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The kill of murre in Newfoundland in the 1977-78, 1978-79, and 1979-80 hunting seasons

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Introduction

Two species of murre winter in large numbers off Newfoundland. These are the Common Murre (*Uria aalge*) and the Thick-billed Murre (*Uria lomvia*). A special provision of the Migratory Birds Regulations allows residents of Newfoundland-Labrador, in addition to Inuit and Indians, to take murre for non-commercial human consumption from 1 September to 31 March. Although murre breed in abundance in Canada, populations require close monitoring because of their slow rate of recruitment. In addition, large numbers are killed or threatened by man's activities in fishing and petroleum exploitation. We estimated an average annual hunting kill of 450 000 ± 50 000 murre of both species combined by hunters in Newfoundland-Labrador during the 3 years of this survey. During this period we were unable to distinguish between the kill of Thick-billed Murre and Common Murre. A technique has now been developed (Cooch and Collins 1982) that provides a means of species identification based on tarsi and feet. A parts survey based on this method would permit the development of estimates of the relative number of each species taken.

The standard national surveys of migratory game bird hunters (Cooch *et al.* 1978) do not produce estimates of the kill of murre in Newfoundland. One reason for this is that it is not practical to query hunters in the National Waterfowl Harvest Survey about late season kill on questionnaires that, in the case of waterfowl, are mailed up to 6 months before some of the kill of murre takes place. A special local survey is therefore required to provide useful estimates of murre kill in Newfoundland. Results obtained in the first 3 years of this experimental survey are described here.

Methods

A special mail questionnaire survey, similar in concept and design to the National Waterfowl Harvest Survey, was used. The sampling frame consisted of all persons who purchased Migratory Game Bird Hunting Permits (MGBH Permits) in Newfoundland in each year. Although all hunters of migratory game birds are legally required to possess that permit, it is not mandatory for murre hunters in that province, the only

one in which murre hunting is authorized. For the purposes of calculation, we assumed that the number of murre hunters who do not buy permits is small compared with the number that do. We do not believe that this resulted in a significant underestimate of the potential number of murre hunters. Separate investigations in Labrador have shown that many Indians and Inuit, exempt from the necessity of holding MGBH Permits, nevertheless think it prudent to buy one.

To stratify the survey, Newfoundland-Labrador was divided into 13 geographical zones, largely on the basis of inshore fisheries surveys (Fig. 1). This stratification was carried out because of expected differences in hunting between geographic zones of permit purchase, particularly between coastal and interior regions and because respondents were expected to be familiar with fisheries zones. A further stratification by date of purchase was included for 2 years because hunters who buy late in the year have only sea ducks and murre as possible legal quarry. Late purchasers are of additional interest because they are not available for inclusion in the sampling frame of the national survey. Since the regular sport duck hunting seasons close on 30 November in Newfoundland, late purchasers were expected to be more active in the murre season.

The sample selection was systematic (by taking permit numbers at regular intervals from the list of hunters) within each stratum. The sample selection process was modified in 1979-80 on the basis of experience in the first 2 years of the survey to optimize allocation of questionnaires. The number of candidates from each stratum was roughly proportional to the number of permits sold in that stratum, except that all late permit purchasers in the first 2 years were sent questionnaires. Some adjustments were made to ensure enhanced representation from coastal areas with small sales. The questionnaires were mailed on 13 April 1978, 27 April 1979, and 26 April 1980.

To avoid confusion with the national survey the questionnaire includes an explanation pointing out the difference between the two surveys and also provides some colloquial names that may be in more common use.

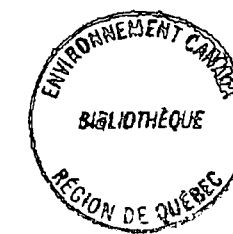
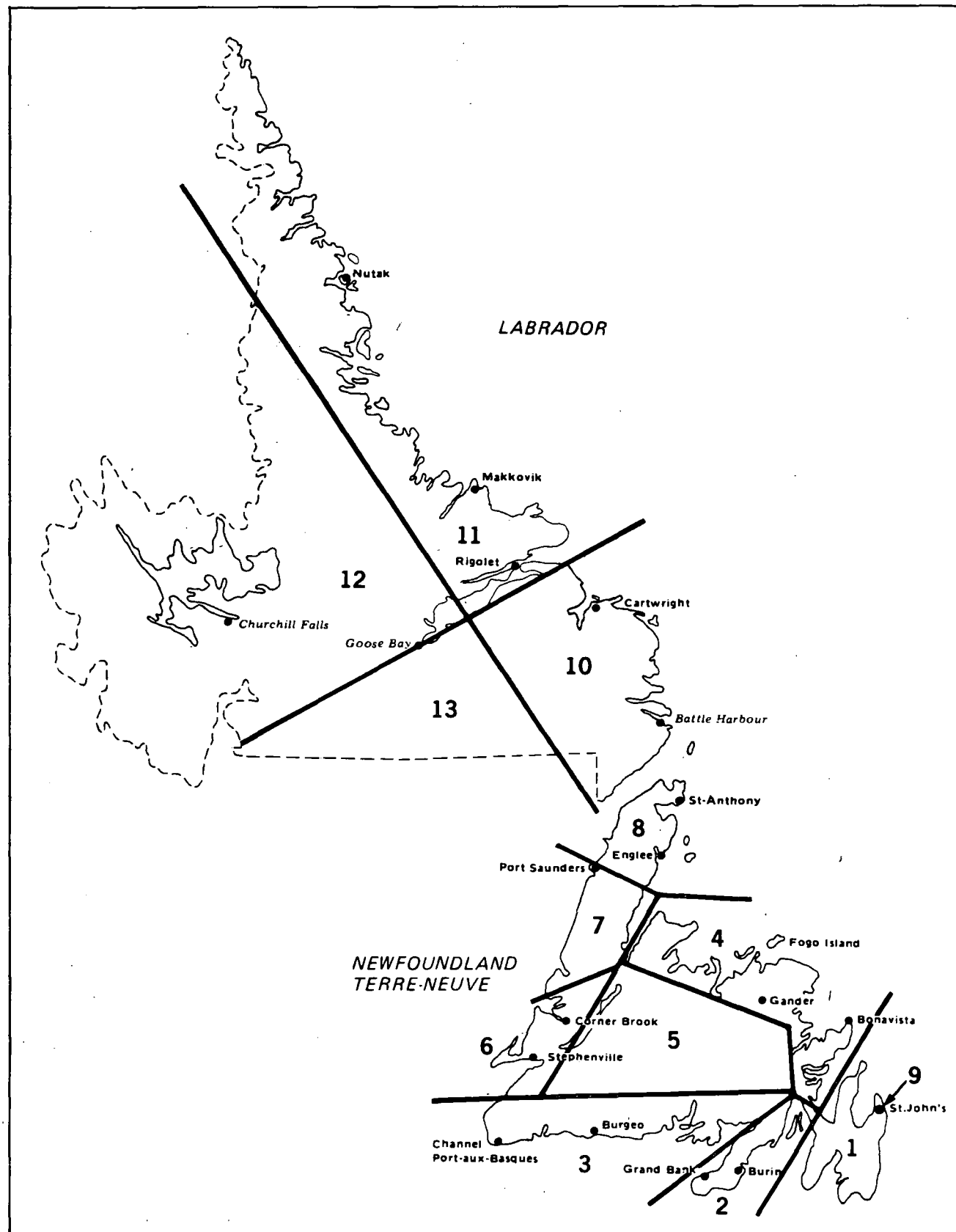
A second wave of questionnaires was sent to those hunters who did not return the first questionnaires within about 6 weeks. Covering letters were sent with each questionnaire except for the first mailing in 1978.

In the analysis of results of the survey, we assumed that hunters who did not specify their hunting locations hunted in the zones where they bought permits. Tests for change between years are based on t-statistics using standard deviations unweighted by sample size because the annual samples involved are generally similar.

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Figure 1
Sample zones



Results

Response to the survey

Table 1 shows the responses to the survey from the strata of hunters who purchased before 1 December. In addition, there were 686 late purchasers in each of the first 2 years, all of whom were sent questionnaires. They returned 375 (1977-78) (54.7%) and 311 (1978-79) (44.4%) questionnaires, respectively. Late purchasers were not sampled separately in 1979-80. There was some evidence of a growing resistance to completion of questionnaires in some strata with small sampling frames.

The overall response was as follows:

	1977-78	1978-79	1979-80
Total permits	36458	37523	37155
Sample size	4693	4695	3990
Sample intensity (%)	12.9	12.5	11.2
Response	2681	2345	1990
Response as % of sample	57.1	49.9	49.8
Estimated no. of active hunters	9005	6829	8025

Estimates of kill

Annual estimates of the total kill of murre by zone of hunting are given in Table 2. We decided not to base estimates of hunter activity and success on zone of permit purchase because some hunters indicated that they hunted in zones other than those where they purchased their permits. The confidence intervals for the total kill at the 0.05 level are:

1977-78	1978-79	1979-80
(467 000-616 000)	(276 000-431 000)	(390 000-567 000)

Using 1977-78 as a baseline, the kill of murre declined significantly in Zones 2, 4, and 7 in 1978-79, and in 1979-80 increased in Zones 2, 5, and 8. As indicated in Table 3 and shown on Figure 2, the estimated kill of murre was down in every month of the 1978-79 season. The annual cumulative kill is given in Figure 3.

Hunter activity

Estimates of the number of days spent by hunters are given in Table 4. Hunter activity declined significantly in 1978-79 but increased in 1979-80. Table 5 shows the percentage of hunters who reported activity in this survey. Although their kill is significant, hunters of murre constitute a minority of permit purchasers in all areas.

Comparison of early with late purchasers

In the 1977 and 1978 surveys late purchasers were found to be more active than earlier purchasers (Table 6). This is reflected in the proportion of permit holders that hunted, the proportion that were successful in killing birds, and in the kill of birds per active hunter. However, the total kill reported by this group ac-

counts for less than 3% of the murre taken. Therefore, the exclusion of this group from the sampling frame of the national surveys is not a major problem and the universe was not retained as a separate stratum in 1979, when all purchasers were lumped.

Comparison of responses to first and second mailings in 1977-78

Persons who choose not to reply to a mail survey may have characteristics that are different from those of the hunters who do reply. Non-response is therefore a source of bias in our estimates. Although we do not know what this bias is, we can learn something about it by comparing results from 1) hunters who responded to the first questionnaire received, and 2) all respondents, including those who only responded after receiving a second questionnaire. Table 7 compares these two groups. If these two points are used to extrapolate to the kill that would have been reported with a 100% response rate (a questionable practice as we have no reason to believe that our estimates are linear functions of response rate) we obtain -1% as the estimated non-response bias on murre kill. This indicates that non-response bias can probably be ignored in comparison to sampling error in this survey.

Discussion

Limitations of the survey

The estimates presented in this report were calculated under the assumptions that the sampling frame was complete, that the sample was representative, and that the information received on the questionnaires was correct. None of these assumptions holds perfectly, so they cause a mixture of upward and downward biases in the results. Many of these biases are common to most mail surveys. See Cooch *et al.* (1978) for a discussion of biases in the national surveys.

We have some additional reservations peculiar to this survey. Some downward bias is introduced in the kill estimates because our sampling frame for murre hunters is incomplete. We feel that a countervailing upward bias in the murre kill estimates is caused by the difficulty that many murre hunters must have in separating their individual kill from their party kill.

Hunting mortality as a component of the population dynamics of murre

Gaston (1980) suggests that the groups of Thick-billed Murre wintering off Newfoundland number about 4 million when they leave the summer areas. Similar calculations were applied to the Common Murre breeding population estimates from Brown *et al.* (1975) and give about 1.5 million of this species. Thus, a rough estimate of the murre population using Newfoundland waters is a 5 million birds. With these approximations our survey indicates an average mortality of about 10% due to shooting in Newfoundland over the 3 years of this survey.

Suppose, as in Gaston and Nettleship (1981), that there is a 60% loss of murre chicks before they reach Newfoundland, and the production of young is 0.7

chicks per breeding pair. If the survival rate (S) does not vary after hatching year and the number of breeding pairs in year i is denoted B_i , then

$$B_i = B_{i-1} S + \frac{B_{i-5} (0.7) (0.4) S^4}{2}$$

if all murre started breeding at age 5.

To maintain a constant breeding population we have $B_i = B_{i-1} = B_{i-5}$, allowing the solution of the above equations to give $S = 0.91$. Although this model is so oversimplified we do not expect it would fit real population data, it establishes heuristically the approximate

mortality that murre populations can safely sustain, which is about 10% for birds of age one or older. Several other mortality factors operate at levels similar to that we have found for shooting in Newfoundland. These include mortality due to fishing operations (Tull *et al.* 1972) and oiling (Nettleship 1977), both of which are less selective of young birds and so are potentially more damaging. We expect that first-year birds are more vulnerable to shooting than older birds, so the mortality estimated by this survey probably included substantially less than 10% of the older age classes.

Table 1
Characteristics of the sample of hunters who purchased permits before 1 December, 1977-78 and 1978-79

Zone	Total permits	Sample size	Sampling intensity (%)	Response	Response as % of sample
1977-78					
1	4 535	450	9.9	267	59.3
2	2 556	260	10.2	161	61.9
3	3 372	340	10.1	192	56.5
4	8 931	890	10.0	565	63.5
5	2 709	270	10.0	164	60.7
6	3 971	400	10.1	242	60.5
7	889	200	22.5	121	60.5
8	3 371	340	10.1	169	49.7
9	2 045	210	10.3	130	61.9
Nfld.	32 379	3360	10.4	2011	59.9
10	762	200	26.2	84	42.0
11	202	200	99.0	76	38.0
12	1 892	199	10.5	114	57.3
13	538	49	9.1	21	42.9
Labr.	3 394	648	19.1	295	45.5
Total	35 773	4008	11.2	2306	57.5
1978-79					
1	4 666	450	9.6	230	51.1
2	2 520	260	10.3	126	48.5
3	3 587	340	9.5	183	53.8
4	9 416	890	9.5	476	53.5
5	2 868	270	9.4	147	54.4
6	3 925	400	10.2	226	56.5
7	874	200	22.9	106	53.0
8	3 532	340	9.6	137	40.3
9	2 183	210	9.6	128	61.0
Nfld.	33 571	3360	10.0	1759	52.4
10	774	200	25.8	78	39.0
11	227	200	88.1	70	35.0
12	1 818	200	11.0	115	57.5
13	448	50	11.2	12	24.0
Labr.	3 267	650	19.9	275	42.3
Total	36 838	4010	10.9	2034	50.7

Table 2
Estimates of kill by zone of hunting

Zone	Murres	
	Kill	SE
1977-78		
1	80 757	12 904
2	55 074	11 518
3	47 288	8 677
4	228 572	25 923
5	553	553
6	4 468	1 509
7	38 583	12 773
8	50 914	11 403
9	11 851	3 410
Nfld.	518 059	36 795
10	18 834	9 431
11	3 589	1 360
12	—	—
13	1 281	1 281
Labr.	23 704	9 614
Total	541 764	38 030
1978-79		
1	106 555	31 333
2	22 271	5 880
3	41 272	10 076
4	115 497	18 114
5	2 669	2 573
6	7 110	3 504
7	10 118	5 686
8	36 937	7 352
9	4 011	2 668
Nfld.	346 439	39 476
10	5 625	2 137
11	966	357
12	—	—
13	529	529
Labr.	7 120	2 234
Total	353 559	39 539

Table 2 (cont'd)
Estimates of kill by zone of hunting

Zone	Murres	
	Kill	SE
1979-80		
1	70 029	13 518
2	60 769	16 506
3	45 038	7 508
4	183 550	27 006
5	5 690	5 355
6	7 733	7 156
7	11 563	5 074
8	81 941	25 267
9	4 491	1 769
Nfld.	470 805	44 588
10	7 066	5 978
11	520	431
12	—	—
13	—	—
Labr.	7 587	5 994
Total	478 391	44 989

The ice maps show that the 1978-79 ice conditions were indeed different from those of the previous season in Zone 4. The date of first freezing in 1977-78 was about 5 January, whereas in 1978-79 ice cover was almost complete by 17 December and remained until the end of February 1979. Similarly, ice cover was earlier and more complete in Zones 1 and 2 when compared with 1977-78. In 1979-80, ice conditions during the winter months were less severe than in 1978-79 and the number of murre killed increased accordingly. Surprisingly, the decrease in kill that occurred in Zones 4 and 8, in part because of ice, was not reflected by increases in kill in Zones 2, 3, or 6. Conventional wisdom suggests that murre displaced from Zones 4 and 8 would move south around the Avalon Peninsula to the ice-free waters off the south coast. Kill did increase in Zones 1 and 9, however, which would seem to indicate some degree of southward movement. Brown *et al.* (1975) suggest that murre wintering off Newfoundland are displaced to the south of Newfoundland by ice. Therefore, ice conditions probably account for much of the change in the kill estimates for Zones 2 and 4. Other factors are obviously important, too, including wind speed and direction.

Tuck (1960) estimated that, in 1956 approximately 200 000 birds were taken annually by subsistence hunters in Newfoundland-Labrador. Those estimates were derived at a time when subsistence hunting was restricted to designated outports and excluded such metropolitan areas as St. John's, Gander, Stephenville, and Cornerbrook. In 1974, the privilege of hunting murre

Ice conditions

To better understand the annual and seasonal changes in murre kill we obtained maps showing ice distribution from Ice Forecasting Central in Ottawa (AES, Dept. of Environment). We were most interested in the kill of murre in Zone 4 from December to February because kill there makes up a large part of the total murre kill (about 42% in 1977-78), and because the kill decreased significantly in 1978-79.

Table 6

Characteristics of late purchasers compared with those of early purchasers

Purchase dates	Purchasers hunting murre (%)	Murre kill per hunter
Up to 30 Nov. 1977	23.7	52.51
1 Dec. 1977 to 10 March 1978	30.1	60.32
Up to 30 Nov. 1978	16.3	49.28
1 Dec. 1978 to 10 March 1979	30.5	42.74

Table 7

Estimated kill of murre calculated after first and second mailings in 1977-78

Location	After first mailing			After second mailing		
	Kill estimate	SE	Respondents	Kill estimate	SE	Respondents
Nfld.	522 802	46 536	1436	518 059	36 795	2351
Labrador	15 605	3 747	196	23 704	9 614	330
Total	538 407	46 687	1632	541 764	38 030	2681

Figure 2

Estimated kill of murre by month, Sept.-March, 1977-78 to 1979-80

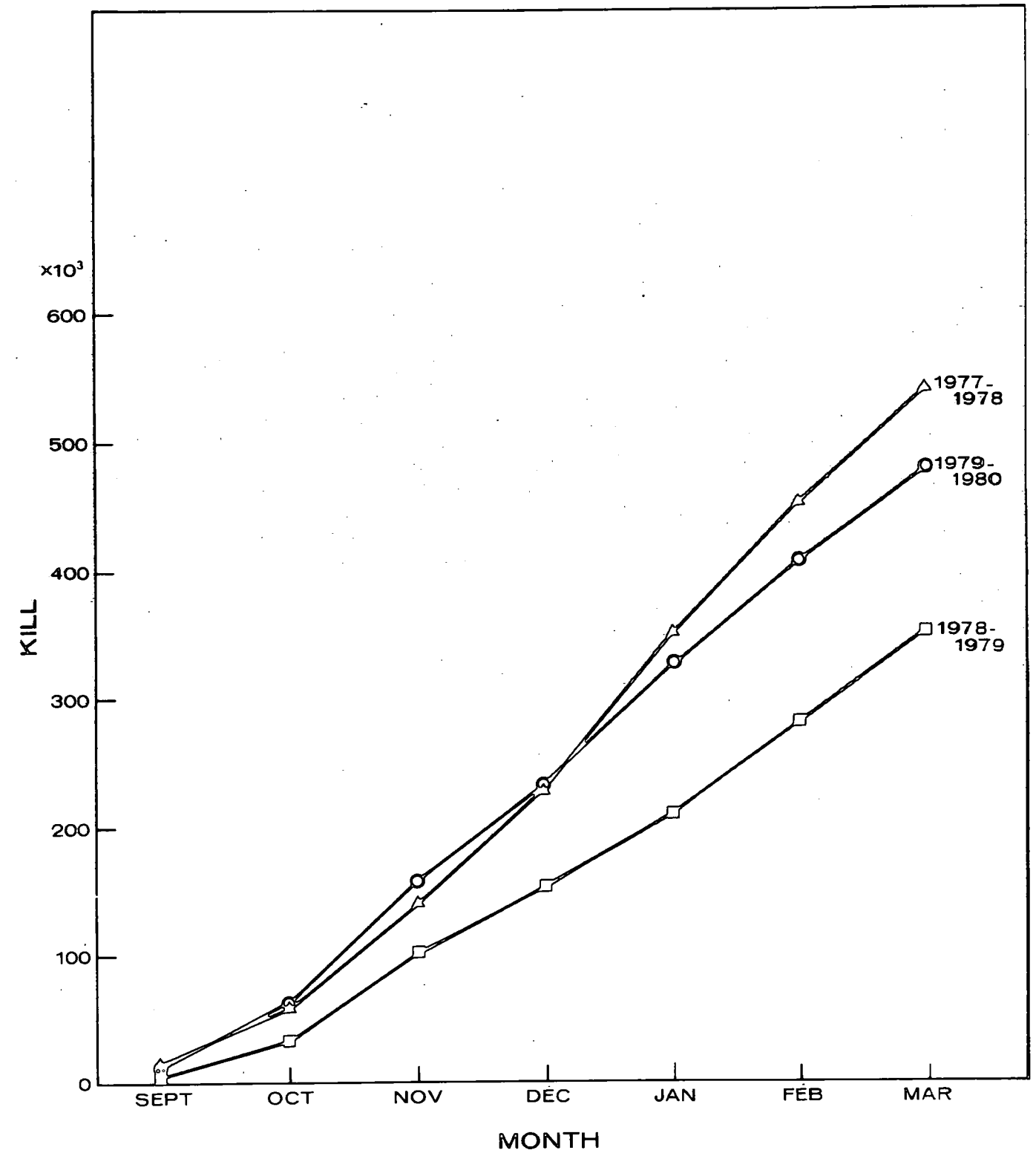
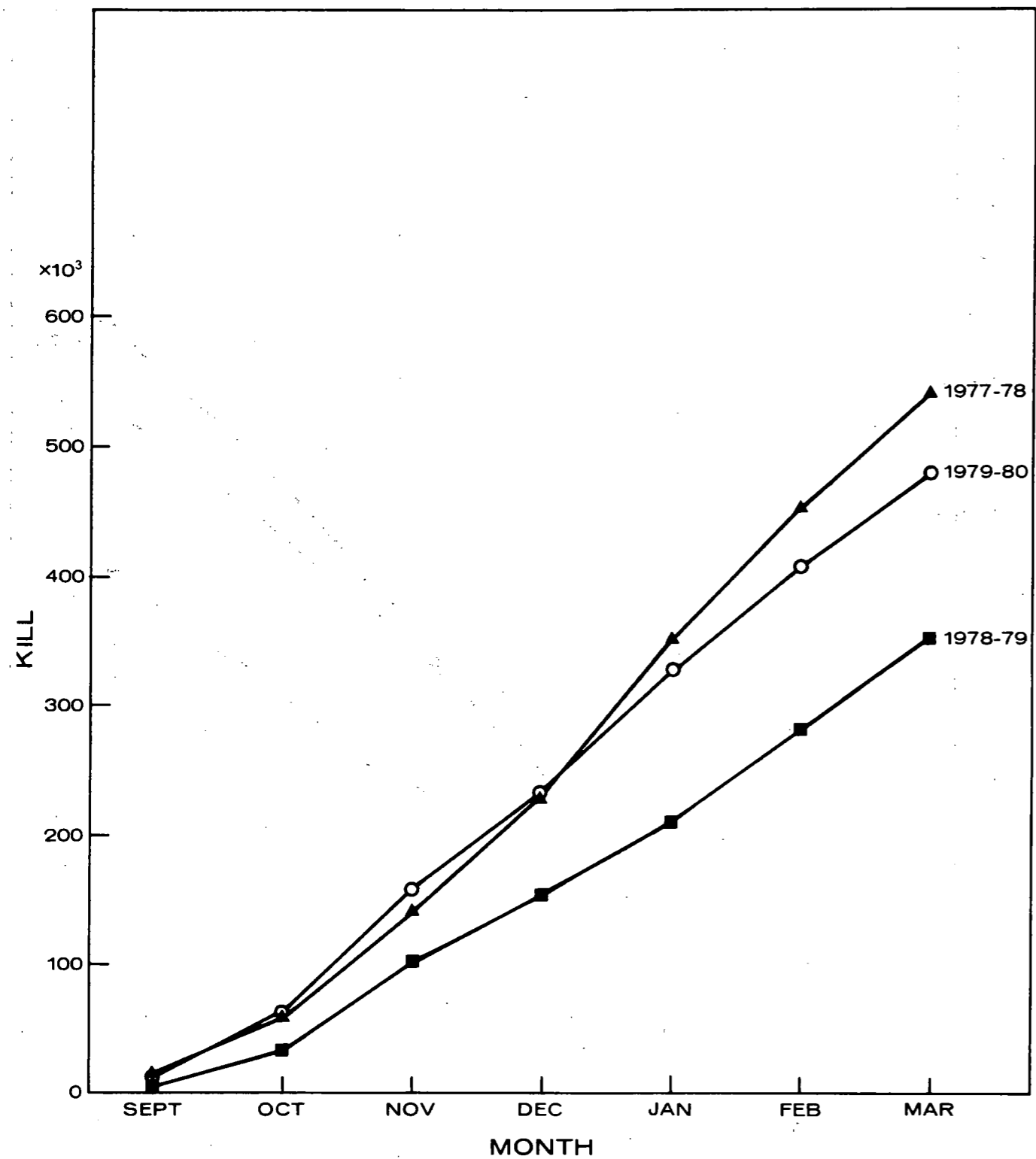


Figure 3
Cumulative seasonal kill of mures in Newfoundland and Labrador, 1977-78 to 1979-80



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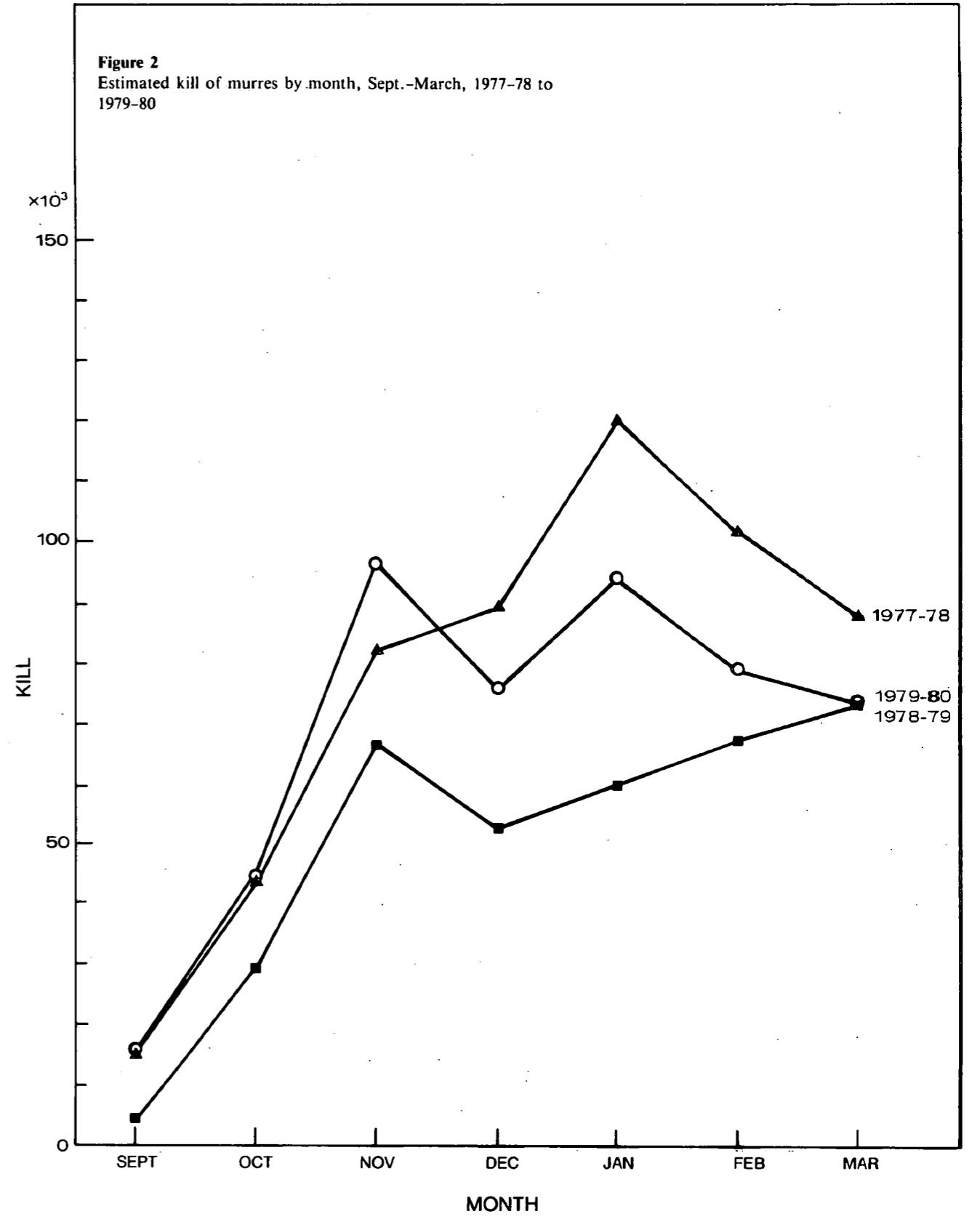


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