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THE AGE OF THE GREY SEAL AT THE FARNE ISLANDS

by

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ABSTRACT

The growth, age-distribution and mortality of the Grey seal breeding population at the Farne Islands, Northumberland, is described from a sample of 674 bulls and cows obtained during the 1972 breeding season.

The age-distribution suggests that bulls do not contribute to the breeding until their eighth year and even then constitute only a small proportion of territory holders. The bulk of the breeding bulls are aged from 12 to 18 years, older animals becoming excluded through senility and death. Cows do not appear to be recruited to the breeding population until their tenth year, though earlier recruitment may be masked by the selective female pup culls of 1963, 1964 and 1965; furthermore, greater timidity of first-time breeders may have improved their chances of escaping from the hunters.

Pup production at the Farne Islands has been recorded since 1956, so it is possible to calculate the total mortality of female year-classes from then until 1962, the last birth year of animals fully recruited at the time of sampling. These data are compared with those calculated from a life-table of the Grey seal. The observed mortalities are less than those which were calculated from the life-table, which probably accounts for the increase in the numbers and lifespan of the Farne Islands population. Possible explanations for differential survival of year-classes are discussed.

The mortality of bulls cannot be calculated from the present data, because it is not known what proportion of the total population was represented in the sample.

INTRODUCTION

The Grey seal (Halichoerus grypus, Fab.) population at the Farne Islands

off north-east England has been described by Coulson & Hickling (1964) and Ponner & Hickling (1971a) who give details of the numbers of pups born each year from the mid-1950s onwards. The annual increase in the number of births since then indicates a similar trend in the total population. This larger population began to pose management problems for the National Trust, who own the islands, by causing considerable damage to the soil and vegetation. As there was no sign of the increase in population abating, the Trust took measures to reduce the seal population as recommended by Ponner & Hickling (1971b); 603 adult females, 132 adult males and 575 juveniles and pups, of which the majority were pups, were culled by a professional sealer. This operation provided specimens from which the growth of the Grey seal and the age distribution of the Farne Islands population could be investigated.

GROWTH

Measurements of length and weight were made on most of the seals on board the sealer's boat. Standard length was measured, in centimetres, from the snout to the tip of the tail with the animal lying on its back (American Society of Mammalogists 1967). Weight was measured in kilograms with a spring balance, no adjustment being made to compensate for the loss of blood.

The relationship between the mean standard length and age in the sample is illustrated in Figure 1. Female seals appear to reach their maximum length at about 15 years of age. This agrees with the observations of Mever (1964) on Scottish Grey seals. Bulls apparently reach maximum length at about 11 years of age. Mever (1964) has shown that the rate of increase in baculum index, a statistic which incorporates both the length and weight of the os penis, becomes asymptotic at about this age. Thus it seems that male Grey seals, though becoming sexually mature in their sixth year (Mever 1964), do not reach full size until their eleventh year.

The relationship between the mean weight and age of the Grey seal (Figure 2) shows more variation than that of length and age, particularly so in the case of the bulls but the sample was smaller than that of the females. The variation is largely due to the specimens being taken during the breeding season. Neither bulls nor cows feed during their time on the breeding grounds and considerable loss of weight may be expected, so individual weights may vary, depending upon the length of time an animal has been ashore.

METHOD OF AGE DETERMINATION

Annual growth rings have been described from both the dentine and cementum of the canine teeth of the Grey seal (Laws 1953; Mansfield & Fisher 1960; Mever 1960, 1964). Mever's accounts point out that the dentine is not deposited after the closure of the pulp cavity, which occurs during the fifth or sixth year.

He states that, as the cement is deposited externally, "there is therefore no reason, theoretically, why it cannot continue to be used to indicate age throughout the entire life of the animal." Five animals branded as pups by Coulson & Hickling in December 1960 (Coulson & Hickling 1962) were taken during the 1972 cull. An examination of the rings in the cementum of the canine teeth of these seals of known age confirmed that they are laid down annually, and the ages of the specimens collected in this work were therefore determined from counts of these growth rings.

Longitudinal sections were cut from the roots of the teeth with a double-bladed diamond saw. The sections were removed from the tooth by a transverse cut, then polished on a fine carborundum stone lubricated with water. They were examined microscopically with transmitted light. After removal of the section, the remaining transverse and longitudinal surfaces of the root were polished and then examined by side illumination, using the microscope light screen devised by Bedford (1964) for determining the ages of fish from polished surfaces of sectioned otoliths. Thus several cut surfaces and a longitudinal section of each tooth were compared to obtain an accurate assessment of the age of each seal.

Most Grey seal pups at the Farne Islands are born in November (Coulson & Hickling 1964), so that for practical purposes the middle of November is a common birthday. Since the cull was performed during this month, all specimens were a whole number of years old.

The uterus of each female was examined to determine whether or not she had pupped that year. If there was no evidence of a recent pregnancy in a young seal (a distended uterus or placental scar) then she was not considered to be part of the breeding population - though she may have been mature and available for fertilization for the first time. Similarly, Hewer (1964) has shown that bulls become sexually mature in their sixth year, and that animals of seven years or more have a baculum index greater than 1.4. The bacula of the male specimens were weighed and measured; those with an index below 1.4 were considered to be immature and excluded from the breeding population.

AGE FREQUENCY DISTRIBUTIONS

The ages of 689 seals (554 females and 135 males) were determined. Five females of six years of age or less showed no signs of having pupped during the breeding season and were consequently excluded from the age-distribution of breeding cows. Similarly, ten males had baculum indices below 1.4, and they have been excluded from the age-distribution of breeding bulls. The age-distribution of the breeding stock is shown in Fig. 3. The oldest cow in the sample was 38 years old and the oldest bull 26 years old. Previously,

the oldest female Grey seal taken in the wild was found to be at least 46 years old (Ronner 1971) and the oldest male 23 years old (Hewer 1964). This suggests that the lifespan of 35 years for cows, used by Hewer in constructing the life-table for the female Grey seal, might be extended.

Although Grey seal bulls have been shown to attain sexual maturity in their sixth year, the age-distribution diagram (Fig.3) suggests that they do not contribute to the breeding population until the age of eight. Even then, they form only a small proportion of the breeding population, possibly because they are not yet sufficiently strong or experienced to successfully challenge the dominance of the established bulls. The majority of breeding bulls are aged from twelve to eighteen years and presumably belong to the age groups which are most able to defend their territories. The older animals become a progressively less important component of the breeding group, because of mortality and the increasing difficulty of holding territories in competition with younger, fitter animals. The sample of territorial bulls considered here, taken on shore, may not be completely representative of the whole male breeding population, since copulations between cows and non-territorial bulls which occur in the water (Ronner 1972) may be age specific.

Younger females are not as well represented in the sample as might be expected from Hewer's determination of the age of maturity in female Grey seals (Hewer 1964). There are several possible explanations. Firstly, there were selective culls of female pups in 1963, 1964 and 1965, when 347 (299 female), 336 (325 female) and 318 (317 female) pups were killed (Coulson & Hickling 1965, 1969). These figures represent 48%, 46% and 46% respectively of the total number of females born in these years, assuming a 1:1 sex ratio at birth. Secondly, as the hunters' boats approached the islands, large numbers of seals entered the water. It is possible that the younger females, perhaps breeding for the first time, were more ready to desert their pups than the older and more experienced breeders, and were consequently disproportionately represented in the sample. A third possibility is that full recruitment to the breeding population does not occur until age class 10, even though the females are known to mature at four or five years of age (Hewer 1964).

MORTALITY

Since 1956 the total number of pups born each year at the Farne Islands has been recorded and seen to have increased at a rate of 9% a year (Ronner & Hickling 1971a). It is therefore possible to determine the total mortality of year-classes for those animals born after 1956 whose year-classes were fully recruited to the breeding stock by 1972, that is year-classes 1956 to 1962.

A pup count was not possible in 1972 because of the cull but, with the application of the 9% annual increase in pup production to the 1971 count, and given that no multiple births occur, it can be assumed that 2192 pregnant cows would have come ashore at the Farne Islands in 1972. If it is further assumed that this number represents only 80% of the total female stock, a pregnancy rate suggested by Hewer (1964), then the size of the stock is 2740 animals. Since the proportion of the female breeding stock which was sampled is known (20.0%), it is possible to determine the number of cows from each of the year-classes 1956 to 1962 which survived until 1972 (Table 1).

Table 1 The mortality of Farne Islands Grey seal cows

Year of birth	No. of females of each year-class in 1972 sample	No. of female pups born* (A)	No. of females of each year-class surviving in 1972 (B)	Mortality $\frac{A-B}{A} \cdot 100$
1962	40	558	200	64.2
1961	41	568	205	63.9
1960	36	510	180	64.7
1959	36	449	180	59.9
1958	24	435	120	72.4
1957	32	427	160	62.5
1956	38	376	190	49.5

* Figures represent half of the totals given by Bonner & Hickling (1971a), assuming 1:1 sex ratio at birth

The results show a very much greater survival than that expected from Hewer's life-table (Table 2). Even when the calculation is made using a 90% pregnancy rate, survival is far too high to agree with Hewer's assumption for a static population. This increased survival would account for the increase in the size of the population and is reflected in the observed longevity.

Table 2 Mortality of Farne Islands cows compared with those from Hewer (1964)

Age class	Mortality assuming a pregnancy rate of:		Calculated mortality, after Hewer (1964)
	80%	90%	
10	64.2	68.1	85.0
11	63.9	68.0	85.8
12	64.7	68.6	86.4
13	59.9	64.4	87.8
14	72.4	75.4	88.2
15	62.5	66.7	90.0
16	49.5	55.1	90.3

There is also a differential survival of the year-classes. For example a smaller proportion of animals born in 1958 survived to 1972, compared with those born in 1956. Since Bever (1964) proposes that 60% of the mortality occurs during the first year of life, it is likely that the effect of any factors influencing mortality will be greatest during this period. If such factors are more extreme in some years than others, so as to cause a large annual difference in first-year mortality, then, since subsequent mortality must be very much less, their effect will be reflected in the proportion of that year-class surviving throughout life.

It is not possible to apply mortality calculations to the male breeding population, because there are no data on the proportion of the total male population that was present in the breeding haulouts and available for sampling. It would be necessary to obtain large, random samples from non-breeding haulouts in two separate years in order to obtain information about the mortality of bulls through direct use of an age frequency distribution.

REFERENCES

AMERICAN SOCIETY OF MAMMALOGISTS, Committee on Marine Mammals, 1967, Standard measurements of seals. J. Mammal., 48: 459-462.

BEDFORD, B. C., 1964. Two mechanical aids for otolith reading. Int. Comm N. West. Atlant. Fish. Res. Bull., No. 1, 1964, 79-81.

BONNER, W. N., 1971. An aged Grey seal (Halichoerus grypus). J. Zool., Lond., 164 : 261-262.

BONNER, W. N., 1972. The Grey seal and Common seal in European waters. Oceanogr. Mar. Biol. Ann. Rev., 10 : 461-507.

BONNER, W.N. & HICKLING, G., 1971a. The Grey seals of the Farne Islands: report for the period October 1969 to July 1971. Trans. nat. Hist. Soc. Northumb., 17 : 141-162.

BONNER, W. N. & HICKLING, G., 1971b. Grey seals at the Farne Islands, a management plan.

COULSON, J.C. & HICKLING, G., 1962. The Grey seals of the Farne Islands: a report on observations made between 1 July, 1960 and September, 1961. Trans. nat. Hist. Soc. Northumb., 14 : 99-100.

COULSON, J. C. & HICKLING, G., 1964. The breeding biology of the Grey seal Halichoerus grypus (Fab) on the Farne Islands, Northumberland. J. Anim. Ecol., 33 : 485-512.

COULSON, J.C. & HICKLING, G., 1965. The Grey seals at the Farne Islands: report for the period 1 May 1963 to 31 March 1965. Trans. nat. Hist. Soc. Northumb., 15 : 121-139.

COULSON, J. C. & HICKLING, G., 1969. The Grey seals at the Farne Islands: report for the period 1 April 1965 to 1 September 1968. Trans. nat. Hist. Soc. Northumb., 17 : 29-43.

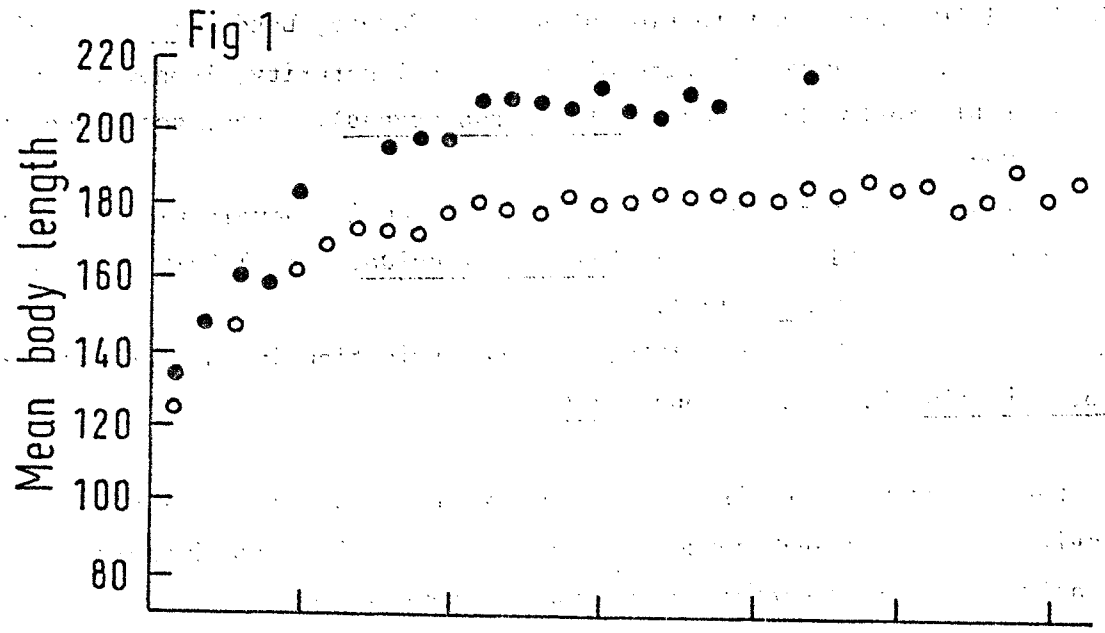
HEWER, H. R., 1960. Age determination of seals. Nature, Lond., 187 : 959-960.

HEWER, H. R.,1964. The determination of age, sexual maturity, longevity and a life-table in the Grey seal (Halichoerus grypus). Proc. zool. Soc. Lond., 142 : 593-624.

LAWS, R. M., 1953. A new method of age determination in mammals with special reference to the Elephant seal (Mirounga leonina, Linn.) Falk. Isles. Dep. Surv. Sci. Rep. 2 : 1-11.

MANSFIELD, A. D. & FISHER, H. D., 1960. Age determination in the Harbour seal, Phoca vitulina L. Nature, Lond., 186 : 92-93.

The work described here is part of the programme of the Institute for Marine Environmental Research on seals research; this is a preliminary report and the analysis of the material and results is continuing.



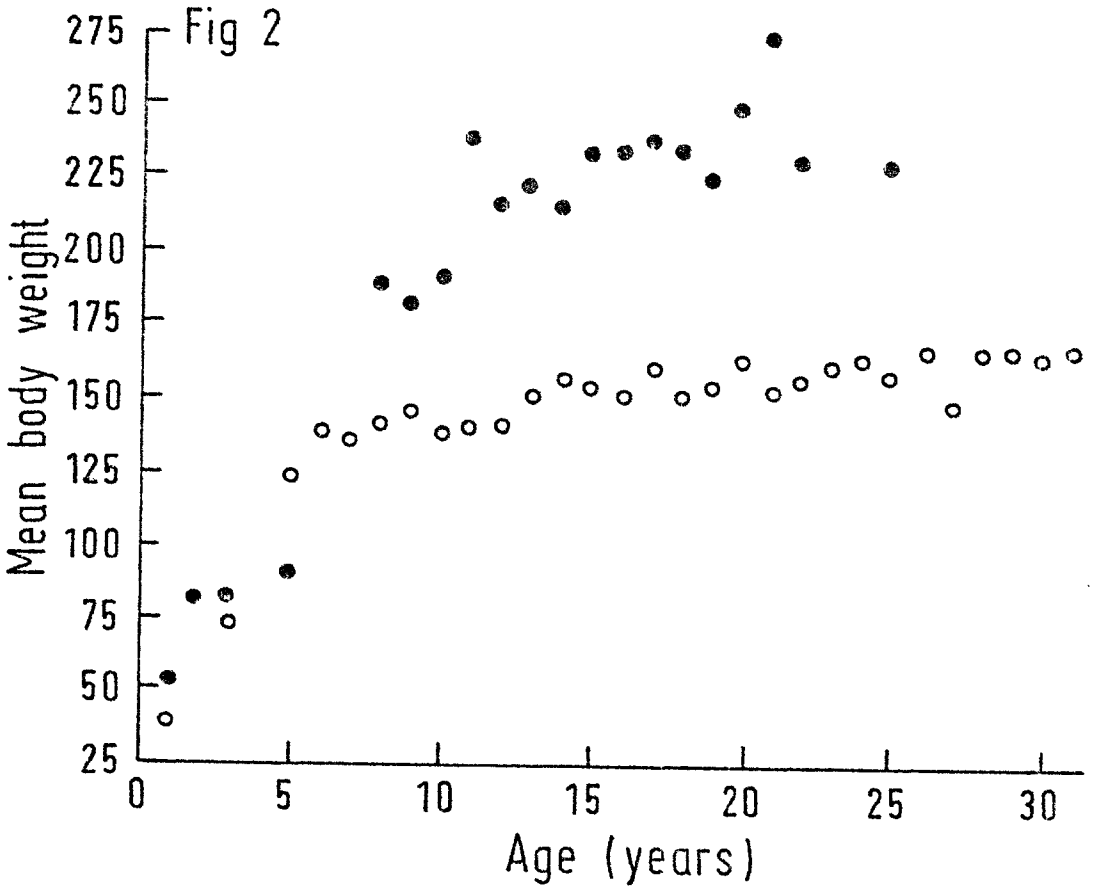


Fig. 1. Mean body length (cm) in relation to age (bulls solid circles; cows open circles).

Fig. 2. Mean body weight (kg) in relation to age (bulls solid circles; cows open circles).

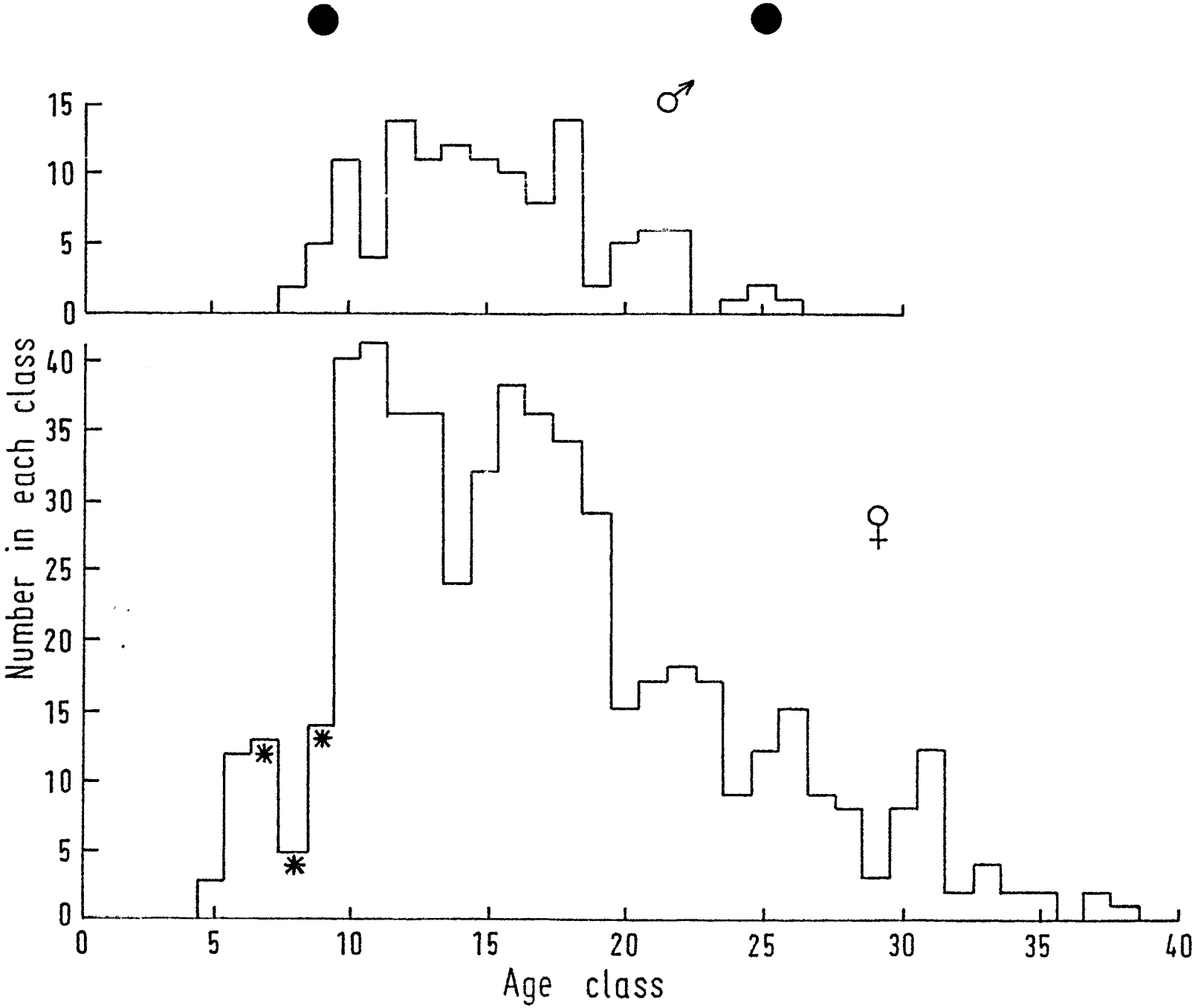


Fig. 3. Age frequency distributions of breeding bulls and cows.
* Indicates year of pup cutting.