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SEX AND AGE COMPOSITION AND MORTALITY OF HOODED SEALS AT NEWFOUNDLAND

BY

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Abstract

After a review of sources to available data, sex ratios are given for 1051 pups (50.9 per cent males) and 2089 adult breeding hooded seals (39.9 per cent males). Age frequencies are presented for a total of 670 male, 1153 female and 306 unspecified hooded seals sampled off Newfoundland-Labrador from 1964 to 1972. Mortality rates have been calculated and it is tentatively concluded that the total annual mortalities are about 16 per cent for breeding females older than 6 years and about 23 per cent for breeding males older than 10 years.

Introduction

Information on age and sex composition and mortality of hooded seals (Cystophora cristata) has been collected in the Northeast Atlantic since 1954. Some of these data have been published in various publications or reports and some are available on file, even if they have not been compiled or fully utilized. However, very few data had been recorded from the Northwest Atlantic, and therefore emphasis of Norwegian seal research at Newfoundland was changed somewhat from harp seals to hooded seals in 1971.

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Age samples collected at Newfoundland in 1971 and 1972 have now been analyzed, and results are presented and discussed in this report together with sex ratios and data from occasional Norwegian sampling in the area in earlier years. An attempt is also made to review sources of other available data.

Sources of information on sex, age and mortality data for hooded seals

Data on the sex and age composition of breeding and moulting hooded seals in the Jan Mayen area and the Denmark Strait were first published by Rasmussen (1957 and 1960). In a later paper, Rasmussen (1962) reviewed data from the Denmark Strait and estimated a total mortality of 22.8 per cent for adult hooded seals (5-15 years) in the years 1957-1960. Recent samples (1962-1964, 1966-1967 and 1970) from this area where all adult age-groups of both sexes are fairly well represented in the catches, have suggested a decreasing adult mortality rate from the early 1960-ies up to 1970 (Øritsland, Helland-Hansen and Benjaminsen, in preparation). Such a development could be explained by the protection of moulting seals in the Denmark Strait since 1960.

Further age samples from Norwegian catches in the Jan Mayen area are available for 1959-1963 and 1968-1969. However, most of these samples are small and without information on sex composition (Øritsland unpublished). Sex composition data from pups at Jan Mayen and adults in the Denmark Strait were published by Øritsland (1964).

Age and sex compositions of hooded seals from Soviet studies in the Jan Mayen area 1960-1965 were published by Khuzin and Yakovenko (1963), Khuzin and Potelov (1963), Potelov (1964), Khuzin (1967) and Beloborodov and Potelov (1967). Data for 1966 were reported by Popov (MS 1966).

At Newfoundland age data were collected from Canadian catches in 1953 (149 or 116 animals?) and in 1966 (206 or 154 animals?). Age frequencies have not been reported from these samples, but mortality estimates were compared to estimates from Jan Mayen samples by Sergeant (MS 1967) who concluded that different mortality rates suggested distinct stocks in the two areas. Revised mortality estimates from these samples and one Norwegian sample collected at Newfoundland in 1971, were presented by Sergeant (MS 1972) who found that female mortality at Newfoundland had increased from 1966 to 1971.

In Greenland age samples were collected in 1970 and 1971. Age-group frezuencies from these and a small sample collected in 1953 were reported by Kapel (MS 1972) who also gave mortality estimates for the 1971 sample from Southwestern Greenland.

Material and methods

All age samples collected from Norwegian catches of hooded seals at Newfoundland from 1964 to 1972 and included in this report are listed in Table 1. The table also includes one Canadian sample (1967c). These data were generously supplied by D.E. Sergeant, Fisheries Research Board of Canada.

In 1967 one sample (1967b) was collected for the specific purpose to study the age composition of breeding females. In 1968 when the Institute of Marine Research did not work at Newfoundland, a small sample without information on sex was collected by a sealer. The rest of the material collected from 1964 to 1970 is from animals dissected for general biological studies and sampled without any known selection as to age or sex,

As many animals as possible were sampled for age and sex in 1971 and 1972. When time permitted specimens and data were collected from these animals for studies of general biology and reproductive performance of females. In order to avoid any selection caused by the preference of females for dissection, all age material has been lumped for age analyses (samples 1971a and 1972a). In addition to our own material, age samples were also collected by sealing inspectors assisted by sealers (sample 1971b and sample 1972c) and by a sealing crew which had been instructed in previous seasons (sample 1972b).

Age samples comprising 164 males and 224 females were collected at Newfoundland in 1973, but these have not been processed yet and are not reported here. However, counts by sex of pups and adults in 1973 are included in the data on sex composition.

Lower jaws were cut off near the middle of the jawbone with a cable-cutter or an axe. They were marked individually or in batches for each sex and day and stored in salt for shipment. At the laboratory jaws were boiled in water without any additive for about one hour to allow the lower canine teeth to be easily extracted. Transverse sections, about 0.2 mm thick, were cut from the middle of one tooth for each animal, using a modification of the doublebladed cutting machine described by Khuzin (1972).

Cementum growth layers (Rasmussen 1960, Khuzin 1967) were counted in transmitted light, using a binocular dissecting microscope or a microprojector. For most of the material age determinations were made independently by two persons, who later reexamined together specimens with differing age determinations. However, age determinations for the 1972 samples were made by one person with a second checking all doubtful determinations and a random sample of the others.

Mortality estimates were made by two methods, using both the regressions of catch curves (Ricker 1958, Chapman and Robson 1960) and the mean ages of fully recruited age-groups (Chapman and Robson 1960). A 5

Sex composition

Sex ratios of pups and adult hooded seals in Norwegian catches at Newfoundland are shown in Table 2. Pup ratios in the rather small samples vary around 1:1, and they add up to a slightly higher proportion of males than females as in other species like the harp seal at Newfoundland (Øritsland 1971). However, the pup ratio differs a little from the ratio among 1125 hooded seal pups with 49.2 per cent males counted at Jan Mayen in 1958-1960 (Øritsland 1964). The statistical probability for this difference is $p > 85$ per cent.

The total sex ratio of adults with about 60 per cent females differs from both the 53.6 per cent females found in a Norwegian sample of 237 animals in 1951 (Rasmussen 1952) ($p > 97$ per cent) and the 72.2 per cent females found in a Canadian sample of 209 animals in 1966 (Sergeant MS 1967) ($p > 99$ per cent).

All adult sex ratios from Newfoundland differ from corresponding ratios in samples from breeding seals in the Greenland Sea. In a total of nearly 3 thousand seals counted in the Jan Mayen area by Norwegian workers in 1954 and 1958 (Rasmussen 1960) and by Soviet investigators in 1962, 1963, 1964 and 1966 (Potelov 1964, Popov MS 1966, Khuzin 1967), no more than 47.7 per cent were females. The statistical probability for the difference between this figure and the present figure of 60.1 per cent females at Newfoundland is higher than 99 per cent ($p > 99$).

Finally our Newfoundland ratio may be compared to the sex composition of 598 moulting seals with 53.2 per cent females counted in the Denmark Strait in 1958-1960 (Øritsland 1964). Also the difference found here is significant ($p > 99$ per cent).

The decreasing percentage of females in Norwegian catches at Newfoundland, from 63.4 in 1971 to 57.7 in 1973, may reflect the price policy introduced by the largest Norwegian skin **A 6** buyer in 1971. Since that season substancially higher prices have been paid for skins from adult males than for skins from females in spite of their poorer quality. However, it may be assumed that also the late opening date for hooded seals at Newfoundland in 1973 contributed to the result this season.

Age composition

Age-group frequencies of separate samples or combinations of samples are given for males in Table 3, for females in Table 4 and for combined male and female samples in Table 5. Graphs illustrating male and female age frequencies are shown in Figures 1, 2 and 3.

The small male samples collected from 1964 to 1967 do not add up to more than 52 animals, so they have been combined in column 1 of Table 3. The 1971 "Norvarg" sample and the total 1972 sample both are large enough to be given separately in columns 2 and 3 of Table 3. However, knowing that the 1971 "Norvarg" sample as well as the 1972 "Polaris" sample (1972a, Table 1) were collected at the edges of the areas where breeding hooded seals were found, these samples were compared to the combined male "Norvarg" and "Polarstar" samples of 1972. Both of these (1972b and 1972c, Table 1) were collected from catches in the middle of the breeding area that year. As shown in Figure 1, the three graphs follow the same general pattern, although they do suggest that the newly recruited males in age-groups 4-8 are relatively more numerous at the edges than in the middle of the breeding area.

Age-group frequencies of female samples are shown in Figure 2. The graphs for the combined female 1967 samples (column 2 of Table 4) and the combined female "Norvarg" and "Polarstar" samples of 1972 (column 6 of Table 4) follow the same pattern, even if primiparous 4-year-olds are more numerous in 1972 than in 1967. By comparison the 1971 "Norvarg" sample (column 4 of Table 4) and the 1972 "Polaris" sample (column 5 of Table 4) both have a surplus of newly recruited young females (age-groups 6 and 7 in 1971 and age-group 4 in 1972). This overrepresentation of the younger animals which is also reflected in the low mean ages found in the two samples (8.4 and 7.3 years respectively), strongly suggests some segregation between age-groups of breeding female hooded seals. It seems clear from these age samples that the newly recruited and perhaps primiparous females do not mix completely with the older multiparous seals, but haul out at the fringes of the breeding areas. The segregation seems to be more pronounced in females than in males, perhaps because most females bear young in their first year after sexual maturity, whereas males do not reach breeding status until they are physically able to compete with their elders.

The combined male age samples (column 4 of Table 3) and combined female age samples (column 8 of Table 4) are compared in Figure 3. The difference between sexes in age of recruitment to the breeding stock is quite evident. It appears that females may be fully recruited at an age of about six years whereas males are not fully represented among the breeding seals until they are about 10 years old . It also appears that among the fully recruited age-groups of breeding seals, males have an appreciably higher mortality rate than females. This may be explained by the difference between sexes in the number of fully recruited age-groups.

Mortality estimates

Two sets of calculated total annual mortalities (Z in per cent) of adult seals for each of the age-group frequencies set out in Table 3, 4 and 5 are listed in Table 6. Exceptions are the combined small male anc female samples collected in 1964-1970 and listed in the first frequency columns of Table 3 and Table 4.

The age-group frequencies indicate full recruitment to the catchable stock of breeding seals at ten years for males (total 1964-1972 sample) and at four (1972 samples and total 1964-1972 sample), five (1967 sample) or six years (1971 sample) for females. Maturity data are not available for males, but for females our data show that a few seals produce their first pup at three years, that the age of 50 per cent natality is about 3.8 years, and that about 70 per cent and 80 odd per cent produce pups at five and six years respectively (Øritsland MS 1973). On the basis of this information we decided to take ten years for males and six years for females as the youngest age-groups to be included in the calculations. In accordance with the advice given by Chapman and Robson (1960), the old age-groups represented by fewer than five animals in the samples, were omitted from the catch curve calculations. The age-groups included and the number of animals in these age-groups are shown for each estimate in Table 6. For the catch curve estimates also 95 per cent confidence intervals have been calculated (Goldstein 1964) and are given in the table.

As indicated by some very wide confidence intervals, the usefulness of the catch curve estimates is limited for the smaller samples. In order to make better use of these samples mortalities were also calculated from the mean age of all fully recruited age-groups. For completeness, these calculations were made for all samples. It appears that deviations between the two estimates are smaller than 2 per cent on either side for all samples which contain more than a total of 250 specimens.

For males the age-group frequencies in 1971 and 1972 did suggest some segregation between the old and the younger animals. However, this apparently does not change the slope of the catch curve for the fully recruited age-groups, and we feel confident that 23 per cent or a rate of 0.23 is a fairly good estimate of total annual mortality of the A 9

For females the segregation between old and young breeders, probably multiparous and primiparous animals, is far more pronounced than for males. Consequently sampling error is more likely to occur for females, and we can not accept the 1971 "Norvarg" sample (Tab. 6, females, 1971) or the 1972 "Polaris" sample (Tab. 6, females, 1972a), yielding mortality estimates as high as those for males, as representative for the stock of breeding females. The 1972 "Norvarg" and "Polarstar" samples (Tab. 6, females, 1972b+c) with a mortality estimate of 13.7 may on the other hand be a little biased towards older animals. We therefore offer the catch curve estimate of 16 per cent or the rate of 0.16 found from the combined 1964-1972 samples as our best guesstimate of total annual mortality of adult breeding females at Newfoundland.

Considering the pronounced difference in age composition between males and females, mortality estimates for combined male and female samples from breeding seals seem rather meaningless. They are recorded in Table 6, however, because they may become useful as a basis for evaluation of future unspecified samples collected by sealers.

The difference between male and female mortality rates seems to be adequately explained if the fewer and older age-groups of males than of females account for about 40 per cent of the adult stock in the breeding areas (see adult sex ratios in Table 2). However, no calculations have been made to test this tentative explanation.

It should be mentioned that Sergeant (1972) found no significant difference between male and female mortalities in his Newfoundland samples from 1953 and 1966. However, he included males down to an age of 5 years in his calculations, and according to our age frequencies this seems to be rather misleading. Possibly for the same reason he also found a male mortality rate as low as 0.160 for the (nearly complete) Norwegian sample of 1971 while our estimate calculated from A 10 is 0.230. Unfortunately age frequencies are not available for the Canadian samples from 1953 and 1966, so Sergeants mortality estimates for these samples can not be tested.

Kapel (1972) found mortality rates of 0.138 for age-groups 3-15 and 0.150 for age-groups 5-10 in his combined 1971 sample from South (southwestern) Greenland. In order to make his data directly comparable to ours we have calculated from his age frequencies annual mortalities for each sex in the 1971 sample and for the combined 1971 and 1972 South Greenland samples (Table 7). The three mean age estimates are very close to each other (about 0.18), suggesting a better mixing of sex and age-groups and in particular a better representation of the younger age-groups of males in South Greenland than at Newfoundland.

The basic assumptions made for estimates of mortality are listed by Ricker (1958) and Chapman and Robson (1960). Having remarked upon the danger of selective sampling of females caused by a possible segregation between old and young, we can only presume that larger samples are nearly random. We are satisfied that no change with time has yet been demonstrated in the mortality of hooded seals of either sex. In spite of the variation between age-groups found in individual samples, the close fit of the observed combined frequencies for each sex to the calculated regression lines (see Figure 3) also makes us believe that mortality does not change appreciably with increasing age after the age of recruitment.

However, we are less confident that recruitment to the breeding stock at Newfoundland has not changed over the past decade. The catch statistics show increasing catches per ship since the early 1960-ies, even if allowance is made for the increasing efficiency of the ships. A recent recovery of a marked seal from Newfoundland at Angmagssalik, East Greenland, has strengthened the theory of a connection between A 11 the breeders at Newfoundland and the moulting animals in the Denmark Strait where hooded seals have been under nearly complete protection since 1960. Norwegian catches in the Denmark Strait averaged nearly 16 thousand hooded seals per year from 1951 to 1960, and the protection of these seals may have contributed to an increase of the breeding stock at Newfoundland.

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Table 1. Age samples collected off Newfoundland-Labrador 1964-1972.

Year	Dates	Coll.	No. of specimens ♂	♀	Unsp.	Sum
1964	21-31/III	"Polarhav"	21	28		49
1965	24/III-2/IV	"Polarhav"	2	3		5
1967a	24/III	"Polarhav"	6	15		21
1967b	28-29/III	"Polarhav"		122		122
1967c	26/III-13/IV	"Theron"	15	12		27
1968	-	"Polarstar"			28	28
1969	23/III-3/IV	"Norvarg"	7	15		22
1970	29/III	"Polarbjørn"	1	7		8
1971a	20/III-6/IV	"Norvarg"	212	368		580
1971b	-	"Kvitungen"			278	278
1972a	17/III-2/IV	"Polaris"	115	133		248
1972b	20-24/III	"Norvarg"	88	166		254
1972c	27/III-4/IV	"Polarstar"	203	284		487
1964-1972	TOTAL		670	1153	306	2129

Table 2. Sex ratios of pups and adult hooded seals in Norwegian catches off Newfoundland-Labrador 1964-1973.

Year	Males		Females		Sum
	No.	%	No.	%	
Pups:					
1964	11		8		19
1967	195	48.6	206	51.4	401
1969	14		15		29
1970	21		14		35
1971	18		19		37
1972	15		11		26
1973	261	51.8	243	48.2	504
Total	535	50.9	516	49.1	1051
Adults:					
1964-1970	52	39.4	80	60.6	132
1971	212	36.6	368	63.4	580
1972	406	41.1	583	58.9	989
1973	164	42.3	224	57.7	388
Total	834	39.9	1255	60.1	2089

Table 3 . Age-group frequencies of male hooded seals collected off Newfoundland-Labrador 1964-1972.

Age-group	1) 1964-1970		2) 1971a		3) 1972a+b+c		4) 1964-1972	
	n*	%	n	%	n	%	n	%
2	0	0.0	0	0.0	0	0.0	0	0.0
3	0	0.0	0	0.0	1	0.2	1	0.1
4	0	0.0	1	0.5	5	1.2	6	0.9
5	1	1.9	6	2.8	4	1.0	11	1.6
6	5	9.6	15	7.1	5	1.2	25	3.7
7	4	7.7	20	9.4	29	7.1	53	7.9
8	1	1.9	29	13.7	42	10.3	72	10.7
9	2	3.8	24	11.3	49	12.1	75	11.2
10	5	9.6	18	8.5	58	14.3	81	12.1
11	4	7.7	31	14.6	45	11.1	80	11.9
12	3	5.8	9	4.2	47	11.6	59	8.8
13	3	5.8	10	4.7	26	6.4	39	5.8
14	3	5.8	13	6.1	24	5.9	40	6.0
15	2	3.8	13	6.1	15	3.7	30	4.5
16	3	5.8	10	4.7	15	3.7	28	4.2
17	2	3.8	4	1.9	8	2.0	14	2.1
18	2	3.8	1	0.5	6	1.5	9	1.3
19	2	3.8	1	0.5	6	1.5	9	1.3
20	0	0.0	2	0.9	6	1.5	8	1.2
21	0	0.0	1	0.5	1	0.2	2	0.3
22	0	0.0	0	0.0	5	1.2	5	0.7
23	1	1.9	0	0.0	2	0.5	3	0.4
24	3	5.8	1	0.5	0	0.0	4	0.6
25	2	3.8	0	0.0	2	0.5	4	0.6
26	0	0.0	1	0.5	1	0.2	2	0.3
27+	4	7.7	2	0.9	4	1.0	10	1.5
Sum	52	99.7	212	99.9	406	99.9	670	99.7
Max. age	31		29		34		34	
Mean age	14.4		10.8		11.5		11.5	

* Included data on 15 males (1967) supplied by D.E. Sergeant, Canada. B 4

Table 4 . Age-group frequencies of female hooded seals collected off Newfoundland-Labrador 1964-1972.

Age-group	1) 1964-1965 +1969-1970		2) 1967a+b+c		3) 1964-1970		4) 1971a	
	n	%	n*	%	n*	%	n	%
2	0	0.0	0	0.0	0	0.0	0	
3	0	0.0	0	0.0	0	0.0	5	1.4
4	3	5.7	14	9.4	17	8.4	48	13.0
5	4	7.5	20	13.4	24	11.9	34	9.2
6	5	9.4	17	11.4	22	10.9	61	16.6
7	4	7.5	8	5.4	12	5.9	57	15.5
8	6	11.3	12	8.1	18	8.9	33	9.0
9	1	1.9	11	7.4	12	5.9	30	8.2
10	6	11.3	9	6.0	15	7.4	21	5.7
11	3	5.7	8	5.4	11	5.4	19	5.2
12	3	5.7	6	4.0	9	4.5	12	3.3
13	2	3.8	9	6.0	11	5.4	10	2.7
14	2	3.8	7	4.7	9	4.5	9	2.4
15	3	5.7	3	2.0	6	3.0	5	1.4
16	3	5.7	5	3.4	8	4.0	3	0.8
17	0	0.0	3	2.0	3	1.5	2	0.5
18	1	1.9	3	2.0	4	2.0	0	0.0
19	1	1.9	1	0.7	2	1.0	4	1.1
20	1	1.9	1	0.7	2	1.0	3	0.8
21	1	1.9	3	2.0	4	2.0	0	0.0
22	2	3.8	1	0.7	3	1.5	2	0.5
23	1	1.9	1	0.7	2	1.0	1	0.3
24	0	0.0	3	2.0	3	1.5	3	0.8
25	0	0.0	1	0.7	1	0.5	1	0.3
26	1	1.9	1	0.7	2	1.0	1	0.3
27+	0	0.0	2	1.3	2	1.0	4	1.1
Sum	53	100.2	149	100.1	202	100.1	368	100.1
Max. age	26		35+		35+		34	
Mean age	11.2		10.3		10.6		8.4	

* Included data on 12 females supplied by D.E. Sergeant, Canada.

Table 4 continued.

Age-group	5) 1972a n	%	6) 1972b n	%	7) 1972a+b+c n	%	8) 1964-1972 n*	%
2	0	0.0	0	0.0	0	0.0	0	0.0
3	1	0.8	2	0.4	3	0.5	8	0.7
4	35	26.3	71	15.8	106	18.2	171	14.8
5	17	12.8	62	13.8	79	13.6	137	11.9
6	17	12.8	36	8.0	53	9.1	136	11.8
7	13	9.8	39	8.7	52	8.9	121	10.5
8	16	12.0	33	7.3	49	8.4	100	8.7
9	6	4.5	41	9.1	47	8.1	89	7.7
10	6	4.5	28	6.2	34	5.8	70	6.1
11	3	2.3	24	5.3	27	4.6	57	4.9
12	7	5.3	11	2.4	18	3.1	39	3.4
13	3	2.3	13	2.9	16	2.7	37	3.2
14	1	0.8	13	2.9	14	2.4	32	2.8
15	2	1.5	10	2.2	12	2.1	23	2.0
16	2	1.5	10	2.2	12	2.1	23	2.0
17	1	0.8	9	2.0	10	1.7	15	1.3
18	0	0.0	9	2.0	9	1.5	13	1.1
19	1	0.8	2	0.4	3	0.5	9	0.8
20	1	0.8	8	1.8	9	1.5	14	1.2
21	0	0.0	7	1.6	7	1.2	11	1.0
22	1	0.8	4	0.9	5	0.9	10	0.9
23	0	0.0	3	0.7	3	0.5	6	0.5
24	0	0.0	2	0.4	2	0.3	8	0.7
25	0	0.0	0	0.0	0	0.0	2	0.2
26	0	0.0	4	0.9	4	0.7	7	0.6
27+	0	0.0	9	2.0	9	1.5	15	1.3
Sum	133	100.4	450	99.9	583	99.9	1153	100.1
Max. age	22		33		33		35+	
Mean age	7.3		9.6		9.0		9.1	

Table 5 . Age-group frequencies in combined samples (males and females) of hooded seals collected off Newfoundland-Labrador 1964-1974.

Age-group	1964-1970 n*	1964-1970 %	1971 n**	1971 %	1972 n	1972 %	1964-1972 n	1964-1972 %
2	0	0.0	0		0		0	
3	0	0.0	6	0.7	4	0.4	10	0.5
4	20	7.1	70	8.2	111	11.2	201	9.4
5	28	9.9	63	7.3	83	8.4	174	8.2
6	28	9.9	111	12.9	58	5.9	197	9.3
7	19	6.7	109	12.7	81	8.2	209	9.8
8	21	7.4	96	11.2	91	9.2	208	9.8
9	16	5.7	81	9.4	96	9.7	193	9.1
10	22	7.8	56	6.5	92	9.3	170	8.0
11	15	5.3	66	7.7	72	7.3	153	7.2
12	14	5.0	37	4.3	65	6.6	116	5.4
13	14	5.0	28	3.3	42	4.2	84	3.9
14	13	4.6	38	4.4	38	3.8	89	4.2
15	10	3.5	25	2.9	27	2.7	62	2.9
16	11	3.9	18	2.1	27	2.7	56	2.6
17	6	2.1	11	1.3	18	1.8	35	1.6
18	7	2.5	3	0.3	15	1.5	25	1.2
19	4	1.4	6	0.7	9	0.9	19	0.9
20	3	1.1	5	0.6	15	1.5	23	1.1
21	5	1.8	3	0.3	8	0.8	16	0.8
22	4	1.4	3	0.3	10	1.0	17	0.8
23	3	1.1	4	0.5	5	0.5	12	0.6
24	7	2.5	4	0.5	2	0.2	13	0.6
25	3	1.1	2	0.2	2	0.2	7	0.3
26	2	0.7	4	0.5	5	0.5	11	0.5
27+	7	2.5	9	1.0	13	1.3	29	1.4
Sum	282	100.0	858	99.8	989	99.8	2129	100.2
Max. age	35		36		34		36	
Mean age	11.4		9.3		10.1		10.0	

* Included 28 unsexed animals 1968.

** Included 278 unsexed animals.

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Table 6. Mortality estimates of hooded seals from age samples collected off Newfoundland-Labrador 1964-1972. Mortality rates are calculated both from regression of catch curves and from mean ages of the fully recruited age-groups.

Sample	No.	From catch curves				From mean ages		
		Z	Conf. interv.	Age-groups	No.	Z	Age-groups	No
Males:								
1971	212	10.6	0.0-24.9	10-16	104	23.0	10-29	117
1972	406	22.7	19.8-25.6	10-20	256	22.8	10-34	271
1964-1972	670	22.6	19.7-25.6	10-20	397	21.2	10-34	427
Females:								
1967	149	6.7	0.0-14.0	6-14	87	14.9	6-35	115
1964-1970	202	9.4	5.6-13.0	6-16	133	14.0	6-35	161
1971	368	23.1	20.7-25.6	6-15	257	21.3	6-34	281
1972a	133	24.8	0.0-41.8	6-10	58	23.0	6-22	80
1972b+c	450	13.7	10.6-16.7	6-18	276	14.9	6-33	317
1972	583	15.6	13.7-17.5	6-18	353	15.9	6-33	395
1964-1972	1134	15.7	14.4-16.9	6-24	804	17.0	6-35	837
Combined:								
1964-1970	282	12.7	8.8-16.5	10-18	112	14.5	10-35	150
1971	858	20.0	13.7-25.9	10-17	279	20.3	10-36	322
1972	989	18.8	16.8-20.9	10-23	443	19.3	10-34	465
1964-1972	2129	17.7	15.5-19.9	10-26	908	18.7	10-36	937

Table 7. Mortality estimates of hooded seals from age samples collected in South Greenland 1970-1971 (Kapel MS 1972). Mortality rates are calculated both from regression of catch curves and from mean ages of fully recruited age-groups.

Sample	No.	From catch curves				From mean ages		
		Z	Conf. interv.	Age-groups	No.	Z	Age-groups	No.
Males:								
1971	122	12.5	0.0-24.5	4-10	67	18.2	4-19	90
Females:								
1971	109	13.0	9.5-16.5	4-11	64	17.5	4-21	83
Combined:								
1970-1971	274	12.9	9.4-16.3	4-13	163	18.1	4-21	174

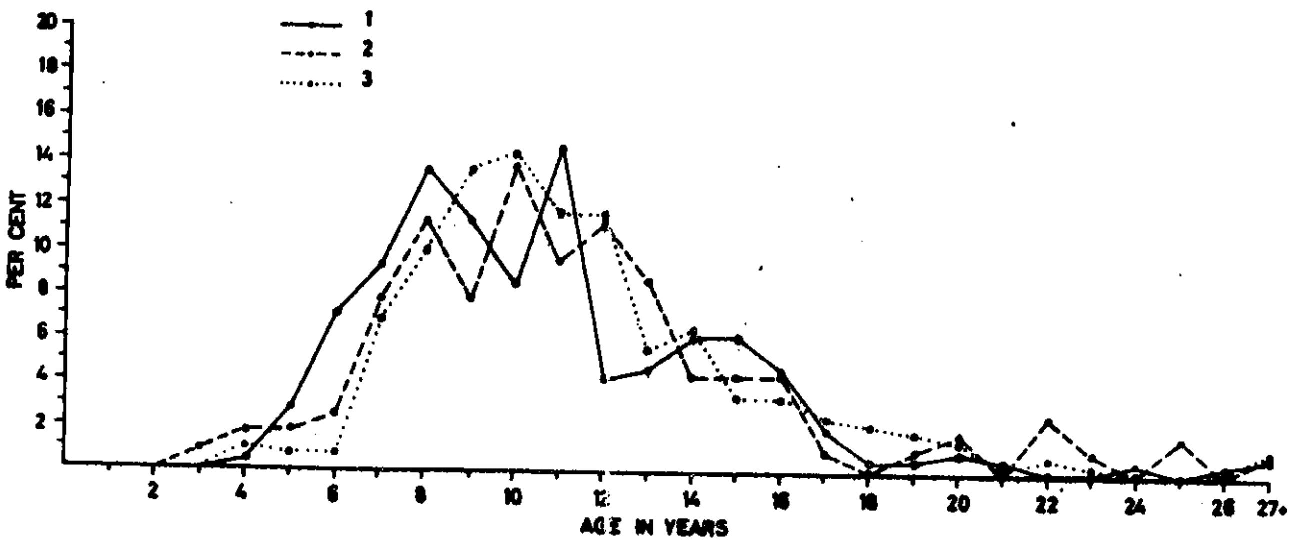

Fig. 1. Age-group frequencies of male hooded seals collected off Newfoundland-Labrador in 1971 and 1972. 1) 1971a, 2) 1972a, 3) 1972b+c (see Table 1).

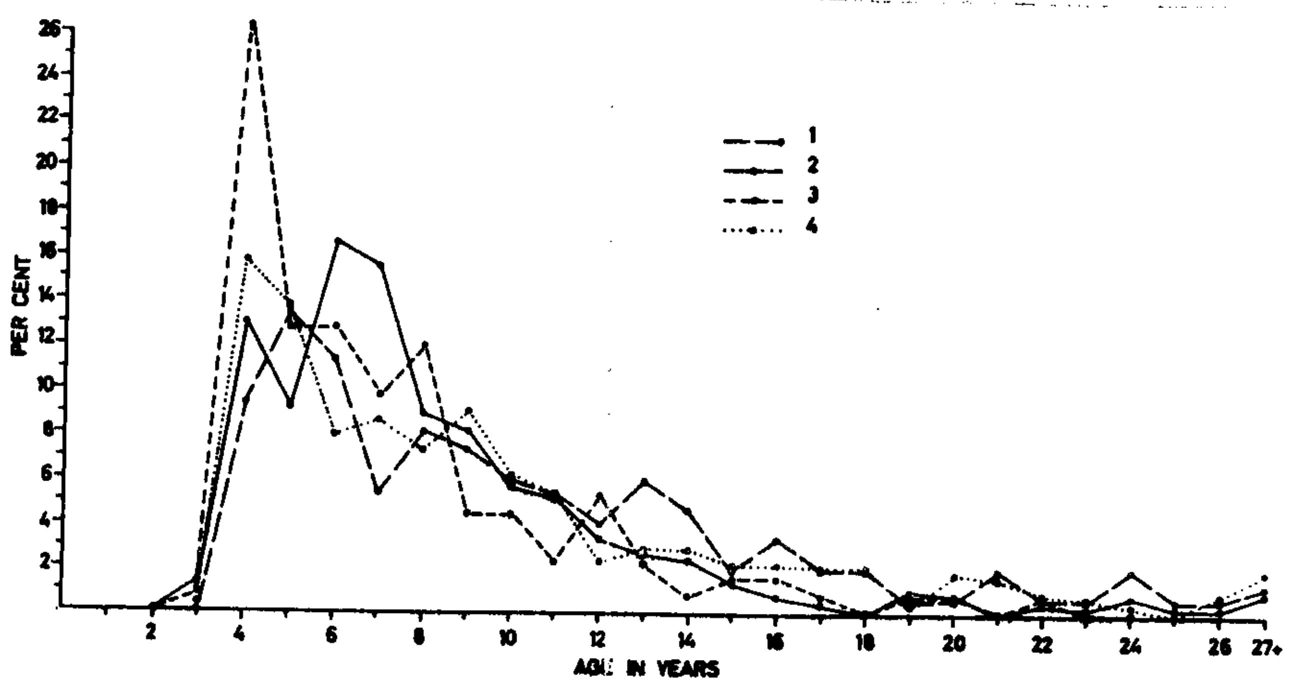

Fig. 2. Age-group frequencies of female hooded seals collected off Newfoundland-Labrador in 1967, 1971 and 1972. 1) 1967a+b+c, 2) 1971a, 3) 1972a, 4) 1972b+c (see Table 1).

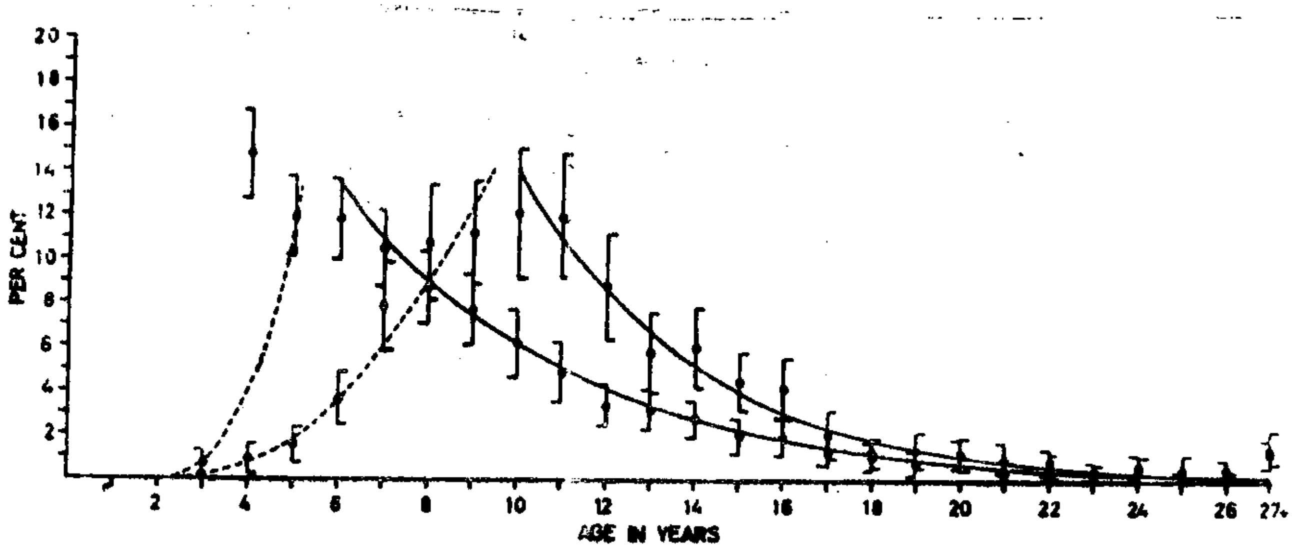

Fig. 3. Age-group frequencies of total male and total female hooded seals sampled off Newfoundland-Labrador in 1964-1972. Open circles = females, closed circles = males, verticale lines indicate 95 per cent confidence intervals.