International Council for the Exploration of the Sea

CM 1980/N:7
Marine Mammals Committee

THE CURRENT STATUS OF THE FARNE ISLANDS GREY SEAL POPULATION

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ABSTRACT

The age structure of the Farne Islands grey seal population is calculated, for both male and female seals, using published figures for pup production and adult and juvenile mortality rates. The age distributions of all the seals culled at the Farne Islands in 1963 - 65 and 1971 - 79 are presented. The effects of these culls are shown in a comparison of the calculated current age structure with the projected age structure, unaffected by any culls and with a continuation of the average pregnancy rate existing up to 1971. The age composition of the female population is used to calculate the apparent pregnancy rate from 1956 to 1979. The pregnancy rate has decreased markedly during the 1970's indicating either a drop in fecundity or an increase in emigration or possibly mortality.

RÉSUMÉ

La structure de l'âge de la population de phoques gris aux Farne Islands est calculée pour les males et les femelles en employant des chiffres déjà publiés de la production des jeunes et des taux de mortalité des adultes et des jeunes. Les distributions d'âge de tous les phoques tués aux Farne Islands en 1963 - 65 et 1971 - 79 sont presentées. Les effets de tuer ces phoques sont montrés dans une comparaison entre la structure de l'âge estimée actuelle et la structure de l'âge projetée, dont la dernière ne tient aucun compte des phoques tués et comprend une continuation du taux de grossesse moyen qui existait jusqu'à 1971. La composition d'âge de la population femelle est utilisée a calculer le taux de grossesse évident de 1956 à 1979. Le taux de grossesse s'est diminué d'une façon prononcée pendant les années 1970, ce qui indique soit une baisse de fécundité, soit une augmentation de la émigration ou, peutêtre, de la mortalité.

INTRODUCTION

The population of grey seals (Halichoerus grypus), at the Farne Islands, off Northumberland is arguably the most studied and best documented of all the British seal populations. It has also been greatly affected by various management plans (e.g Bonner and Hickling, 1971) by the National Trust, who own the Farne Islands.

Accurate figures for the pup production at the Farne Islands have been recorded since 1956 and published regularly by Hickling and colleagues in the Transactions of the Natural History Society of Northumbria.

The management of the seal population at the Farne Islands resulted in pups being culled in 1963 to 1965 as a fishery protection measure (Coulson and Hickling, 1965, 1969) and major adult and pup culls in 1972 (Bonner and Hickling, 1974) and 1975 (Hickling, Hawkey and Harwood, 1976).

Smaller adult and pup culls, in conjunction with disturbance measures, have taken place in 1977, 1978 and 1979. A small number of seals have been taken by the Sea Mammal Research Unit (SMRU), for scientific purposes in this period.

Analyses of the ages of the seals taken in 1972 (Platt, Prime and Witthames, 1975) and 1975 (Harwood and Prime, 1978) have been published, the latter report also provides estimates of juvenile and adult survival rates for the Farne Islands grey seal population.

The aim of this report is to assemble all the pup production and cull data available up to and including 1979, and to assess the present status of the Farne Islands grey seal population.

MATERIALS AND METHODS

With the exception of a few animals lost and not sampled in 1972 and 1975 (Bonner & Hickling, 1975; Hickling, Hawkey & Harwood, 1976), the canine teeth from all the juvenile and adult seals taken at the Farne Islands since 1971 were examined to determine their ages. The methods used were those described by Platt, Prime and Witthames (1975), and Harwood and Prime (1978). The age frequency distributions for the animals killed in 1972 and 1975 have been proportionately increased to allow for the animals lost and not sampled. "Age Class - 0" includes both pups, and the foetuses of pregnant cows shot during the breeding season.

To calculate the age structure of the female population for each year, the stable age structure for a population increasing at 7% per annum (the rate of increase at the Farne Islands (Summers, 1978)), was first calculated using survival values from Harwood and Prime (1978). This was calibrated using the 1956 pup production and fecundity values from Harwood and Prime (1978) to give the number of females in age-classes 0 - 40 in 1956. The survival values from Harwood and Prime (1978) were then applied to this age-structure and the published pup production figures from 1957 to 1979 to provide an estimate of the age-structure of the population in each year. The survival rates for animals from age 5 to 8 were set at 0.931, 0.933, 0.934 and 0.935 to allow for their gradual recruitment to the breeding population. In years where there was a cull, the appropriate number of females (shown in Table 1) was removed from each age-class. The number of sexually mature females in the population was calculated by assuming that 16% of 5 year olds, 61% of six year olds, 96% of seven year olds and 100% of animals over seven years are mature (Harwood and Prime, 1978; SMRU unpublished data).

A similar procedure was followed to obtain the projected age frequency for the male segment of the population. Survival was 0.66 in the first year and 0.93 in the immature years two to six (Harwood and Prime, 1978). Although male grey seals are sexually mature at about this age they are not completely recruited to the breeding population until aged ten years (Platt, Prime & Witthames, 1975). Adult survival has been calculated to be 0.80 (Harwood and Prime, 1978) and survival rates of 0.90, 0.87 and 0.83 were used for years seven to nine respectively.

The apparent fecundity rate for each year from 1956 to 1971, before the first major adult cull, was calculated by dividing the number of pups born in each year by the estimated number of mature cows in the population in that year.

The probable age-structure of the population if there had been no culls was estimated by calculating expected pup productions for the years 1972 to 1979. The average fecundity rate for the period 1956 to 1971 was applied to the number of mature cows estimated to be present in each of the years 1972 to 1979. The survival rates previously used were applied to these pup production figures to give projected age frequency distributions for unculled male and female populations in 1980.

RESULTS

The age frequency distributions of all the seals taken at the Farne Islands in 1963 - 65 and 1971 - 79 are presented in Table 1 (females) and Table 2 (males). When a large number of pups were shot and not sexed, a 1:1 sex ratio has been assumed.

The 42 years old female taken in 1979 is worthy of special mention, being older by 4 years than the previous oldest seal recorded from the Farne Islands, which was taken during the cull in 1972. The greatest age recorded for a female grey seal is 46 years (Bonner, 1971).

Figure 1 shows that the average fecundity for the years 1956 - 71 was 91%; over this period pup production increased steadily. Since 1972, the year of the first major adult cull, pup production has dropped considerably. This decline can be partly attributed to the number of cows removed during the culls of 1972 and 1975. However, as Figure 1 clearly shows, apparent fecundity has also decreased markedly over this period, reaching a minimum of 43% in 1978.

The differences between the calculated actual age structure and the projected age structure of an unculled population can be seen in Figures 2 (females) and 3 (males). In both figures the differences in frequency from age class 9 and over are entirely due to culling of these older animals. The effects of the principally female pup culls of 1963 - 65 are shown in the large difference between the actual and projected age structures at age classes 15 to 17 in Figure 2. The troughs in the graphs at age classes 5 and 8 are a result of the 1972 and 1975 culls when large numbers of pups were taken in addition to the adults.

The increasing discrepancy between the actual and projected frequencies in the youngest age classes (8 and under) cannot be accounted for entirely by the culls. The apparent decrease in fecundity contributes significantly

to the difference between the two age frequencies.

DISCUSSION

The data presented in Figure 1 appear to show that the culls at the Farne Islands since 1972 have resulted in a dramatic decline in the fecundity of the grey seal population. However, some caution should be used in interpreting these results. Fecundity rates have been calculated on the assumption that natural mortality rates and immigration and emigration have remained constant since 1972. However, Summers and Harwood (1978) point out that seal culls can have a number of indirect effects, whose magnitude can be very difficult to assess.

For example, there has been a considerable redistribution of the grey seal breeding assemblies in Orkney, whose pups have been hunted since 1962 (Summers, 1976). If the culls at the Farne Islands have had a similar effect, the rate of emigration from this population could have been increased. However, an aerial survey of the east coast between the Firth of Forth and Norfolk in December 1977 revealed no new breeding assemblies that might have been formed by seals emigrating from the Farnes (Hickling, Hawkey and Harwood, 1978). There has, however, been a considerable change in the distribution of pups among the islands of the Farnes group since 1972 (Hickling and Hawkey, 1979).

It is also possible that juvenile and adult mortality rates may have increased in recent years. At present there is no evidence for this, but it is virtually impossible to measure year to year variations in these parameters. In addition, as Summers and Harwood (1978) point out, the disturbance associated with adult culls can result in increased desertion and mortality of pups.

A further possibility is that at least part of the decline in fecundity may be independent of the culls, perhaps caused by high pollutant levels in part of the seals' feeding range. PCB pollution has been implicated as a possible factor in the dramatic decline in pregnancy rate observed in Baltic grey seals (Helle, Olsson and Jensen, 1976).

If, as seems likely, the decline in apparent fecundity has been caused by the culls since 1972 a possible mechanism can be postulated. The major secondary effect of adult culls is the disturbance associated with the cull which can cause desertion and can also deter females from coming ashore to pup (Summers and Harwood, 1978). Females which desert or fail to pup may not be impregnated and will therefore fail to pup in the subsequent breeding season. The number of pups born at the Farnes each year is determined by regular ground counts on all the islands during the breeding season. Although this technique has been used since 1956, it may be that the inevitable disturbance associated with these counts and related research activities, has had a more profound effect on the seals since the beginning of culling.

A result of the lower than expected pup production will of course be fewer (female) recruits to the breeding population, showing principally 6 years from the birth of a particular year class. For example, the lowest recent pup production figure, 1162 in 1978, follows 6 years after the 1972 cull, when there was a shortfall of over 400 pups. The natural mortality of the pups not culled that year may also have been underestimated.

If disturbance measures similar to those effected in 1977-79 are continued it is anticipated that pup production and apparent fecundity will remain at at their current levels.

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Figure 1. Pup production and calculated apparent fecundity for the Farne Islands grey seal population, 1956 - 1979.

(Pup production figures for 1956-78 from Summers (1979). For 1978 from Hickling and Hawkey (1979), and for 1979 from Hickling and Hawkey (pers. comm.).

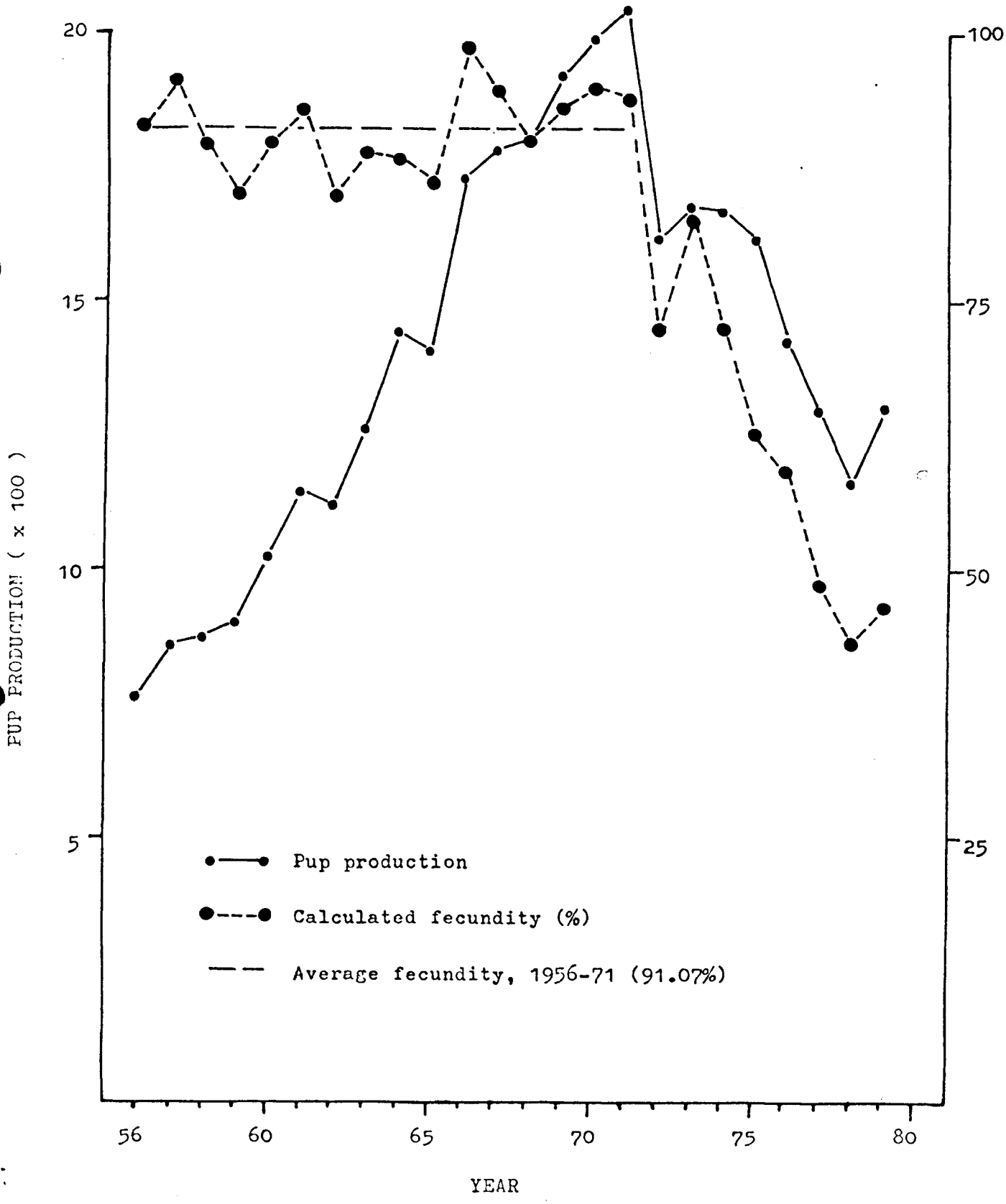

Figure 2. Calculated age structure for Farne Islands female grey seals at the start of the 1980 breeding season.
A - actual age structure as a result of culls in 1963-1965 and 1971-1979,
B - Projected age structure if no culls had taken place.

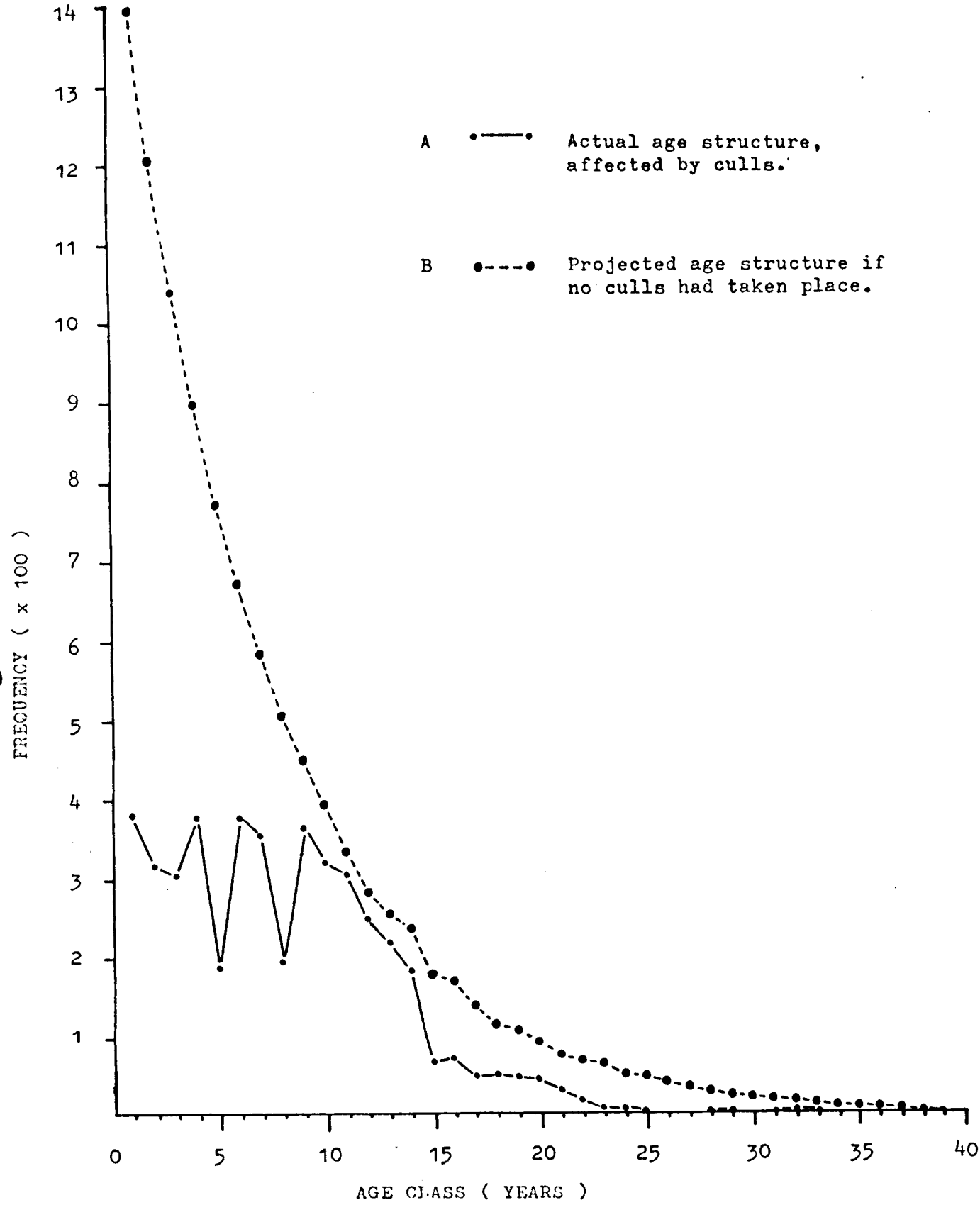

Figure 3. Calculated age structure for Farne Islands male grey seals at the start of the 1980 breeding season.
A - Actual age structure as a result of culls in 1963-65 and 1971-79,
B - Projected age structure if no culls had taken place.

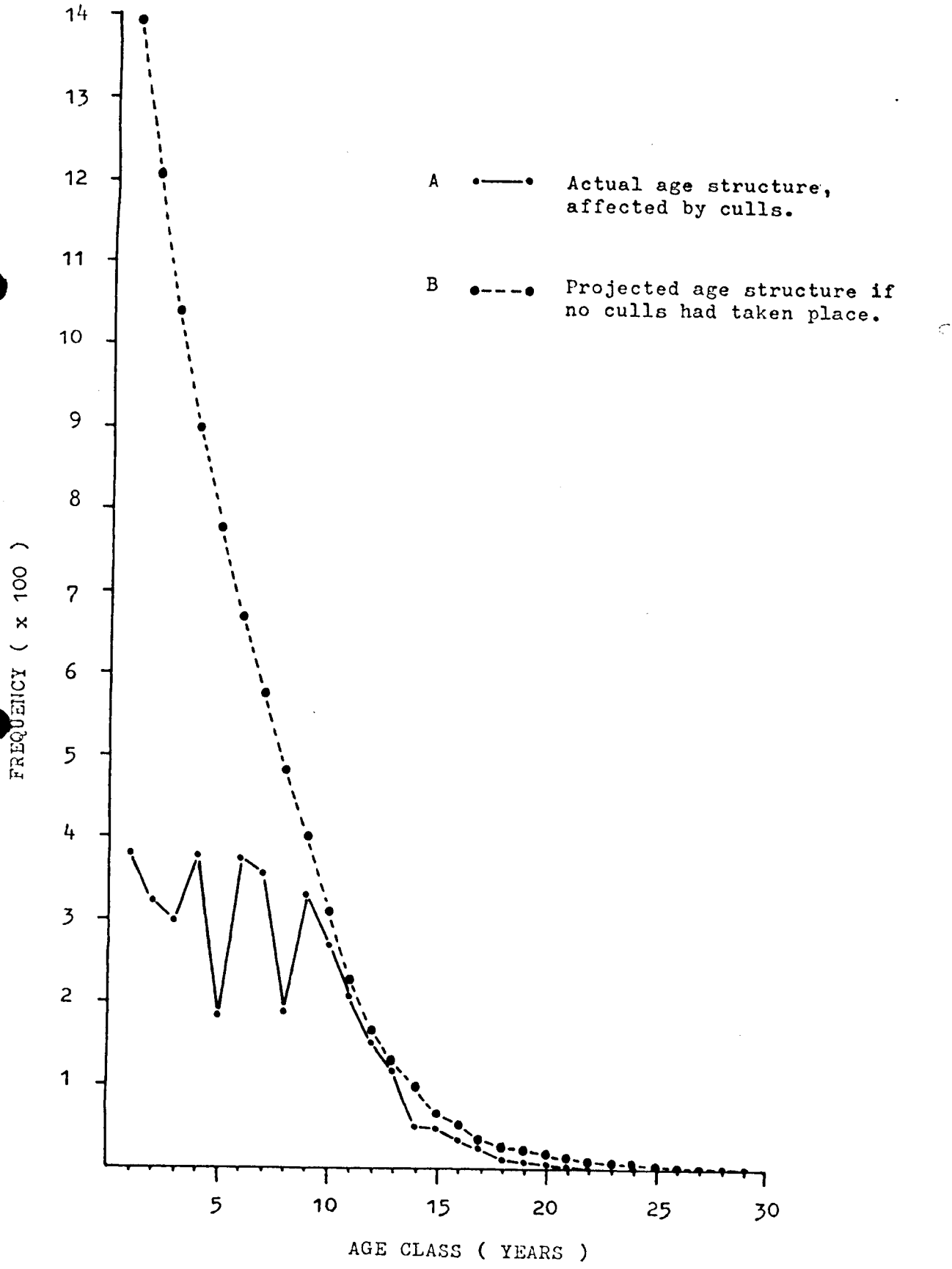

Table 1. Age frequency distributions of all female grey seals taken at the Farne Islands, 1963 to 1979

Age Class	Year Taken 1963	1964	1965	1971	1972	1974	1975	1976	1977	1978	1979
0	289	331	317	7	317	1	429		119	70	81
1				5	3		9			2	2
2						1	1			3	
3					1						1
4										1	
5					5	1	3	1	1	1	1
6					13		5	2	8		6
7					14	1	26		13	1	2
8					5		35		4	6	9
9					15		42	1	5	3	8
10					45		14	1	8	3	4
11					46	1	11	2	6	1	3
12					39		9		8	3	4
13					39	1	27		3		5
14				1	26	1	34		3	2	2
15				1	35		26	3	13	2	1
16					43		17	1	6	3	2
17					40	1	34	1		3	3
18				2	37	1	30	1	4	3	4
19					32	1	23	2	8	1	5
20					16	1	16		4	1	5
21					18		19			3	2
22					20		21	1	8	1	3
23					18		12		3	1	
24				1	10		15		4		3
25					13		12		4	2	1
26					16		5	1	1	5	2
27					10		3			2	1
28					9		3	1	3	1	1
29					3		10	1		1	2
30					9		6		1	1	2
31					13		5		1	2	
32					2		4			1	
33					4		3		1	1	1
34					3		4		1		
35					2		1				1
36						1	1			1	1
37					2						
38					1						
42											1
TOTALS	289	331	317	17	924	12	915	19	240	131	169

Table 2. Age frequency distributions of all male grey seals taken at the Farne Islands, 1963 - 1979

Age Class	Year Taken 1963	1964	1965	1971	1972	1974	1975	1976	1977	1978	1979
0	58	5	1	9	311	3	429		119	63	81
1				4	8		2			5	
2					1	2				4	1
3					2	1	1			3	1
4					2					8	1
5					1		1			3	2
6						1	1			2	1
7						1	1			3	
8					2	1	1		1	2	3
9					5		22		1	2	3
10					11	1	22		2	4	3
11				1	6		16		1	4	5
12					14	1	12		1	5	4
13					12	1	16		1	4	2
14					12		13		1	3	3
15					12		8		1	1	2
16					10		11		2	5	2
17					10		6		2	3	4
18					14		5			2	2
19					2		7			2	1
20					5		3			3	2
21					6		5			1	1
22					6		1			1	3
23							1				
24					1					1	
25					2		1				1
26					1						
27							1				
TOTALS	58	5	1	14	456	12	586		132	133	128