–2	16.5
188	10/12	♂	fawn	11.0	213	31/12	♀	fawn	8.0
189	13/12	♂	fawn	10.5					

*) After removal of the viscera.

J. H. Schultz A/S . Universitets-Bogtrykkeri
1953