INTERNATIONAL COMMISSION FOR THE NORTHWEST ATLANTIC FISHERIES

RESTRICTED

Serial No. 2509
(D.c.11)

ICNAF Res.Doc.71/8

ANNUAL MEETING - JUNE 1971

Progress report on Norwegian studies of Harp seals at Newfoundland

by Torger Øritsland
Institute of Marine Research
Bergen, Norway

Introduction

Recent Norwegian seal research at Newfoundland was started in 1964. Field work in that season was concentrated on collection of samples for blood protein studies and studies of breeding biology. In 1965 physiological studies were performed, and in 1967, 1969 and 1970 material and data were collected for general biological studies of both harp and hooded seals. No field work was done in 1966 or 1968, but a good sample for age analysis was collected by sealers in 1968. Some results of these studies have been reported to the ICNAF Panel A (Seals) in 1968 and 1969, (Nævdal MS 1968, Øritsland MS 1969 a and b).

Some effort has also been made to revise and analyse Norwegian sealing statistics. Provisional analyses were reported to the Seal Panel in 1966 and 1967 (Øritsland MS 1966 and MS 1967 b).

The purpose of this report is to summarize results from Norwegian studies of harp seals at Newfoundland from 1964 to 1970.

Distribution of seals

Observed and reported ice edges and patches of seals have been plotted in 1965, 1967, 1969 and 1970 as shown in Figures 1 - 4. In these years one, two or more separate harp seal breeding lairs have formed in the area from Hamilton Inlet southwards to Roundhill Island before the middle of March. During lactation these lairs drift south with the pack-ice, and may end up in the Strait of Belle Isle or Notre Dame Bay before the last moulted pups have taken to the sea or been killed in late March or early April. Patches of juvenile seals, bedlamers, form in the area from Funk Island to Gray Islands off Notre Dame Bay or further north in late March. As bedlamers gradually mix with adult males in moulting patches in early April, the animals move north, and may be found off Hamilton Inlet or further north in late April.

Populations

Results from blood protein studies (Nævdal MS 1968 and 1969) failed to reveal any significant difference between the breeding herds of harp seals in the North Atlantic.

A total of 60 harp seal pups have been tagged off Newfoundland - Labrador in 1969 and 1970. Out of these a total of 10 were recaptured in the hunting area before the seasons ended. Two animals have been recaptured off West Greenland in the autumn of the year they were tagged: one near Jakobshavn in August 1969 and one near Ritenbank in October 1970. So far Norwegian taggings have not yielded definite information on the distinctness of harp seal populations, but none of the 435 harp seal pups which have been tagged near Jan Mayen through the years, has been recaptured west of Cape Farvel.

Some 450 harp seal skulls which have been collected at Newfoundland (147), in the Jan Mayen area (ab. 100) and in the Barents Sea, are deposited in the Zoological Museum in Trondheim. No results are yet available from this collection.

Age composition of catches

Age-group frequencies in samples collected in 1964, 1967 and 1968 were reported to the Seal Panel in 1969 (Øritsland MS 1969 b, see Table 1). Unfortunately the small 1964 sample contains 33 specimens of breeding females, and therefore is not representative for moulting animals. However, the other two samples are not "contaminated" in this way.

Additional data from samples of moulting animals collected in 1969 and 1970 are now available and are presented in Table 2.

It is still an open question, however, whether the age-composition of catches of moulting harp seals does represent the age-compositi in the stock. Impressions from field work in all hunting areas of the North Atlantic and the information given in Figures 1 - 4 suggest that adult males gather in patches near the lairs of breeding females shortly after the formation of the breeding lairs Somewhat later the juvenile seals of both sexes congregate, and after the pairing season the patches of juveniles and the adult males gradually mix to form moulting patches (in early April on the Front). Adult females join these moulters in increasing numbers during April.

Information from counts of pelts in 1967 and 1969 on the change in age- and sex-composition through April in patches of moulting harps, was reported in 1969 (Øritsland MS 1969 b). Additional information from 1970 is now available, and a summary of all counts is presented in Table 3 and in Figure 5 B. Independent data from sampling for age analysis during April in 1967, 1969 and 1970 are presented in Table 4 and Figure 5 A. The data available up to now suggest that the proportion of juveniles of both sexes remains fairly constant through April, whereas the proportion of adult males decrease. The important point, however, is that adult females do not join these moulting patches in appreciable numbers before the second half of April. The data suggest that adult females constitute no more than 15-20% of the catches in late April. Corresponding data from the Jan Mayen area and the Barents Sea indicate similar changes through April in these areas (Øritsland unpubl.). Further evidence derived from subsamples for age analysis is presented in Table 5 and Figure 6.

These data indicate a decreasing trend in the mean age of males and a definite increase of the mean age of females through April. The mean age and sex ratio of an age sample collected in the moulting season therefore will depend upon the date of sampling. To be comparable, samples from different years should be collected at comparable dates. Characteristics of the present samples, partly derived from Table 4, are given below:

		Percentage by date in April			Mean	
Year	No.	1-10	11-20	21-30	age	% ♂
1964	127	15.7	7.9	37.0	11.0	22.0
1967	281	64.1	29.9	6.0	8.5	72.9
1968	702	(5)	(90)	(5)	8.7	-
1969	915	56.5	40.5	3.0	6.7	67.9
1970	516	0.0	9.3	50.4	5.6	61.7

It is evident that no sample is strictly comparable to any of the others. It is assumed, however, that the 1967 and 1969 samples which both have a load in early April, can be compared. Tentatively it may also be assumed that the 1968 sample, definitely loaded in mid April, can be compared to the sample of 1970 which is loaded in late April. If this is accepted, it follows that the indicated decreasing trend of the mean age may be real.

Sex ratio

Counts of pups and juvenile seals in 1967 and 1969 were reported in 1969 (Øritsland 1969 b). Together with additional information from 1970, these data are shown in Table 6. A possible change with date in the sex ratio of pups is suggested, but the total ratios for pups and juveniles are very close to each other, both showing that males are slightly more numerous than females.

Sexual maturity of females

Data on age at first ovulation from known-age breeding and moulting female harp seals sampled in 1964 and 1967 were presented in 1969 (Øritsland MS 1969 a and b). No substantial new samples have been collected, and the same basic data are shown in Tables 7 and 8. This information indicate that female harp seals mature in age groups from 4 to 12 or 13. The age of 50 per cent maturity was found to be about 5.6 for breeding and about 7.4 for moulting seals, with an overall median age of maturity of about 6.5 years. The difference between breeders and moulters is easily explained by the fact that immature individuals do not breed, but they are present among the moulters.

Fertility

Data on the rate of births or pregnancies are not available. Therefore, data from ovaries of breeding and moulting mature seals sampled in 1964 and 1967 were analysed in order to get some information on fertility. Presuming that mature females ovulate once every year, that ovulations alternate regularly between the two ovaries and that successful matings result in *corpora lutea* which are retained as visible *corpora albicantia* for at least three years after their formation, frequencies of *corpora* missing in the regular sequence were recorded for the three most recent breeding seasons. If these missing *corpora* indicate missed pregnancies, the counts suggest an overall fertility of about 92% among mature harp seals. An increase from about 90% in age groups 6-12 to about 93% in older age groups is suggested. There is also some evidence for an increase in overall fertility of about 1% from 1964 to 1967. The counts of *corpora* are shown in Table 9 as they were reported in 1969 (Øritsland MS 1969 a).

Sealing statistics

Norwegian sealing statistics for Newfoundland have been revised and were reported to the Seal Panel in 1967 (Øritsland MS 1967 a).

Annual statistics for 1968, 1969 and 1970 have also been reported. All available sealing statistics for the ICNAF area up to 1968 have been published by ICNAF Headquarters (1970) and statistics for 1969 are available in manuscript. Provisional data on Norwegian sealing in 1970 (Øritsland MS 1970) have been reviewed but no changes were necessary. The published Canadian statistics (ICNAF Headquarters 1970) are somewhat lacking in detail up to 1965, but Sergeant (MS 1967) has given some estimates of division between subareas. Canadian data for 1970 are not available. Some information on Danish (Greenland) and Soviet catches in the ICNAF area have also been published (ICNAF Headquarters 1970), but occasional French and U.S. catches have not been reported.

By and large the available statistics seem to give a fairly good coverage for the years from 1947 to 1969 although somewhat lacking in detail before 1965.

Pup catches and survival of year-classes

Tentative indexes of survival of year-classes based on relative frequencies of age-groups in samples from the Front, in relation to corresponding frequencies derived from data in a life table constructed by Sergeant (MS 1960), were presented in 1969 (Øritsland MS 1969 b). Revised indexes are given in Table 10. They are based on all available Norwegian age samples, and calculated by dividing relative frequencies in age samples by corresponding relative frequencies in column "Young excl." in Table 11. Weighted means have been calculated for each year-class, using factors roughly corresponding to the size of each age sample (1964:1, 1967:2, 1968:4, 1969:5 and 1970:3).

The revised indexes must still be regarded as tentative, but they are offered as an attempt to quantify earlier rather subjective guesstimates of year-class survival for harp seals. Bearing in mind that age samples hardly are representative of the stock, it is worth attention that the "survival index" is rather consistently high or low through several or all age samples for some year-classes.

In Table 10 the "survival indexes" are compared to total pup catches in the Front area and in the ICNAF area. No definite correlation has been discovered between survival index and estimated pup catch on the Front. Weighted index means in relation to total pup catches are plotted in Figure 7. Plots for the years 1946 - 1959 show no obvious trend, but plotted values for 1960 - 1968

suggest that total pup catches higher than 170 - 180 thousand may have had an adverse effect on the survival of year-classes in these years.

Catch in relation to hunting activity

The first attempt to calculate catch per unit of hunting effort for Norwegian sealing at Newfoundland was made in 1966 (Øritsland MS 1966). A definite downward trend was found in total Norwegian catches of harp seals on the Front per "unit of effort day" from the mid-fifties to 1966. A new attempt is presented in Figure 8, showing total Norwegian catches of harp seals (all age-groups) on the Front per unit of hunting activity for the years 1946 - 1970. The estimates are based on the formula

$$C/\ n\frac{P}{T}$$

where C is catch in number of animals,
n is number of ships, and
$\frac{P}{T}$ is an average efficiency index[1] brake horse power per gross ton (mean values).

The data suggest that the availability of harp seals may have been reduced by some 60 per cent during the years from 1955 to 1970. Catches per unit of activity are plotted against units of activity in Figure 9.

Accumulated catch of year-classes

Estimated total catches by 1970 of some year-classes which were selected because pup catches in these years were exeptionally high, are shown in Table 12. To the actual catches of pups have been added the estimated catches represented by each year-class in each year. These estimates are based on actual catches of one year old or older seals, and "normal" relative age-group frequencies under the heading "Young excl." in Table 10.

Although the estimated catches of one year old or older animals should be recalculated from actual age-group frequencies in age samples, the accumulated catches may serve as an useful reminder. According to these estimates even the year-class produced in 1967 may have yielded more than 295 thousand seals by the end of the season 1970. For this year-class, however, the accumulated catch may be corrected, using actual age-group frequencies in Norwegian samples from 1968, 1969 and 1970:

Year	Per cent in sample	Catch of one year or older	Catch of 1967 year-class
1967	-	-	280 442
1968	19.2	36 238	6 958
1969	4.6	55 472	2 552
1970	6.4	(33 403)	(2 138)
		Accumulated catch	292 090

From this it may be assumed that pup production in 1967 was at least 292 thousand.

References

ICNAF Headquarters 1970. (Sealing statistics 1937-68). Statist. Bull. int. Commn NW. Atlant. Fish., 18:124-140.

Nævdal, G. MS 1968. Blood protein polymorphism in harp seals off eastern Canada. Serial Pap. int. Commn NW. Atlant. Fish., 2072:1-5.

Nævdal, G. 1969. Blood protein polymorphism in harp seals off eastern Canada. J. Fish. Res. Bd Canada, 26:1397-1399.

Øritsland, T. MS 1966. Norwegian catch and effort statistics for harp and hooded seals in the Front area and the Gulf area, 1937-1966. Serial Pap. int. Commn NW. Atlant. Fish., 1760:1-5.

Øritsland, T. MS 1967a. Revised catch and effort statistics for the Norwegian seal hunt in the Front and Gulf areas off Newfoundland, 1937-1967. Serial Pap. int. Commn NW. Atlant. Fish., 1959:1-3.

Øritsland, T. MS 1967b. Provisional analysis of Norwegian catches of harp seal pups in the Front area, Newfoundland. Serial Pap. int. Commn NW. Atlant. Fish., 1960:1-3.

Øritsland, T. MS 1969a. Some results of Norwegian research on seals, 1964 and 1967. Serial Pap. int. Commn NW. Atlant. Fish., 2212:1-5.

Øritsland, T. MS 1969b. Additional results of Norwegian research on seals 1964, 1967, 1968 and 1969. Serial Pap. int. Commn NW. Atlant. Fish., 2271:1-10.

Øritsland, T. MS 1970. Provisional catch and effort statistics for Norwegian sealing in Front area, Newfoundland, 1970. Serial Pap. int. Commn NW. Atlant. Fish., 2445:1.

Sergeant, D.E. MS 1967. Canadian catch statistics for harp and hooded seals by area, 1949-1966. Serial Pap. int. Commn NW. Atlant. Fish., 1882:1-19.

Sergeant, D.E. MS 1960. Life tables for harp seals of the western North Atlantic. Arctic Unit Fish. Res. Bd Canada, Mimeogr Rep. Sept. 1960, 5 pp, 3 tables.

Table 1. Age-group frequencies of moulting harp seals in Front area, Newfoundland, from samples collected in 1964, 1967 and 1968.

Age group	1964		1967		1968	
	No.	%	No.	%	No.	%
1	3	2.4	55	19.6	135	19.2
2	6	4.7	31	11.0	74	10.5
3	8	6.3	5	1.8	42	6.0
4	11	8.7	6	2.1	27	3.8
5	7	5.5	19	6.8	30	4.3
6	12	9.4	22	7.8	20	2.8
7	6	4.7	19	6.8	46	6.6
8	5	3.9	13	4.6	38	5.4
9	5	3.9	5	1.8	31	4.4
10	8	6.3	8	2.8	28	4.0
11	4	3.1	13	4.6	22	3.1
12	4	3.1	6	2.1	12	1.7
13	3	2.4	5	1.8	15	2.1
14	3	2.4	10	3.6	18	2.6
15	5	3.9	10	3.6	14	1.9
16	4	3.1	6	2.1	12	1.7
17	5	3.9	8	2.8	15	2.1
18	8	6.3	9	3.2	26	3.7
19	4	3.1	9	3.2	21	3.0
20	0	0.0	4	1.4	16	2.3
21	4	3.1	4	1.4	10	1.4
22	2	1.6	1	0.4	17	2.4
23	2	1.6	3	1.1	8	1.1
24	3	2.4	2	0.7	7	1.0
25	1	0.8	2	0.7	3	0.4
26	0	0.0	1	0.4	5	0.7
27+	4	3.1	5	1.8	10	1.4
SUM	127	99.7	281	100.0	702	99.6
UNDET.					35	(4.7% of total)

Table 2. Age-group frequencies of moulting harp seals in Front area, Newfoundland, from samples collected in 1969 and 1970.

Age group	1969		1970	
	No.	%	No.	%
1	371	40.6	132	25.6
2	42	4.6	109	21.1
3	34	3.7	33	6.4
4	30	3.3	30	5.8
5	39	4.3	29	5.6
6	28	3.1	15	2.9
7	36	3.9	18	3.5
8	44	4.8	26	5.0
9	35	3.8	15	2.9
10	29	3.2	22	4.3
11	23	2.5	13	2.5
12	16	1.8	7	1.4
13	19	2.1	6	1.2
14	21	2.3	11	2.1
15	21	2.3	8	1.6
16	12	1.3	11	2.1
17	25	2.7	3	0.6
18	16	1.8	6	1.2
19	19	2.1	6	1.2
20	16	1.8	4	0.8
21	10	1.1	5	1.0
22	5	0.5	2	0.4
23	7	0.8	2	0.4
24	3	0.3	0	0.0
25	4	0.4	1	0.2
26	4	0.4	0	0.0
27+	6	0.7	2	0.4
SUM	915	100.2	516	100.2
UNDET.	106	(10.4 of total)	26	(4.8 of total)

Table 3. Moulting harp seals in Front area, Newfoundland. Catch composition from counts of pelts by age-group (bedlamers and saddlers), sex and date in 1967, 1969 and 1970.

Date in April	Sample size	Juveniles				Adults			
		♂		♀		♂		♀	
		No.	%	No.	%	No.	%	No.	%
1967									
12 - 14	237	30	12.7	25	10.5	163	68.8	19	8.0
23	119	8	6.7	9	7.5	74	62.2	28	23.5
Subtotal	356	38	10.7	34	9.6	237	66.6	47	13.2
1969									
02 - 05	391	97	24.8	87	22.3	205	52.4	2	0.5
12 - 13	343	110	32.1	104	30.3	125	36.4	4	1.2
16 - 20	720	188	26.1	193	26.8	261	36.3	78	10.4
22	132	39	29.5	44	33.3	35	26.5	14	10.6
Subtotal	1.586	434	27.4	428	27.0	626	39.5	98	6.2
1970									
19	76	32	42.1	29	38.2	13	17.1	2	2.6
28 - 29	280	75	26.7	80	28.6	79	28.2	46	16.4
Subtotal	356	107	30.1	109	30.6	92	25.8	48	13.5
1967 + 1969 + 1970									
01 - 05	391	97	24.8	87	22.3	205	52.4	2	0.5
06 - 10	-	-		-		-		-	
11 - 15	580	140	24.1	129	22.2	288	49.7	23	4.0
16 - 20	796	220	27.6	222	27.9	274	34.4	80	10.1
21 - 25	251	47	18.7	53	21.1	109	43.4	42	16.7
26 - 30	280	75	26.7	80	28.6	79	28.2	46	16.4
Total	2.298	579	25.2	571	24.8	955	41.6	193	8.4

Table 4. Moulting harp seals in Front area, Newfoundland. Catch composition from age samples by age-group (1-6 years and 7 years+), sex and date in 1967, 1969 and 1970.

Date in April	Sample size	Juveniles ♂ No.	Juveniles ♂ %	Juveniles ♀ No.	Juveniles ♀ %	Adults ♂ No.	Adults ♂ %	Adults ♀ No.	Adults ♀ %
1967									
2 - 9	180	65	36.1	43	23.9	65	36.1	7	3.9
13 - 15	84	14	(16.7)	10	(11.9)	50	(59.5)	10	(11.9)
23 - 26	17	4	-	2	-	7	-	4	-
Subtotal	281	83	29.5	55	19.6	122	43.4	21	7.5
1969									
2 - 5	309	100	32.4	96	31.1	110	35.6	3	1.0
6 - 7	208	84	40.4	46	22.1	72	34.6	6	2.9
13	114	21	(18.4)	15	(13.2)	68	(59.6)	10	(8.8)
18 - 20	257	88	34.2	74	28.8	63	24.5	32	12.5
22	27	12	-	8	-	4	-	3	-
Subtotal	915	305	33.3	239	26.1	317	34.6	54	5.9
1970									
19	48	15	-	19	-	14	-	0	-
28 - 29	260	90	34.6	61	23.5	71	27.3	38	14.6
Subtotal	308	105	34.1	80	26.0	85	27.6	38	12.3

Table 5. Moulting harp seals in Front area, Newfoundland. Mean age from age samples, by sex and date.

Date in April	♂		♀	
	No.	Mean age	No.	Mean age
1967				
2 - 9	130	8.4	50	3.1
13 - 15	64	(12.3)	20	(8.2)
22 - 26	11	-	6	-
Subtotal	205	9.8	76	5.1
1969				
2 - 5	210	8.0	99	1.7
6 - 7	156	8.2	52	3.1
13	89	(10.4)	25	(4.8)
18 - 20	151	7.0	106	5.1
22	16	-	11	-
Subtotal	622	8.0	293	3.6
1970				
19	29	-	19	-
28 - 29	161	7.0	99	6.1
Subtotal	190	6.9	118	5.4

Table 6. Sex ratio of harp seals in Front area, Newfoundland, 1967, 1969 and 1970.

Dates	Males/♂		Females/♀		Sum
	No.	%	No.	%	
Pups					
11.03 - 23.03 1967	241	48.2	258	51.7	499
25.03 - 10.04 1969	234	51.2	223	48.8	457
26.03 - 17.04 1970	534	51.3	507	48.7	1.041
Sub-total	1.009	50.5	988	49.5	1.997
Juveniles					
12.04 - 23.04 1967	38	52.8	34	47.2	72
02.04 - 22.04 1969	434	50.3	428	49.7	862
19.04 - 29.04 1970	107	49.5	109	50.5	216
Sub-total	579	50.3	571	49.7	1.150
Total	1.588	50.5	1.559	49.5	3.147

TABLE 7. Harp seals in Front area, Newfoundland. Sexual maturity of breeding females collected 12-20 March 1964 and 11-23 March 1967.

Age at last ovulation	No.	Age at 'first' ovulation 4	5	6	7	8	9	10	11	12	13	14	15
4	0	-	-	-	-	-	-	-	-	-	-	-	-
5	2	1	1	-	-	-	-	-	-	-	-	-	-
6	6		3	3	-	-	-	-	-	-	-	-	-
7	8	1	3	2	2	-	-	-	-	-	-	-	-
8	10	-	-	4	3	3	-	-	-	-	-	-	-
9	3	-	-	-	2	1	0	-	-	-	-	-	-
10	2	-	-	-	-	-	1	1	-	-	-	-	-
11	6	-	-	-	1	1	3	1	0	-	-	-	-
12	6	-	-	-	1	2	0	1	2	0	-	-	-
13	9	-	-	-	-	-	-	3	4	2	0	-	-
14	9	-	-	-	-	-	1	2	2	1	3	0	-
15	3	-	-	-	-	-	-	-	1	1	1	0	0
	64												
Sum	(48)	1	7	9	7	4	4	3	6	3	4	0	0
%		2.1	14.6	18.8	14.6	8.3	8.3	6.3	12.5	6.3	8.3		
Acc. %		2.1	16.7	35.5	50.1	58.4	66.7	73.0	85.5	91.8	100.1		

TABLE 8. Harp seals in Front area, Newfoundland. Sexual maturity of moulting females collected 3-30 April 1964 and 14-26 April 1967.

Age	No.	Age at 'first' ovulation 4	5	6	7	8	9	10	11	12	13	14	15
4	7	0	-	-	-	-	-	-	-	-	-	-	-
5	6	0	0	-	-	-	-	-	-	-	-	-	-
6	5	1	2	1	-	-	-	-	-	-	-	-	-
7	5	-	2	0	1	-	-	-	-	-	-	-	-
8	3	-	1	1	1	0	-	-	-	-	-	-	-
9	2	-	1	0	0	1	0	-	-	-	-	-	-
10	4	-	-	3	1	0	0	0	-	-	-	-	-
11	1	-	-	1	0	0	0	0	0	-	-	-	-
12	3	-	-	-	1	0	0	1	1	0	-	-	-
13	2	-	-	1	0	0	0	0	0	1	0	-	-
14	1	-	-	-	-	-	-	1	0	0	0	0	-
15	3	-	-	-	-	-	-	1	1	0	1	0	0
	42												
Sum	(14)	1	4	2	2	1	0	1	1	1	1	0	0
%		7.1	28.6	14.3	14.3	7.1	0.0	7.1	7.1	7.1	7.1	0.0	0.0
Acc. %		7.1	35.7	50.0	64.3	71.4	71.4	78.5	85.6	92.7	99.8	100.0	100.0

TABLE 9. Fertility of sexually mature female Harp seals in Front area, Newfoundland. Counts of *corpora lutea* and *albicantsa*, and estimates of missing *corpora* for the three most recent breeding seasons (ovulations), presuming that ovulations alternate regularly between ovaries.

Age	Year of	Breeding females			Moulting females			Total		
		No.	No.	%	No.	No.	%	No.	No.	%
groups	coll.	count.	miss.	miss.	count.	miss.	miss.	count.	miss.	miss.
	1964	8	1		36	3				
6-12								124	13	9.5
	1967	68	8		12	1				
	1964	35	4		23	1				
13-18								165	11	6.3
	1967	91	4		16	2				
	1964	38	2		8	1				
19 UP								135	10	6.9
	1967	80	7		9	0				
Unknown	1964	23	3		9	2		32	5	
	1964	104	10	8.8	76	7	8.4			
ALL								456	39	7.9
	1967	239	19	7.4	37	3	7.5			

Table 10. Harp seal pup catches at Newfoundland and survival of corresponding year-classes expressed by relative frequency in age samples from the Front, Newfoundland, divided by relative frequency of age groups in life table (Sergeant MS 1960). Parentheses indicate estimated catches and size of age samples.

Year class	Catch of pups front 10^3	Total catch of pups	"Survival index" from age samples					
			1 1964 (127)	2 1967 (281)	4 1968 (702)	5 1969 (915)	3 1970 (516)	Weighted mean
1945			2.38	0.57	1.83	0.60	0.40	1.00
46		73	4.20	1.56	3.43	1.33	0.00	1.85
47		102	2.17	1.27	1.55	0.71	0.67	1.10
48		137	1.48	2.46	2.09	1.22	0.57	1.50
49	(169)	227	1.70	2.13	2.31	1.62	1.11	1.78
1950	(174)	226	0.92	1.56	2.47	1.62	0.73	1.61
51	(215)	319	0.86	1.00	1.17	1.20	0.92	1.09
52	(126)	198	0.97	1.57	0.81	1.50	0.80	1.15
53	(161)	198	0.86	1.38	0.83	0.62	0.33	0.74
54	(109)	175	1.62	0.64	1.00	1.00	1.00	0.99
1955	(159)	252	0.89	0.66	0.75	0.88	0.70	0.78
56	(245)	341	0.80	1.28	0.53	0.75	0.81	0.78
57	(71)	165	0.87	0.72	0.86	0.56	0.43	0.66
58	(56)	141	1.57	0.41	1.03	0.69	0.44	0.75
59	(181)	239	0.89	0.94	1.00	0.82	0.69	0.86
1960	(81)	171	1.13	1.26	1.10	0.86	1.10	1.04
61	126	179	0.69	1.30	1.22	0.98	0.66	1.00
62	(114)	214	0.43	1.03	0.47	0.72	1.02	0.74
63	(159)	278	0.17	0.27	0.65	0.52	0.65	0.52
64	(168)	273		0.20	0.49	0.65	0.48	0.50
1965	(90)	190		1.00	0.66	0.43	0.85	0.67
66	(167)	257		1.40	0.95	0.41	0.75	0.78
67	185	280			1.37	0.42	0.70	0.81
68	97	156				2.90	1.92	2.53
69	186	(238)					1.83	(1.83)

Table 11. Relative age-group frequencies of harp seals of the Northwest Atlantic derived from life table by Sergeant (MS 1960).

Age	Per cent	
	Young incl.	Young excl.
0	18.6	
1	11.4	14.0
2	9.0	11.0
3	7.4	9.1
4	6.3	7.7
5	5.4	6.6
6	4.9	6.0
7	4.4	5.4
8	4.0	4.9
9	3.6	4.4
10	3.2	3.9
11	2.9	3.6
12	2.6	3.2
13	2.3	2.8
14	2.1	2.6
15	1.9	2.3
16	1.7	2.1
17	1.5	1.8
18	1.2	1.5
19	1.0	1.3
20	0.9	1.1
21	0.8	0.9
22	0.6	0.7
23	0.5	0.6
24	0.4	0.5
25	0.4	0.5
26	0.3	0.4
27+	0.8	0.9
SUM	100.1	99.8

Table 12. Total catches of selected year-classes of harp seals in the Northwest Atlantic.

Year	Year-class			
	1951	1956	1963	1967
1951	318.626			
52	15.266			
53	8.240			
54	8.134			
1955	6.243			
56	3.169	341.397		
57	4.803	11.206		
58	8.467	17.247		
59	3.984	7.398		
1960	5.413	9.473		
61	797	1.349		
62	4.105	6.841		
63	2.358	3.980	278.350	
64	2.171	3.799	10.855	
1965	1.396	2.363	5.907	
66	1.703	2.888	6.738	
67	1.221	2.093	4.476	280.442
68	652	1.160	2.392	5.073
69	834	1.556	3.334	6.113
1970	650	1.300	2.700	4.550
Accumulated catch	398.232	414.050	314.752	296.178

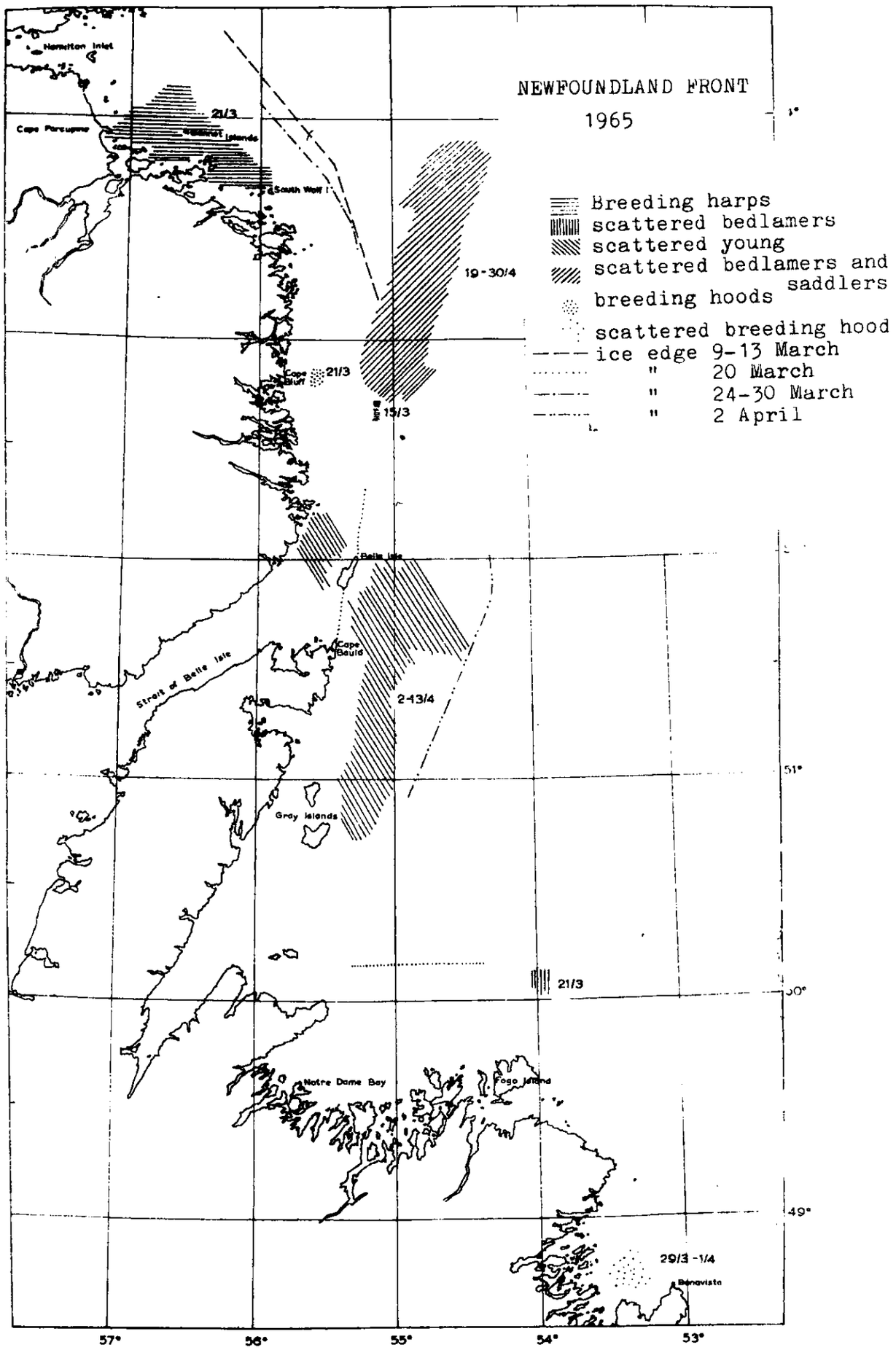
NEWFOUNDLAND FRONT
1965
Breeding harps
scattered bedlamers
scattered young
scattered bedlamers and saddlers
breeding hoods
scattered breeding hood
ice edge 9-13 March
" 20 March
" 24-30 March
" 2 April
Hamilton Inlet
Cape Porcupine
21/3
Wolf Islands
South Wolf I.
19-30/4
Cape Bauld
21/3
15/3
Belle Isle
Strait of Belle Isle
Cape Bauld
2-13/4
Gray Islands
21/3
Notre Dame Bay
Fogo Island
29/3 -1/4
Bonavista
57°
56°
55°
54°
53°
51°
50°
49°

Figure 1.

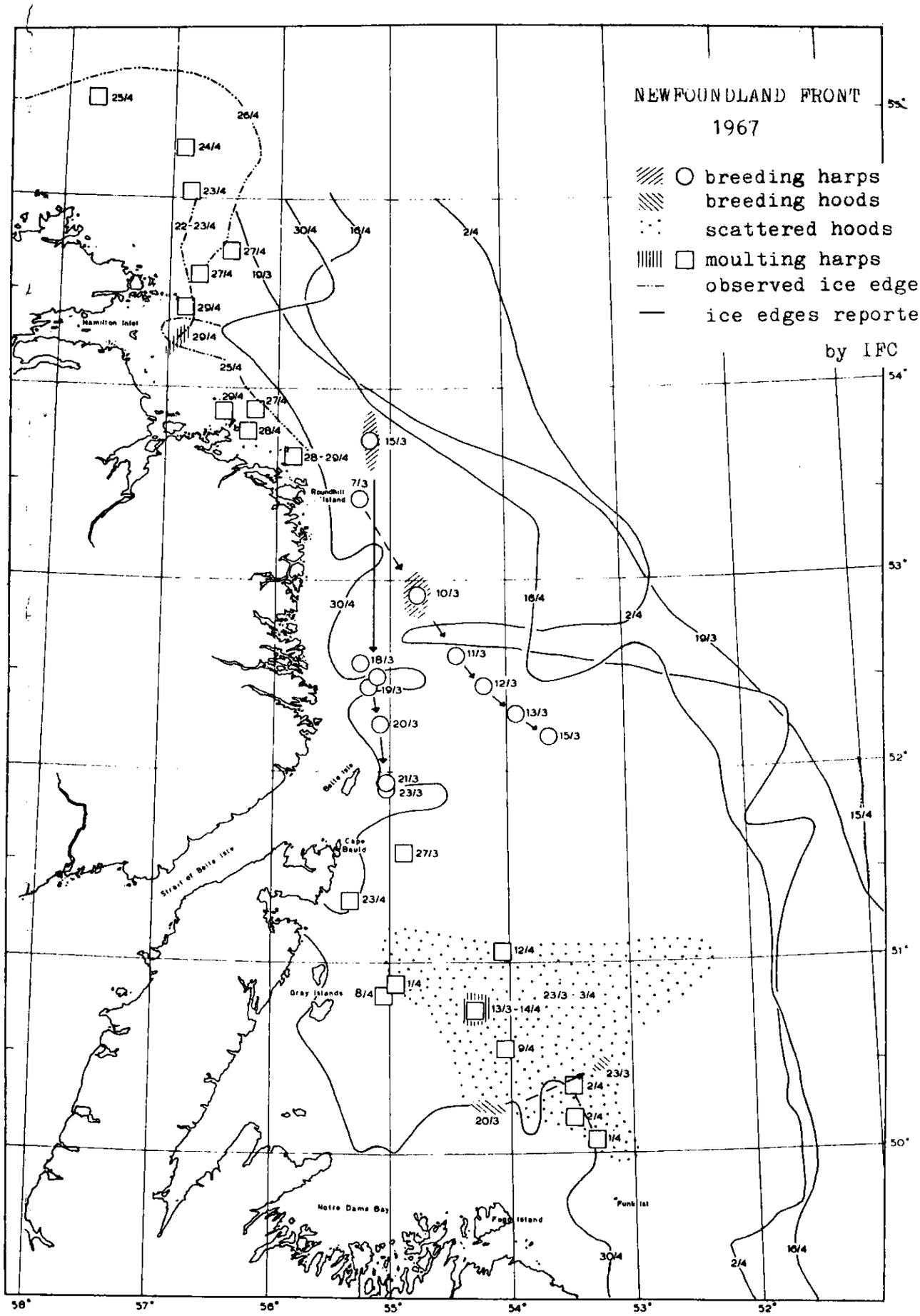
NEWFOUNDLAND FRONT
1967
breeding harps
breeding hoods
scattered hoods
moulting harps
observed ice edges
ice edges reported
by IFC
25/4
26/4
24/4
23/4
22-23/4
27/4
27/4
10/3
29/4
29/4
25/4
29/4
27/4
28/4
28-29/4
15/3
7/3
Roundhill Island
30/4
16/4
2/4
10/3
18/3
19/3
20/3
11/3
12/3
13/3
15/3
19/3
15/4
21/3
23/3
Belle Isle
Cape Bauld
27/3
23/4
Strait of Belle Isle
12/4
1/4
8/4
Gray Islands
13/3-14/4
23/3 - 3/4
9/4
23/3
2/4
2/4
1/4
20/3
Notre Dame Bay
Fogo Island
Punk Isl
30/4
16/4
2/4
58°
57°
56°
55°
54°
53°
52°
55°
54°
53°
52°
51°
50°

Figure 2.

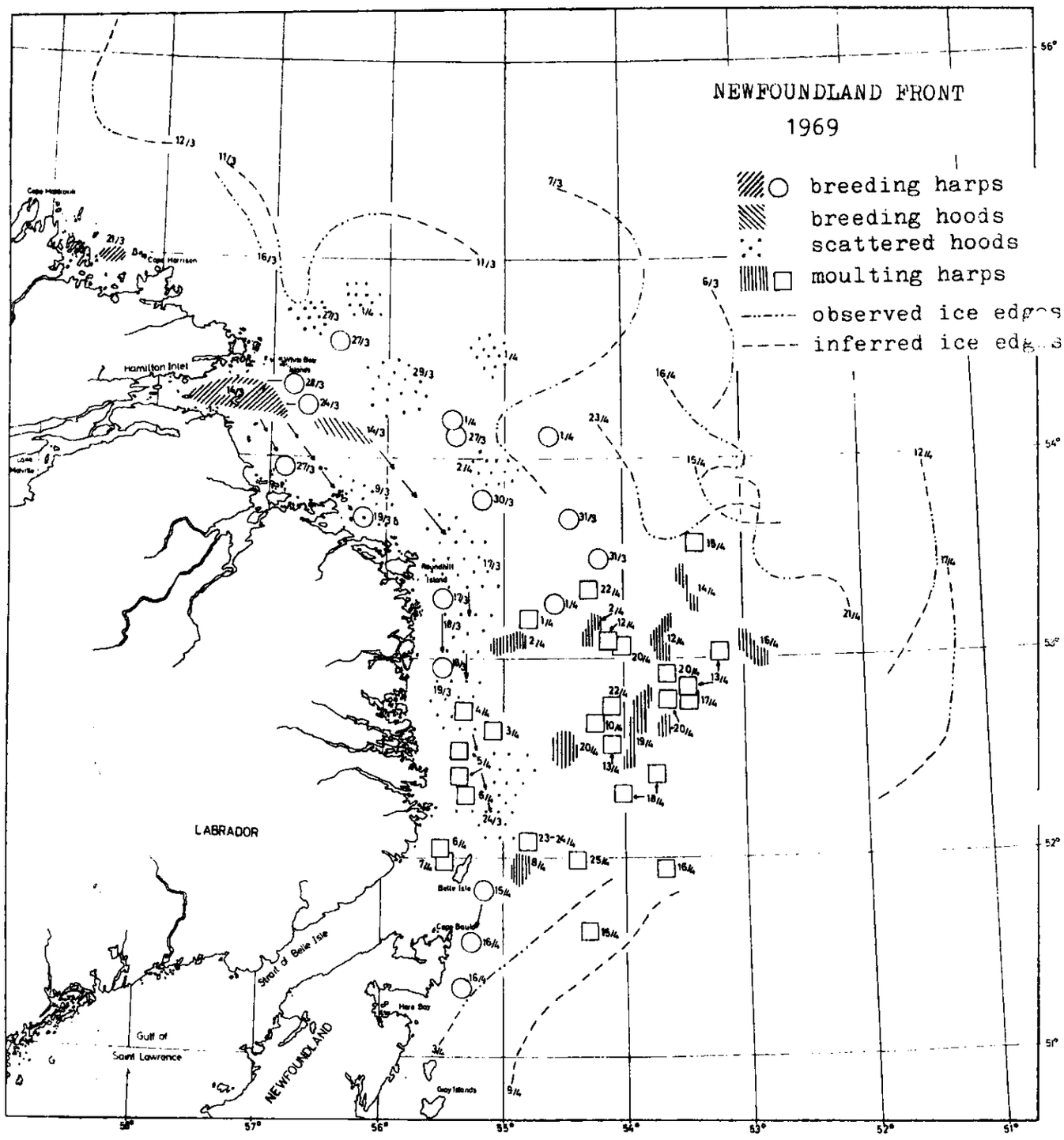
NEWFOUNDLAND FRONT
1969
breeding harps
breeding hoods
scattered hoods
moulting harps
observed ice edge
inferred ice edge
LABRADOR
NEWFOUNDLAND
Hamilton Inlet
Strait of Belle Isle
Gulf of
Saint Lawrence
56°
54°
52°
51°
58°
57°
56°
55°
54°
53°
52°
51°

Figure 3.

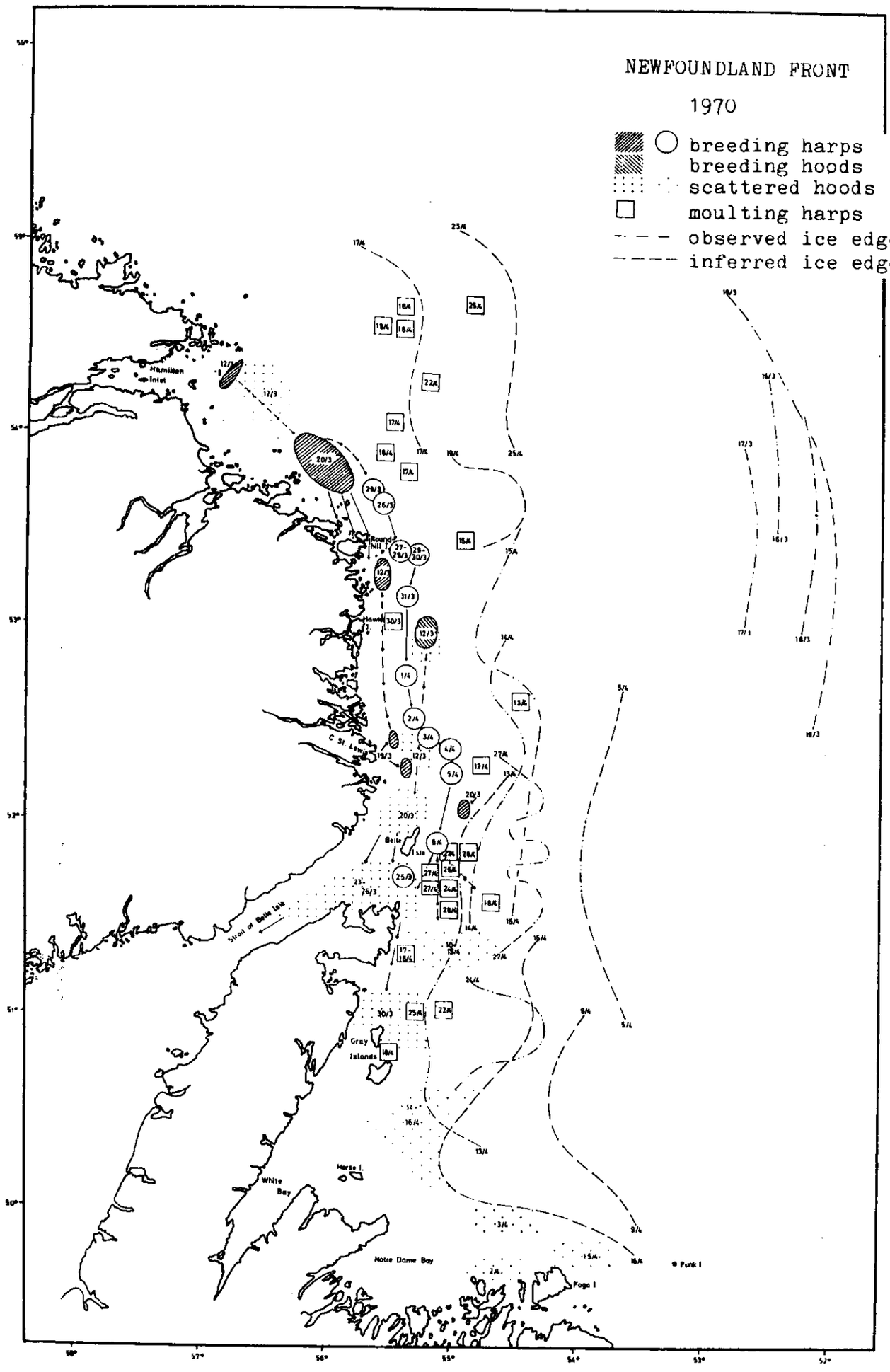
NEWFOUNDLAND FRONT
1970
breeding harps
breeding hoods
scattered hoods
moulting harps
observed ice edges
inferred ice edges
Hamilton Inlet
Belle Isle
Strait of Belle Isle
Gray Islands
White Bay
Horse I.
Notre Dame Bay
Fogo I
Funk I

Figure 4.

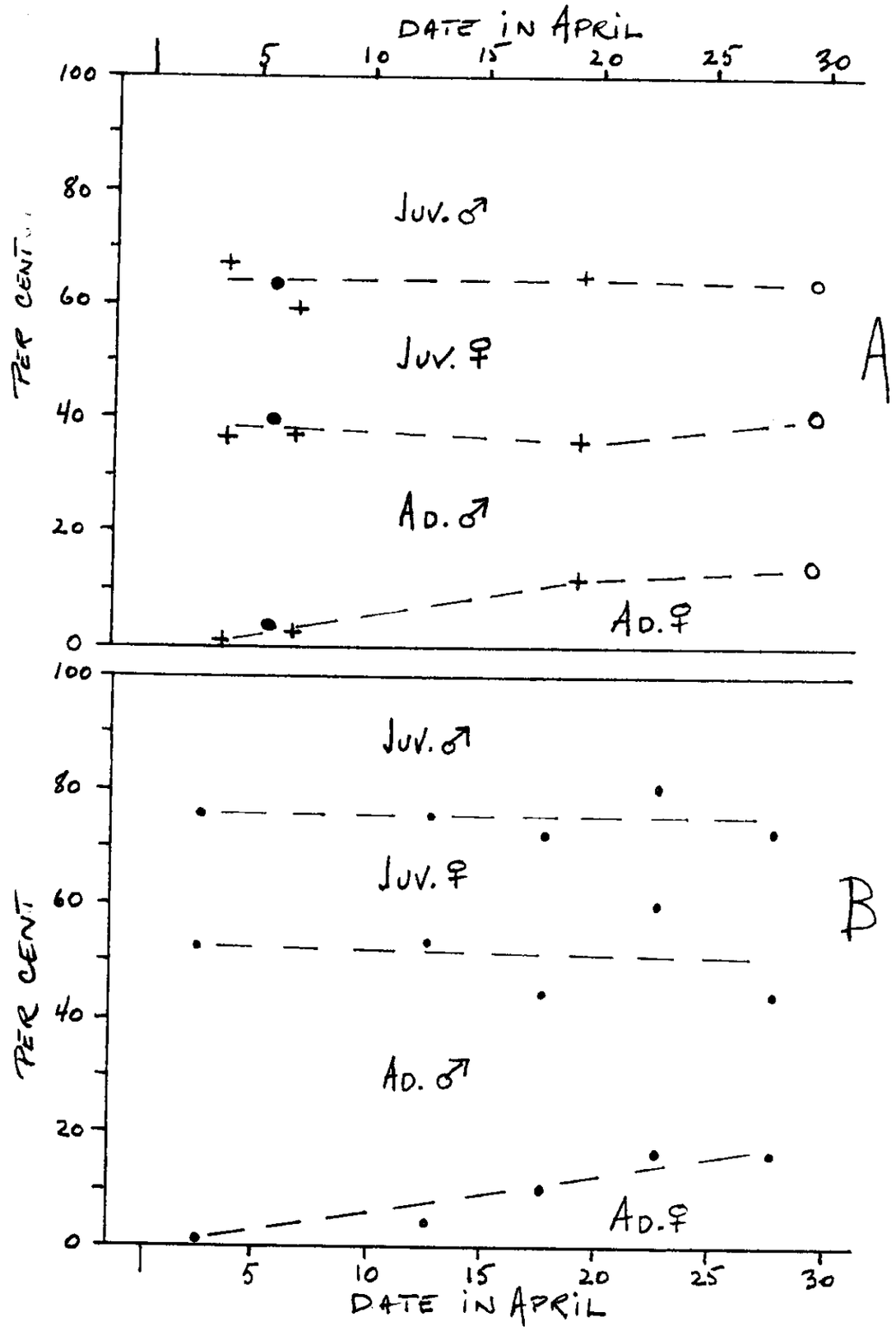

Figure 5. Age and sex composition of catches of moulting Harp seals in Front area, Newfoundland, through April.
A) From age samples (Tab. 4), • 1967, + 1969, o 1970.
B) From counts of pelts (Tab. 3).

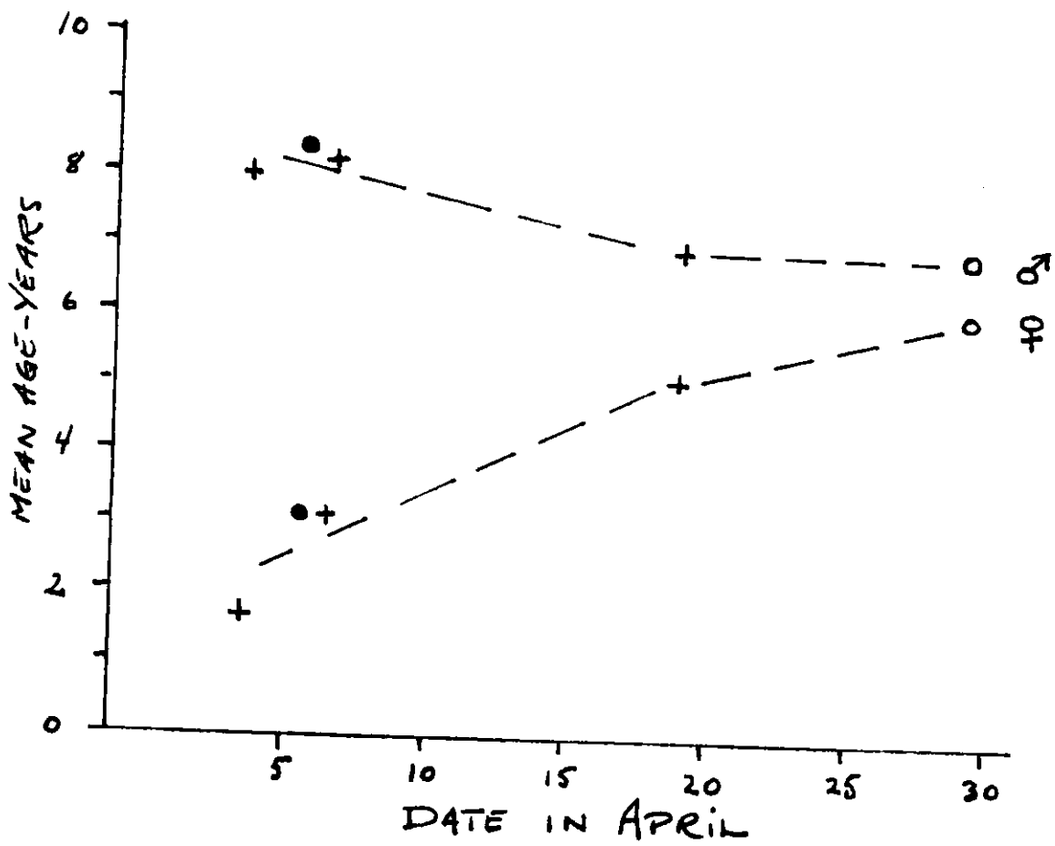

Figure 6. Mean age of males and females in catches of moulting Harp seals in Front area, Newfoundland, through April (Tab. 5). • 1967, + 1969, o 1970.

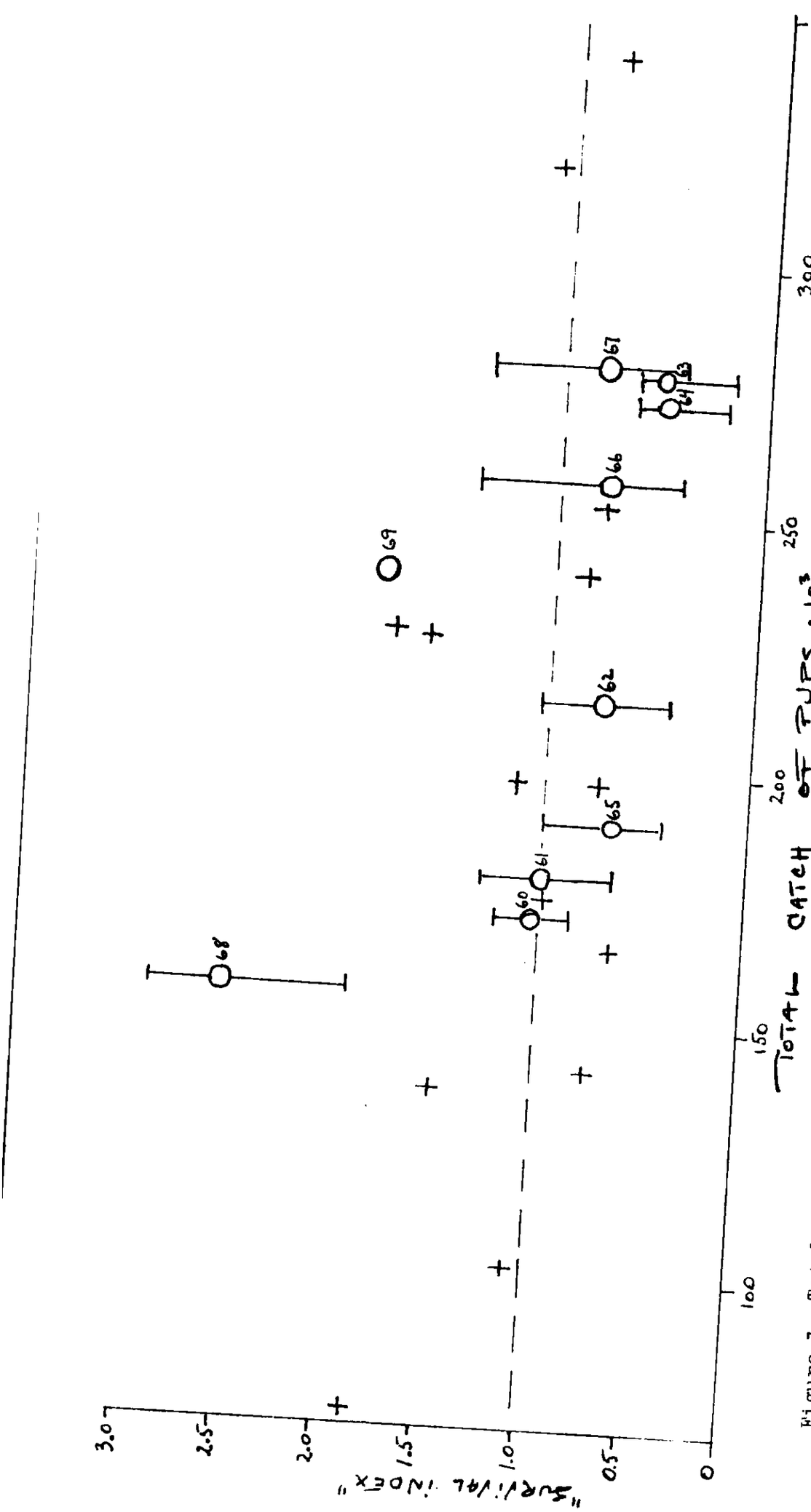

Figure 7. Total catch of harp seal pups at Newfoundland and survival of corresponding year-classes as indicated by "survival index" (Tab. 10). +: weighted mean for year-classes 1946 - 1959. O: weighted mean for year-classes 1960 - 1969 (with range).

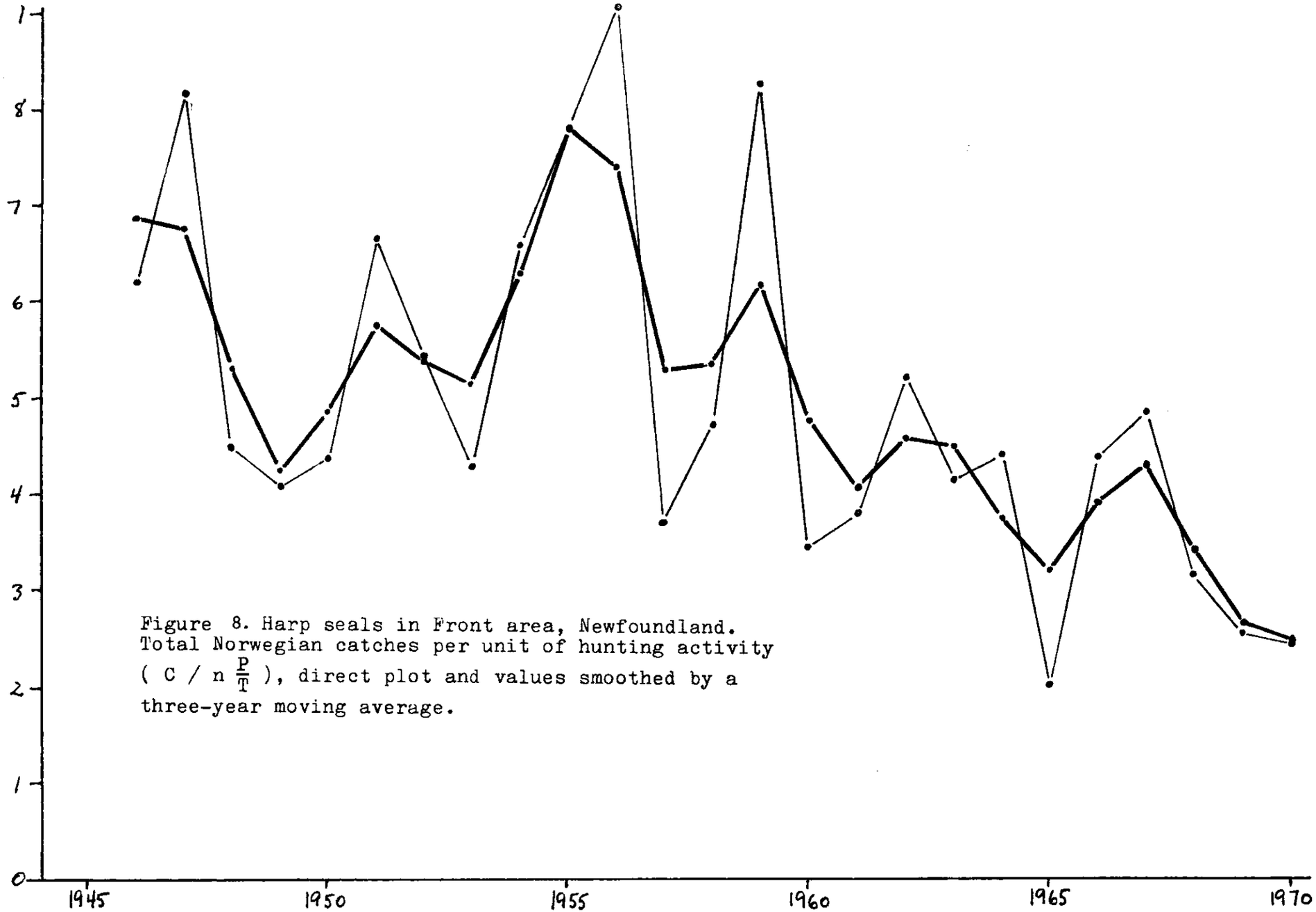

Figure 8. Harp seals in Front area, Newfoundland. Total Norwegian catches per unit of hunting activity ($C / n \frac{P}{T}$), direct plot and values smoothed by a three-year moving average.

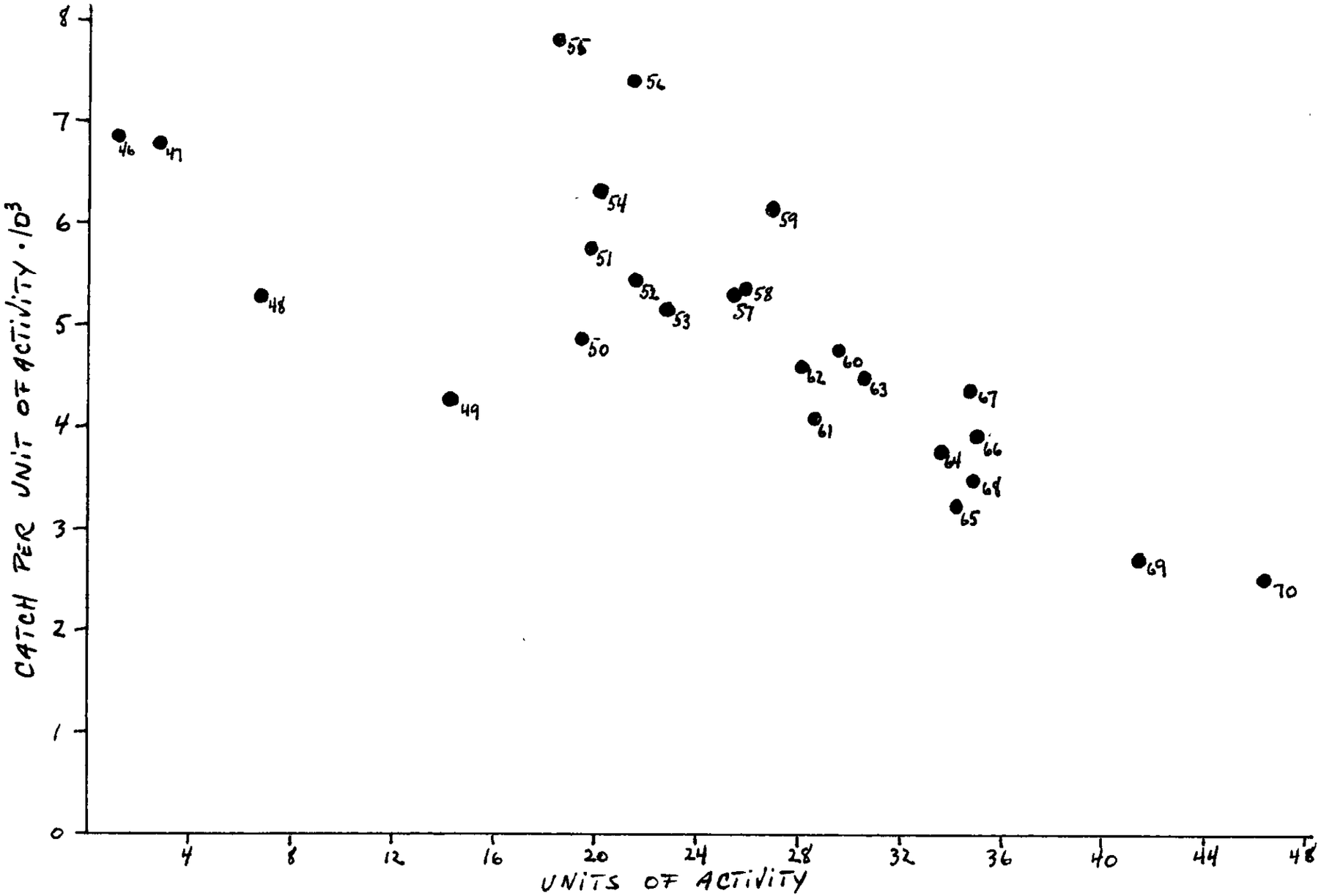

Figure 9. Harp seals in Front area, Newfoundland. Total Norwegian catches per unit of hunting activity ($C / n \frac{P}{T}$), in relation to t' hunting activity. Values smoothe by a three-year moving average.