BREEDING BIOLOGY AND ECONOMIC POTENTIAL OF AN INLAND-NESTING POPULATION OF THE COMMON EIDER *Somateria mollissima borealis*, IN NORTHERN QUÉBEC

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TABLE OF CONTENTS

LIST OF TABLES AND FIGURES

Page

SECTION I - INTRODUCTION

The northern Québec population of the Common Eider (*Somateria mollissima borealis*) has recently been the subject of a number of studies. In 1980, the Makivik Research Department and the Canadian Wildlife Service conducted a joint survey of the breeding populations of some of the major archipelagos in Ungava Bay (Chapdelaine and Bourget, 1981; Nakashima, Kemp and Murray, 1982). Detailed ecological and geographical information about the Common Eider were also gathered from Inuit hunters in order to make their knowledge of the species available to the scientific community (Nakashima, *in prep*). The present study is the first detailed biological examination of inland breeding colonies. Studies conducted this past summer experimented with various management techniques aimed at enhancing down production and duckling survival.

Local economic development was the main impetus behind the location of the present study site at Qamanialuk and Tasirqjuarosik, two lakes along the west coast of Ungava Bay. This particular area is of interest because of the proximity of its densely-nesting, largely unexploited, population of eiders to the community of Kangirsuk. The area is also of biological interest because of the unusual inland-nesting habit of its breeding population. In addition, information on the breeding biology of the Common Eider in northern Québec is important to answer the demands for appropriate management which are expected to arise in the near future. The present study responds to the multiple demands of management, economic development and scientific interest.

SECTION II - THE STUDY AREA

The study area is located along the west shore of Ungava Bay, Nouveau Québec. It is approximately 16 km northeast of Kangirsuk, the closest community, and directly north of the mouth of the Payne River. It includes two major bodies of water which lie between 15 and 30 m above sea level. The larger and more northerly one is known as Virgin Lake, or as the Inuit refer to it, "Tasirqjuarosik". South of Tasirqjuarosik, and connected to it, by a swiftly running channel of water, is the lake, Qamanialuk. From Qamanialuk the water drains into Kyak Bay via a complex series of intersecting streams and ponds.

Qamanialuk is almost square in outline, measuring about 2 km on each side. It is characterized by the presence of numerous islands, islets, emergent rocks and shallow shoals. Tasirqjuarosik is a much larger and deeper lake. Its islands and islets are fewer and more dispersed. A large island (1.25 x 2 km) almost divides the south end of the lake into two halves. Along its NE-SW axis, the lake measures over 8 km, while its greatest width is 4 km. Two other adjacent lakes, the most southerly of which borders upon the north end of Tasirqjuarosik were also included in the study area. In summer, these lakes are only accessible from Tasirqjuarosik via a series of portages.

For the purposes of this report, the study area was subdivided into three regions: Qamanialuk, Tasirqjuarosik South and Tasirqjuarosik North. The boundaries of these three regions are shown in Figure 1. The Inuit names for these areas will be used for the remainder of this report.

The lands surrounding the lakes are a mixture of poorly-drained willow-sedge bogs, lichen tundra and exposed bedrock. The vegetation of islands usually falls within one of two main types. The first is dominated by moist and lush growths of moss, usually in association with fine and short-cropped grasses, and *Rubus chaemaemorus*. The second type

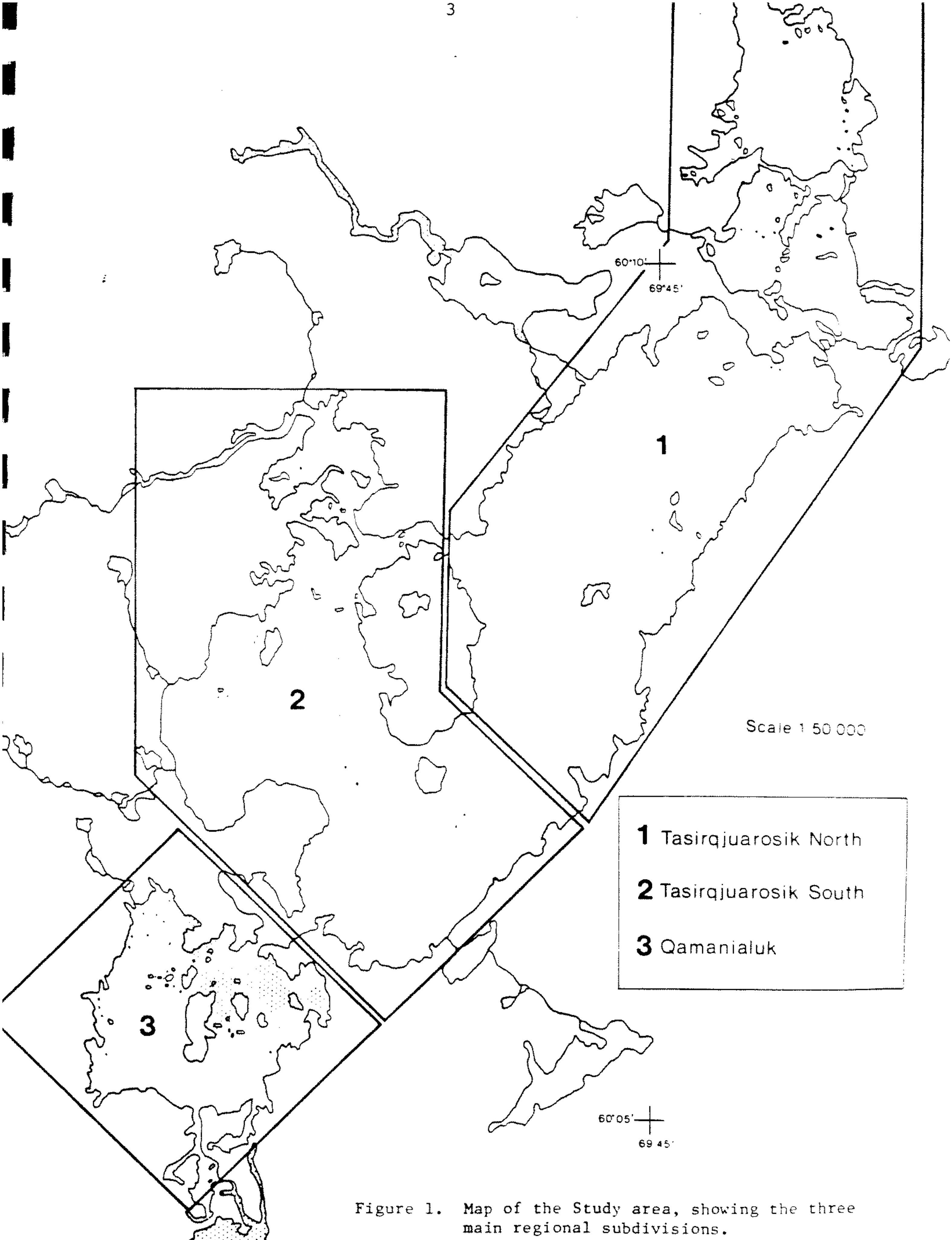

Figure 1. Map of the Study area, showing the three main regional subdivisions.

is lichen-dominated, often with Ledum decumbens, and Salix spp. Islands which are intermediate between the two types also occur, either supporting both vegetation types in varying proportions, or a heavy growth of moss which appears to be in the process of drying-out, and being taken over by lichens. Shorelines and boggy ground which were flooded during spring high-water support dense growths of sphagnum moss.

SECTION III- SURVEY OF THE TASIRQJUAROSIK AND QAMANIALUK COMMON EIDER BREEDING POPULATIONS

(i) Methods

In order to prepare for the appropriate management of the Common Eider population of Tasirqjuarosik and Qamanialuk, and in order to accurately assess the economic potential of the area's eiderdown resources, we require information on the size of the breeding population, its down production and quality, and the distribution and accessibility of its colonies. This information was collected by means of island by island surveys. All surveys were carried out on foot, although in most cases a boat was needed to gain access to the nest islands.

The survey technique was identical to that used during the 1980 Makivik-Canadian Wildlife Service surveys of eider breeding areas in Ungava Bay (Chapdelaine and Bourget, 1981; Nakashima, Kemp and Murray, 1982). Parallel and adjacent transects were walked back and forth across the island until the entire surface area had been covered from end to end. Information was collected on each nest as it was encountered.

Due to the limitations imposed by time and manpower, not all islands could be surveyed in this manner. Upon larger islands (i.e. islands # 89, 91, 92, 144 to 146, 149) (see Fig. 2), when it became apparent that nests were few and of sparse occurence, two parallel lines of survey were walked around the island perimeter (where from past experience we found that most nests tend to occur) and one to four evenly spaced transects were walked across the centre of the island. In this manner, although the entire surface area of the island was not surveyed, it is unlikely that a group of five or more eider nests could have been overlooked. As isolated eider nests contribute relatively little towards the objectives of management and economic development, their localization was of low priority.

Figures 2 and 3 show all the islands that were surveyed in Qamanialuk and Tasirqjuarosik, respectively. Surveyed islands are indicated by identification numbers.

For each nest, information was collected on the nest contents, the nest status and the amount and purity of its down.

Nest status was assigned as follows:

Status 1. Pre-incubation (eggs cold);

Status 2. Incubation (eggs warm);

Status 3. Hatching (at least one egg starred, pipped or cracked, or at least one young);

Status 4. Hatched (nest empty, but condition of remains of egg membrane in nest provide evidence of successful hatching);

Status 5. Fate unknown (empty nest of this year but with insufficient evidence to allow us to assign it to status 4 or 6;

Status 6. Abandoned and consumed by predator, or vice-versa (some evidence of eggs/young having been eaten).

[N.B. Evidence for predation (i.e. status 6) proved difficult to associate with specific nests as gulls (the most common predator) usually carried eggs away from the nest before consuming them. Therefore, the few nests assigned to status 6 were combined with those of status 5.]

Nest down was classified according to relative volume on an increasing scale from 0 to 5. Eiderdown quality or purity was subjectively qualified as A (cleanest) to C (dirtiest). The down of eider nests in volume-quality categories of 3A, 3B, 4A, 4B, 5A and 5B were collected (n=3 for each category except 5A, where n=1) in an attempt to translate these categories into available grams of clean down per nest. The number and status of Herring Gull (Larus argentatus) nests on and in the vicinity of census islands was noted. The results of the gull census are reported in Section VI.

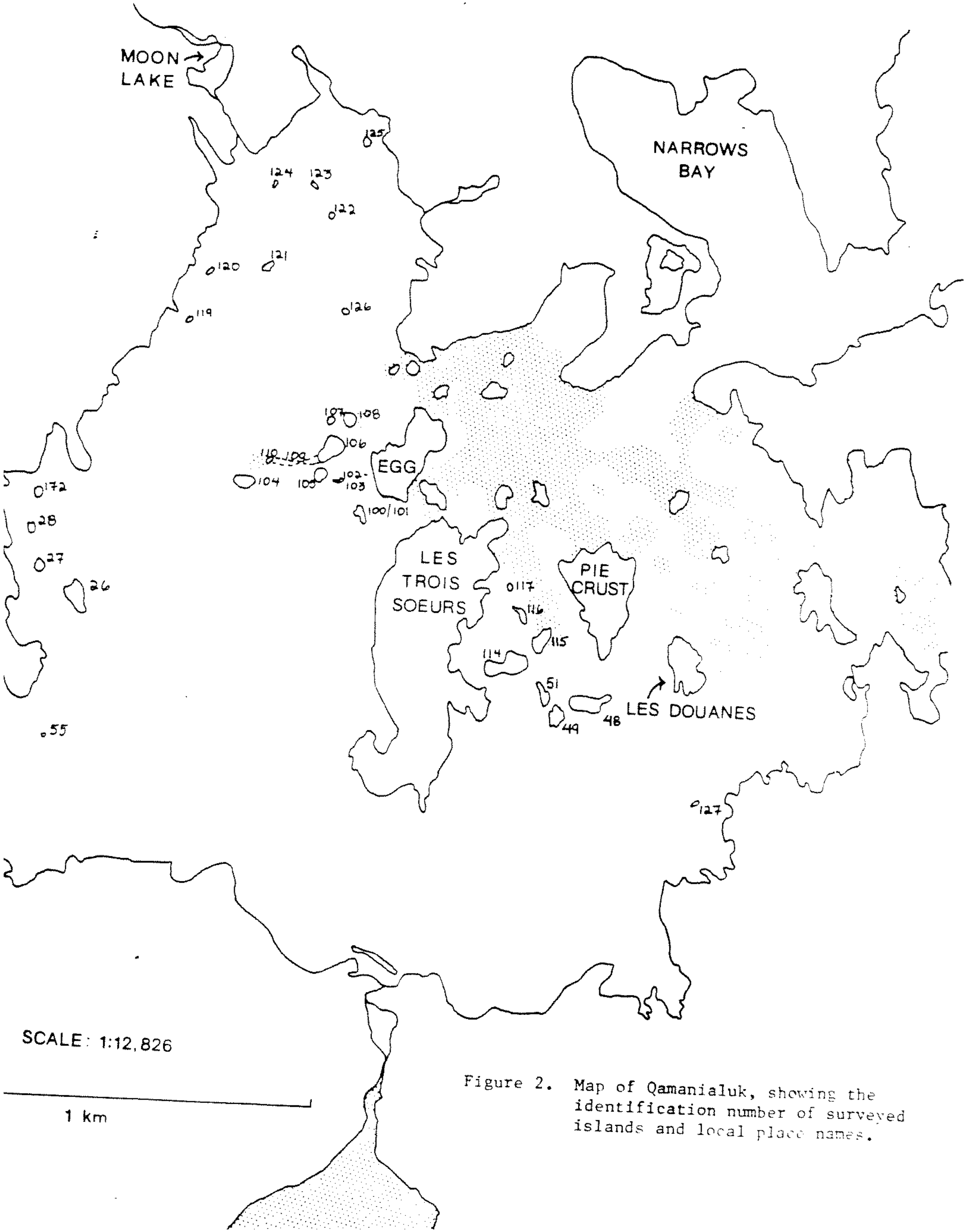

Figure 2. Map of Qamanialuk, showing the identification number of surveyed islands and local place names.

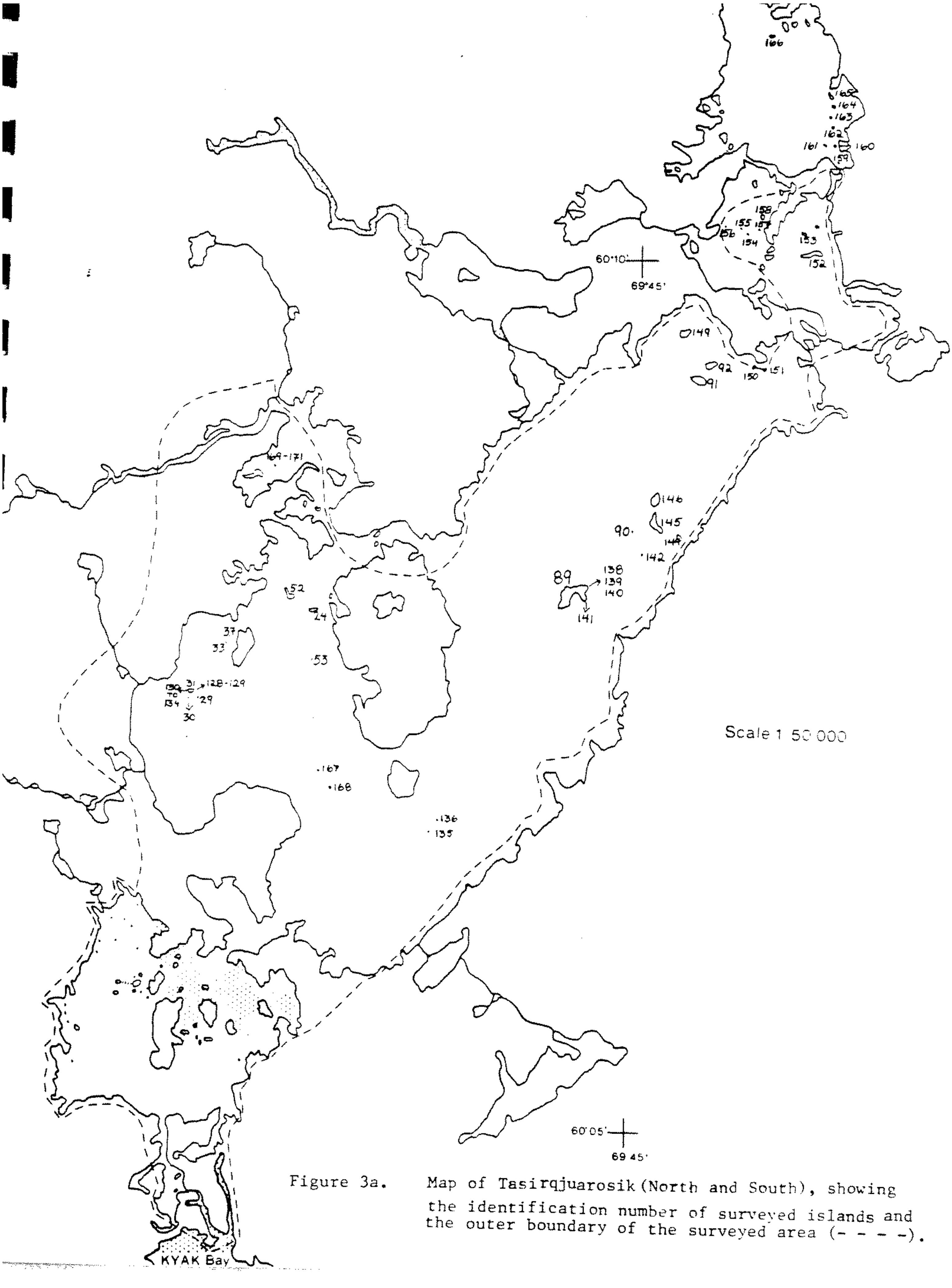

Figure 3a. Map of Tasirqjuarosik (North and South), showing the identification number of surveyed islands and the outer boundary of the surveyed area (- - - -).

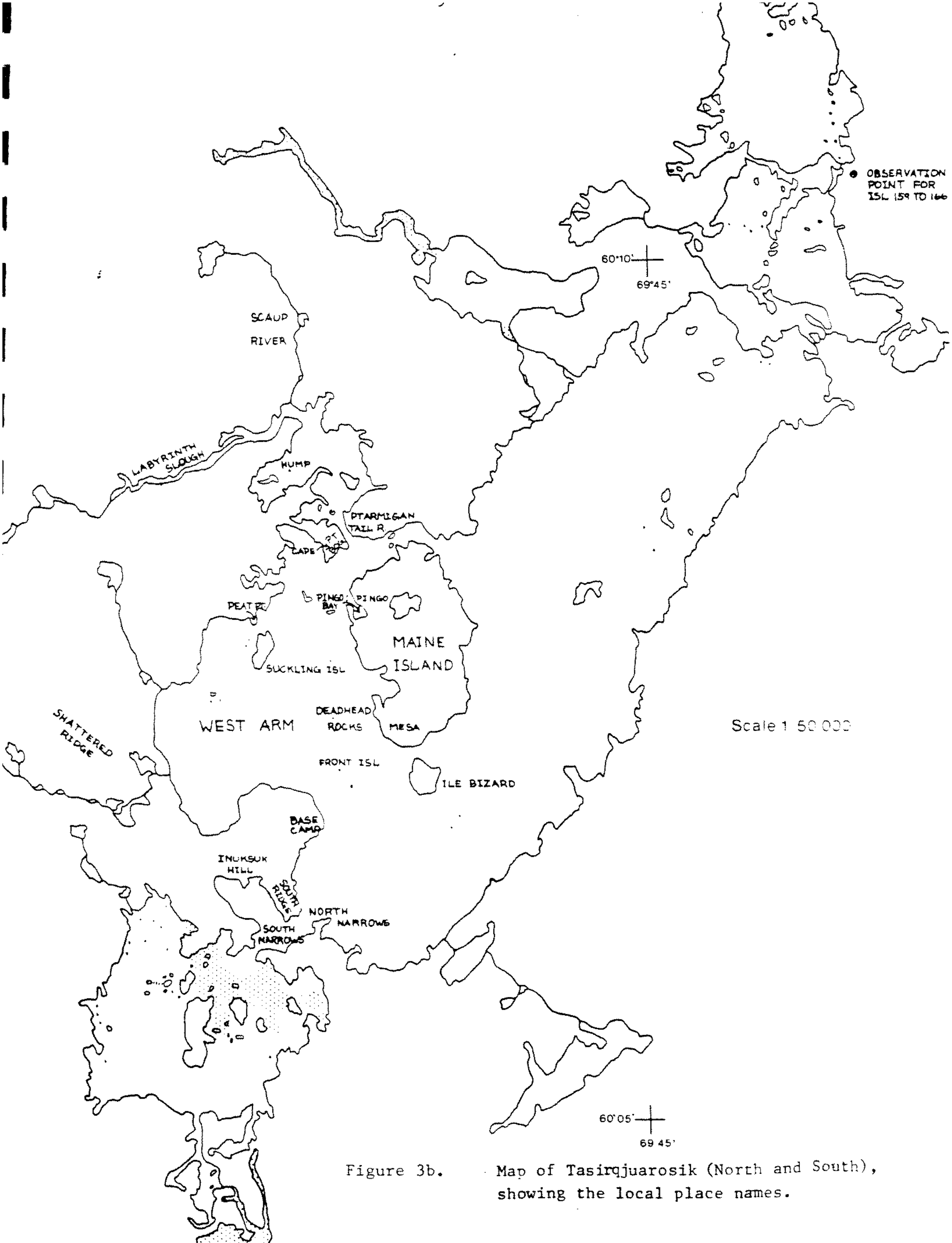

Figure 3b. Map of Tasirqjuarosik (North and South), showing the local place names.

A brief description of island topography and vegetation was made. For all except the very largest islands, a maximum length and width were paced. These measurements, inserted into an elliptical formula, provided an approximation of island area for the very smallest islands. The areas of most islands were determined by measurement from enlarged Geological Survey aerial photographs.

(ii) The Number and Distribution of Breeding Pairs

The survey results for all three regions are presented in Table 1. A total of 1,886 nests were counted in the entire study area. Of the nests that were located, 70.2% contained eggs or young (status 1, 2 or 3), 11.0% contained evidence of having hatched successfully (status 4), and 18.8% were empty and of unknown fate (status 5). In order to determine the actual number of nesting pairs we must correct for the complication of renesting. We have no data on the frequency of renesting. However, as some of the status 5 nests (empty and fate unknown) may represent previous nesting attempts of eider pairs with nests of status 1 to 4 at the time of the survey, eliminating these nests provides us with a minimum count of 1,532 nesting pairs. The actual number of nesting pairs is probably somewhere between these two figures.

A total of 68 islands were surveyed with a total surface area of 119,757 m^2. Of these islands, 15 had no Common Eider nests. No attempt was made to survey all islands in the study area, although it is believed that no major eider breeding sites were missed. Areas where nesting is believed to occur, but which were located beyond the limits of reasonable accessibility to the researchers are discussed in Section III-(v).

Average nest densities of 27.7 nests per island and 0.016 nests per m^2 were calculated from the survey results. As evidence of the clumped distribution of eider nesting, note that five of the 68 surveyed islands

Table I. Results of the breeding survey of Common Eiders and Herring Gulls in Oamanialuk and Tasirqjuarosik, 1982.

	COMMON EIDER						NUMBER OF COMMON EIDER NESTS					HERRING GULL
(a) REGION	(b) SURVEY DATES	(c) NO. OF ISLANDS SURVEYED	(d) AREA SURVEYED (M^2)	(e) TOTAL NO. OF NESTS	(f) $\bar{X}$ NESTS PER ISLAND	(g) $\bar{X}$ NESTS PER M^2	(h) STATUS 1 PRIOR TO INCUBATION (%)	(i) STATUS 2 INCUBATION (%)	(j) STATUS 3 HATCHING (%)	(k) STATUS 4 HATCHED (%)	(l) STATUS 5 FATE UNKNOWN (%)	(m) NUMBER OF NESTS
OAMANIALUK	July 10, 13, 14	28	27,100 $\bar{X}$ = 968	723	25.8	0.027	11 (1.5)	570 (78.8)	20 (2.8)	11 (1.5)	111 (15.4)	58
TASIROJUAROSIK SOUTH	July 9, 16, 19, 21, 22, 24, 25	21	12,415 $\bar{X}$ = 591	798	38.0	0.064	8 (1.0)	494 (61.9)	74 (9.3)	125 (15.7)	97 (12.2)	6
TASIROJUAROSIK NORTH	July 26, 27	19	80,242 $\bar{X}$ = 4223	365	19.2	0.005	0	122 (33.4)	25 (6.8)	71 (19.5)	147 (40.3)	3
ALL REGIONS	-	68	119,757	1,886	27.7	0.016	19 (1.0)	1,187 (62.9)	119 (6.3)	207 (11.0)	354 (18.8)	67

(7.4%) supported greater than 50% of the eider nests. These five islands constitute only 6.6% (7,881 m^2) of the total area surveyed. Mean nest density for these islands was 196 nests per island and 0.30 nests per m^2 (0.07 to 0.85 nests/m^2).

Comparison of survey results for the three regions indicate that in spite of the large size of the area surveyed in the Tasirqjuarosik North region, it supports the least nests, half the number of each of the two more southerly regions. Tasirqjuarosik South and Qamanialuk were found to have 42.3% (798 nests) and 38.3% (723 nests) of the total number of surveyed nests respectively. These figures may be somewhat deceptive as it is believed that a large colony of Common Eiders may exist at the north end of the most northerly lake in the North region. We were unable to gain access to this island (#166) due to the difficulty of portaging a boat to this lake.

The mean number of nests per island differs considerably between regions and between islands within a region. Mean nest per island densities of 38.0, 25.8 and 19.2 were recorded for Tasirqjuarosik South, Qamanialuk and Tasirqjuarosik North respectively (See Table I). Density as nests per m^2 follows a similar pattern with Tasirqjuarosik South having the highest figure of 0.064 nests per m^2, and Qamanialuk and Tasirqjuarosik North following with 0.027 and 0.005 nests per m^2 respectively. The percentage of nests in different status categories also varied between regions. Nests containing eggs or young (i.e. status 1, 2 or 3) accounted for 83.1%, 72.2% and 40.2% of total nests surveyed for the Qamanialuk, Tasirqjuarosik South and Tasirqjuarosik North regions respectively. Naturally, the number of empty nests, whether hatched or of unknown fate, increased in the opposite proportion. These differences are most likely linked to survey date, and not a product of geographic variation in nesting chronology.

(iii) A Comparison between the Survey Results of 1980 and 1982

In 1980, the Makivik Research Department and the Canadian Wildlife Service carried out surveys of Common Eider colonies at a number of localities in Ungava Bay. Although almost all effort was concentrated on the offshore, some of the inland colonies of Tasirqjuarosik and Qamanialuk were censused on July 22, 1980, by members of the Research Department and hunters from Kangirsuk.

Thirteen islands were surveyed that day; 6 in Qamanialuk, 5 in Tasirqjuarosik South and 2 in Tasirqjuarosik North. All of these islands were resurveyed in 1982. Confusion in the 1980 data makes us uncertain that we have correctly identified islands # 25, 29 and 30. All other islands were correctly identified with the aid of maps and photographs of the islands taken in 1980 and 1982.

The 1980 and 1982 survey results for these 13 islands are presented together in Table 2. From the data, we can see that relative to 1980, almost twice as many nests were counted in 1982. Two conclusions can be drawn from the data; a) the disparity between the two data sets is a real one and therefore the eider population of the study area is substantially greater in 1982 than it was in 1980 or b) the disparity between the data is an artifact of differing survey methods.

Population increase in the study area, though difficult to substantiate, is an interesting issue. Firstly, Inuit hunters have described a distribution shift in nesting Common Eiders. It is believed that, in some areas, disturbances in the vicinity of offshore nest colonies have encouraged an increasing number of eiders to shift their nest sites from offshore islands to inland ones (Nakashima, *in prep.*). It would be interesting to be able to document this change.

Secondly, Inuit are aware that the numbers of breeding eiders have been locally augmented elsewhere (e.g. Ile Bicquette, Québec; Iceland).

Table II - Survey results for islands surveyed in both 1980 and 1982, Qamanialuk and Tasirqjuarosik.

ISLAND NUMBER	1980 SURVEY DATE	1980 # NESTS STATUS 1 to 3	1980 # NESTS STATUS 4	1980 # NESTS STATUS 5	1980 TOTAL # OF NESTS	1980 TOTAL # OF EGGS/Y	1982 SURVEY DATE	1982 # NESTS STATUS 1 to 3	1982 # NESTS STATUS 4	1982 # NESTS STATUS 5	1982 TOTAL # OF NESTS	1982 TOTAL # OF EGGS/Y
QAMANIALUK												
25*+	July 22	9	17	5	31	25	July 10	62	0	13	75	171
26	July 22	23	36	41	100	60	July 14	261	5	40	306	624
27	July 22	1	NA	NA	1	3	July 14	26	1	9	36	60
28	July 22	12	8	NA	20	6	July 14	30	1	2	33	86
55 ≠	July 22	NA	NA	NA	16	NA	July 14	35	3	0	38	101
127 ≠	July 22	NA	NA	NA	19	NA	July 14	10	1	2	13	22
TASIROJUAROSIK SOUTH												
29*	July 22	18	NA	NA	18	51	July 19	0	0	0	0	0
30*	July 22	30	NA	NA	30	27	July 19	5	1	0	6	20
31	July 22	30	45	2	77	30	July 19	11	1	2	14	37
52	July 22	70	31	7	108	93	July 16	118	0	23	141	405
53	July 22	92	48	1	141	293	July 16	226	1	21	248	781
TASIROJUAROSIK NORTH												
150	July 22	9	NA	NA	9	30	July 26	11	22	6	39	51
151	July 22	9	25	1	35	29	July 26	41	17	19	77	130
TOTAL					605						1,026	

* Correspondance between the identification of these islands for 1980 and 1982 is not certain.
≠ 1980 count from helicopter hovering over the island.
\+ Island #25 (1980) is equal to #100/101 in the 1982 data set.

Qamanialuk and Tasirqjuarosik, due to their relative inaccessibility to hunters in summer, have been considered by the community as potential sites for such a program of local enhancement. Any increase in breeding numbers would be a welcome sign that such a program might prove successful.

Unfortunately it is difficult to substantiate that the difference in numbers between the 1980 and 1982 counts is real. Close examination of the two data sets makes it apparent that incomplete data collection in 1980 precludes the possibility of straightforward comparisons with the 1982 data. In 1980, on 7 of the 13 islands, only the number of nests with eggs or young were recorded (Table II). The lateness of the survey date (July 22) suggests that many nests would be empty, having successfully hatched. The failure to include "hatched" (status 4) and "fate unknown" (status 5) nests in the nest count for these seven islands probably accounts for a large part of the disparity between the 1980 and 1982 nest counts. Furthermore, on high density nest islands such as #53, the concentrated activity of many eiders in a small area soon destroys evidence of status 5 nests. Therefore, even though an effort was made to collect this data, a late survey as in 1980, would tend to underestimate the number of status 5 nests.

Although disparities in data collection technique forego a direct comparison of the 1980 and 1982 data, it is encouraging that there is correspondence between the relative size of island colonies within each data set. If nothing else, this fact suggests that there exists a stability between years in the intensity of use of any particular island.

Finally, although an inland shift of Common Eiders may be evident in some areas of northern Québec, one Inuk who participated in the 1980 counts, and who has been familiar with the Qamanialuk/Tasirqjuarosik region since childhood, was of the opinion that 1980 breeding numbers were less than they were when he was young (25 to 30 years ago).

(iv) The Local Potential for Eiderdown Harvesting

Eiderdown is one of the primary reasons for interest in the study area. The Kangirsuk Inuit are considering an increase in down harvesting activities for this area in the near future. They have also considered encouraging the growth of the local population of eiders to increase eiderdown production.

In this study, an assessment was made of the present production of eiderdown in Qamanialuk and Tasirqjuarosik. The eiderdown of each nest was classified into one of 6 categories of down volume (from 0 to 5) and one of three categories of down purity (A to C). Three quarters of the nests surveyed contained sufficient down to be classified in the upper three volume categories (1,427 nests out of 1,886). Of these nests, 75.1% (1,072) were considered to be of purity A and B (see Table III).

Nests of down volume "0" or "1" are of little use as a source of eiderdown. These nests constituted 10% (190 nests) of the total nests surveyed. Volume "2" nests are marginal in their usefulness. They contributed another 13.9% (262 nests) to the total number of nests surveyed.

Qamanialuk and Tasirqjuarosik South had a larger percentage of volume "3", "4" and "5" nests, than did Tasirqjuarosik North. For the former two areas, these nests represented 73.8 and 85.5% respectively of the total nests in each area. In contrast, in the Tasirqjuarosik North region, only 57.8% of the nests had down volumes greater than or equal to "3" (Table III).

The down categories for volume and cleanliness are subjective and defined relative to one another. In an attempt to quantify these categories, nest samples were collected for each of the upper 3 down volumes and upper two purity categories (i.e. 3A, 3B, 4A, 4B, 5A and 5B).

Table III - Regional breakdown of the number of nests in eiderdown volume and purity classes. Oamanialuk and Tasirqjuarosik, 1982.

Volume Class / Quality	0	1 a	1 b	1 c	2 a	2 b	2 c	3 a	3 b	3 c	4 a	4 b	4 c	5 a	5 b	5 c	Un-classified	Total
OAMANIALUK		0	2	56	19	20	76	130	84	107	103	58	30	16	3	3		
# of nests (%)	16 (2.2)	58 (8.0)			115 (15.9)			321 (44.4)			191 (26.4)			22 (3.0)			0	723
TASIROJUAROSIK SOUTH		1	1	35	4	8	53	78	108	98	170	104	43	49	23	9		
# of nests (%)	7 (0.9)	37 (4.6)			65 (8.1)			284 (35.6)			317 (39.7)			81 (10.2)			7	798
TASIROJUAROSIK NORTH		0	0	71	1	5	76	23	39	37	55	17	27	3	9	1		
# of nests (%)	1 (0.3)	71 (19.5)			82 (22.5)			99 (27.1)			99 (27.1)			13 (3.6)			0	365
TOTAL		1	3	162	24	33	205	231	231	242	328	179	100	68	35	13		
# of nests (%)	24 (1.3)	166 (8.8)			262 (13.9)			704 (37.3)			607 (32.2)			116 (6.2)			7 (0.4)	1,886

Down samples were air-dried and then cleaned by hand using the traditional lyre-like cleaning rack which is strung taut with parallel strands of string or sinew. Although an effective means of cleaning down, the end product is probably somewhat less clean than that produced by commercial down-cleaning methods. In Iceland, cleaning by machine is followed by tedious removal of feathers by hand. We do not know how much down weight would be reduced by further cleaning, but we believe it to be insignificant.

The uncleaned and cleaned weights of the down samples (n=16) are presented in Table IV. The mean weight of cleaned eiderdown product for nests of volume categories 3, 4 and 5, are 6.4 gm, 10.7 gm and 14.4 gm respectively. If we weight these figures for down production per nest by the number of nests in each category, we arrive at a mean production of clean eiderdown of 9 gm per nest (considering only nests of down volumes 3 and greater, i.e. 75% of total nests).

Figures from other sources provide the following estimates of cleaned down production per nest. Hyman (1982) quotes a figure of 13.0 gm of cleaned down per nest for Iceland. For the St. Lawrence, Bédard (pers. comm.) suggests the lower figures of 8-10 gm per nest.

Combining our down production figures with our census results, we obtain an estimated yield of 12.7 kg of cleaned eiderdown for the study area. At $400 per kilogram, the market value of the cleaned product would be $5,000. Down production can be increased in a number of ways. Aside from increasing the number of nests, down can be collected earlier in the incubation period. This would result in a cleaner product with less losses of matted down during cleaning. Cooch (1965) provides an extensive discussion of eiderdown collection techniques and suggests other ways to maximize clean down production without excessively disturbing the colony. Colony disturbance affects clean down production as each time the females are flushed from the nest they may contaminate the down with excretions. In Iceland, down is collected twice, early and late in the incubation period (Hyman 1982). This may not be a good

Table IV

Uncleaned and cleaned weights of elderdown samples collected from colonies in Tasirqjuarosik and Qamanialuk, July 1982

DOWN QUANTITY & QUALITY	COLLECTION DATE	ISLAND NUMBER	DOWN WEIGHT PRIOR TO TO CLEANING (GMS)			DOWN WEIGHT AFTER CLEANING (GMS)				
			DIRTIEST 1/3 *	CLEANEST 2/3 *	TOTAL	DIRTIEST 1/3 *	CLEANEST 2/3 *	TOTAL	MEAN WEIGHTS	
3A	July 24	32	22.2	30.7	52.9	2.3	9.4	11.7	9.2	6.4
3A	July 24	32	39.3	57.3	96.6	1.8	6.6	8.4		
3A	July 27	151	22.4	42.9	64.3	2.1	5.4	7.5		
3B	July 24	32	12.6	33.7	46.3	0.3	2.9	3.2	3.6	
3B	July 24	32	9.5	40.6	50.1	0.3	2.9	3.2		
3B	July 27	151	23.2	61.5	84.7	1.2	3.2	4.4		
4A	July 24	32	29.7	41.7	71.4	2.0	6.8	6.8	9.7	10.7
4A	July 24	32	26.4	48.2	74.6	0.2	5.8	6.0		
4A	July 27	151	38.5	90.6	129.1	5.4	10.85	16.3		
4B	July 27	151	44.5	102.1	146.6	3.2	5.8	9.0	11.0	
4B	July 27	151	40.2	63.8	104.0	2.7	8.35	11.1		
4B	July 27	151	69.6	107.2	176.8	4.6	8.35	13.0		
5A	July 27	150	57.1	96.2	153.3	4.9	8.4	13.3		14.4
5B	July 27	150	64.5	122.4	186.9	4.6	12.8	17.4	14.8	
5B	July 27	151	54.8	97.0	151.8	3.7	7.8	11.5		
5B	July 28	53	82.6	205.4	287.0	5.1	11.4	15.5		

* Each elderdown sample was roughly subdivided according to cleanliness such that the dirtiest 1/3 of the sample was weighed and cleaned separately from the cleanest 2/3.

strategy in northern Québec where the birds are less tame. It may increase the frequency of nest desertion during the incubation period, may encourage the abandonment of ducklings unprepared to leave the nest once hatching has begun and may increase nest predation. On Ile Bicquette where the eiders are less tame than in Iceland, the Thibeaults collect down only once, at mid-incubation (Bruemmer 1979).

(v) Eider Colonies in Areas Adjacent to the Surveyed Area

It is believed that the above surveys included all of the major eider nesting areas existing in the study area. Solitary nests and nesting groups of less than or equal to five nests were found at various scattered locations including mainland sites (Narrows Bay (3); North Narrows (1); north of the Egg (1)) and sites on larger islands (Suckling Island (4 + 1)). No doubt many other isolated nests went undiscovered. Nevertheless for the purposes of management and eiderdown harvesting these isolated nests were not considered to be of great significance.

Observations made during the course of the summer suggest that other nesting areas do exist in areas adjacent to those surveyed. The most promising nest area, briefly mentioned earlier is located at the most northerly end of the Tasirqjuarosik North region. This group of islands, labeled # 166, was not surveyed. However, on July 27, 1982, during a visual inspection of the area from a ridge at 60°11'N, 69°42'W, a helicopter flushed some eiders, while it hovered over the island group at an altitude of about 20 metres. Although we were at a distance of 1.9 km SSE of #166, we were able to observe, with the aide of spotting scopes, that at least four females flushed from the islands and another group of at least 15 females flew around them. These islands appeared to be very lush green, and at least from a distance, resembled surveyed islands that supported many nests. It is also noteworthy that by this date (July 27), the majority of the nesting females would have already left the nest area. Surveys on July 26 and 27 in this same region, indicated that at this time, almost 60% of nests of the year are empty.

Consequently, the number of eiders actually nesting on island #166 could have been substantially greater than the few that we saw.

Another unsurveyed area that may support nesting eiders, is Moon Lake and other lakes in its vicinity. Moon Lake drains into the northwest corner of Qamanialuk. Pairs of Common Eiders were observed flying inland along the Moon Lake drainage, and on a few occasions drakes were visible on and about a small island towards the north end of Moon Lake. A survey in the summer of 1983 has since shown that no eiders nest on this lake.

Finally, observations on June 16 from a promontory north of islands number 169 to 171, and north of Labyrinth slough (60°9'N, 69°50'W) revealed individual pairs of Common Eiders flying north along the drainage of Scaup River. No more than three pairs were seen, and they continued north until lost from sight. Other than this suggestion that Common Eiders are nesting inland along Scaup River, we have no other indication of where and to what extent, eiders are nesting in this part of the Tasirqjuarosik region.

This is the full extent of our knowledge of Common Eider nesting in the study area. Inuit hunters have informed us of another lake along the seacoast, which supports a large number of eider colonies. It is located approximately 4 km due east of the most northerly lake in the Tasirqjuarosik North region (60°11'N, 69°37W). Unfortunately, we did not have an opportunity to investigate this area.

SECTION IV - NEST SUCCESS AND EGG HATCHING SUCCESS

(i) Methods

Islands #52, 53 and 100/101 were selected for detailed study of breeding success. Islands number 52 and 53 are located in the Tasirqjuarosik South region, immediately west of Maine Island. Island 100/101 is a small island in Qamanialuk which was initially divided into two by the high waters of the spring run-off (thus the double identification number). It is located almost due south of the observation post named "The Egg" (Fig. 2).

Nest and egg success were determined by means of regular nest checks on each of these islands. Nests were individually identified by placing small numbered rocks to one side of the nest basin. This identification system allowed us to keep track of the fate of each nest on an island. The eggs within each nest were also individually marked in order to allow us to detect, during subsequent visits, whether new eggs had been added to the nest, or marked ones lost. Eggs were initially tagged with either graphite (pencil) marks or white paint dots applied to the surface of the egg. Neither of these methods proved very durable. This problem was resolved with the use of a permanent felt pen marker. Small numbers were written on the large end of the egg. Although some marks required touching-up after a period of two weeks in the nest, they rarely disappeared so completely as to lead to misidentification. No deleterious effect of the marker upon the survivorship of eggs was discernable, although no systematic study of the matter was made. Experiments by David Bird (pers. com.) in which substantial portions of the surface of chicken eggs were colored with felt markers, revealed no harmful effects.

The schedule of nest checks for each of the three islands appears in Table V. Between 8 and 10 checks were made on each island during the nesting stage of the breeding cycle. The interval of time between nest

Table V - Nest and egg hatching success data from serial nest checks of islands #52, 53 and 100/101. Qamanialuk and Tasirqjuarosik, 1982.

		NEST SUCCESS			EGG SUCCESS				
(a) ISL #	(b) DATES OF NEST CHECK	(c) NO. OF NESTS [1]	(d) NESTS HATCHED (%)	(e) NESTS HATCHED & HATCHING (%)	(f) NO. OF EGGS [1] LAID	(g) NO. OF EGGS LOST	(h) NO. OF EGGS OF FATE UNKNOWN	(i) HATCHED EGGS (%)	(j) HATCHED & HATCHING EGGS (%)
52	Je 23 Jy 3, 4, 9, 16, 21, 24, 29,	129	84 (65.1)	89 (69.0)	439	94	46	283 (64.5)	299 (68.1)
53	Je 22, 24, 28 Jy 4, 5, 9, 16, 21, 28	207	145 (70.0)	157 (75.8)	833	199	64	527 (63.3)	570 (68.4)
100/101	Je 25, 26, 30 Jy 6, 10, 15, 18, 23, 31	71	40 (56.3)	42 (59.2)	214	93	8	106 (49.5)	113 (52.8)
TOTAL	-	407	269 (66.1)	288 (70.8)	1,486	386	118	916 (61.6)	982 (66.1)

[1] This total excludes data from nests containing one or more eggs which were not hatching at the time of the last nest check. This total is a minimum as we were unable to account for nests initiated and destroyed (col. c) or eggs laid and lost (col. f) between consecutive nest checks.

checks varied between one and ten days with a mean of 4.7 days. Ice conditions during breakup proved to be a particularly troublesome, but not insurmountable, obstacle to maintaining regular nest checks.

Nest check procedure was as follows. Previously marked nests were examined one by one in order to determine their contents. If eggs were present we noted whether or not they were covered with down and/or nest material, and whether or not they were warm. The identification number of marked eggs was noted. New eggs received new identification numbers. Once hatching had begun, we noted the condition of hatching eggs, or the presence of young.

(ii) Nesting Success

A nest was considered to have successfully hatched if we could find evidence that at least one of the eggs in the nest check had hatched. An inner egg membrane that is easily detachable from the shell is considered to be characteristic of an egg that has hatched. Thus, if we found pieces or a whole egg membrane in this condition, nearby or within the nest, we considered that nest to have hatched. For the purpose of this section of the report, if at least one duckling was found in the nest, this also was considered a hatched nest. A nest with at least one egg starred, pipped or cracked, was considered to be "hatching".

Of a total of 465 Common Eider nests initiated on the three islands, 55 nests were still in the incubation stage at the time of the last nest check. Nest checks and banding activities are known to have caused abandonment of three other nests. These 58 nests are excluded from the following calculations. Of the remaining 407 nests, 66.1% (269 nests) hatched successfully, and another 4.7% (19 nests) were observed hatching but could not subsequently be confirmed as hatched. Nest success (% nests hatched) for the three islands were 56.3% for Island #100/101, 70.0% for Island #53, and 65.1% for Island #52. If we expand the definition of successful to include all nests that reached hatching stage, the nest success rate increases to 59.2%, 75.8% and 69.0% respectively (Table V).

(iii) Egg Hatching Success

Hatching success can be assessed by nest (the percentage of initiated nests that produce at least one offspring) or by egg (the percentage of total eggs laid that hatch successfully).

The fate of individual eggs was judged in the following manner. Eggs that disappeared from a nest before the completion of a normal incubation period (25 days) were considered to be lost or unsuccessful. Signs of predation or observed predation events also allowed us to designate eggs as lost. After the completion of 25 days of incubation, eggs that disappeared from the nest without leaving evidence of having hatched, were classified as "fate unknown". Finally, starred, pipped or cracked eggs were classified as hatching, and an egg was hatched if a duckling was found in the nest. Although an effort was made to judge the fate of each egg individually, this was generally not possible when determining whether eggs had hatched. Ducklings were not often found in the nest. Therefore, if evidence was found to indicate that at least one egg had hatched from a nest, then all eggs present in the nest at the time of the previous nest check, were considered to have hatched.

Egg success rates for 439 eggs on Island number 52 (excluding 31 eggs which were laid in nests with at least one egg remaining unhatching at the last check) are 64.5% successfully hatched, and 68.1%, if we also include those observed to be hatching. Island 53 exhibited almost identical success rates for its 833 eggs (excluding 173 eggs), with 63.3%, having hatched and 68.4%, hatched and hatching. Hatching rates for Island 100/101 were considerably lower. Of its 214 eggs (excluding 5 eggs), 49.5% successfully hatched, and 52.8% either hatched or hatching (Table V).

(iv) Discussion

There is considerable variation in Common Eider hatching success elsewhere in the world. Colonies in the St. Lawrence estuary successfully hatched between 14.4% and 52% of eggs laid (Milne and Reed, 1974). On West Spitsbergen, Ahlen and Anderssen (1970) documented a hatching success of 27%. Hatching success was very high in the Cape Dorset area of Baffin Island, where 76.6% and 85.5% of laid eggs hatched in 1955 and 1956, respectively (Cooch, 1965). Our results for Qamanialuk (48.5%) and Tasirjuarosik (63.7%) fall in the middle and upper portions of this range of values.

In those areas where the degree of nest concealment varies due to the presence or absence of vegetation, and the nature of this vegetation, hatching success has been found to vary directly with nest cover (Milne 1974; Milne and Reed 1974; Choate 1967). Open, grassy islands in the St. Lawrence estuary had hatching success rates of only 14.4% and 15% (Milne & Reed 1974). At the Sands of Forvie Reserve, Scotland, hatching success rates in short heather and grassy sites averaged 41.7% (vs. 87.1% at other sites with more cover). The high nest success of the West Foxe Islands, near Cape Dorset, must be in part due to the fact that 90% of eider nests were sheltered by rocks. Only 10% were in open grassy sites (Cooch 1965). All nests on the three study islands of the present study were completely exposed, being situated on flat islands covered with short cropped grass or moss. Considering the exposure of the nest sites, the success rates are impressive.

The building of stone or other types of shelters at Tasirqjuarosik/Qamanialuk colonies, may be a means to increase hatching success. Edwards (in Cooch 1965) and Houston (in Cooch 1965) have reported local increases in the number of nesting eiders in response to the erection of stone shelters at Payne Bay and Cape Dorset, respectively.

Milne and Reed (1974) also attribute differences in hatching success on islands in the St. Lawrence to differences in the density of breeding gulls. In our study, island 100/101 had the lowest hatching success. It differed from islands 52 and 53 in that it was located in the Qamanialuk region where 86.6% of all gull nests occurred. It supported two Herring Gull nests, with two others located within 100 meters of its shore. Only one gull nest occurred in the vicinity of each of the islands 52 and 53.

Duckling production for each region can be calculated by combining our egg success and our census data. Assuming that the eider colony on island 100/101 is representative of the colonies in Qamanialuk, we obtain an average egg production per nesting attempt of 3.05 eggs/nest (total eggs ÷ number of nests). Total egg production for the region is therefore 2,205 eggs (3.05 eggs/nest x 723 nests). The hatching success rate for the 100/101 colony was 49.5%. Therefore we expect a total duckling production for the Qamanialuk region of 1,091 ducklings (2,205 eggs x 0.495).

For the Tasirqjuarosik region, using islands 52 and 53 as examples, average egg production per nest was 3.78 eggs/nest. Total egg production for the region is therefore 4,396 eggs (3.78 eggs/nest x 1,163 nests). The hatching success rate for islands 52 and 53 was 63.7%. Therefore total duckling production for the Tasirqujuarosik region was 2,800 ducklings (4,396 x 0.637).

Duckling production for the entire study area is 3,891 ducklings. Keep in mind that this represents the estimated number of ducklings that successfully hatch. It does not include mortality once the duckling has left the nest. These 3,891 ducklings are the product of between 1,532 and 1,886 eider pairs, yielding a production of between 2.1 and 2.5 ducklings per eider pair. The exact number of eider pairs remains unknown as we do not know the frequency of renesting (see page 9). Duckling production per nest or pair has been measured in other areas. In the St. Lawrence estuary, on open and wooded islands, only 0.5 to 1.3 ducklings were produced per nest, respectively (Milne and Reed, 1974). In northeast Scotland, 2.6 ducklings were produced per nest (Milne 1974) and at Spitsbergen this figure was 1.9 ducklings per nest (Ahlen and Andersen 1970).

SECTION V - THE RESPONSE OF EIDERS TO COLONY DISTURBANCE

In order to minimize predation, encourage population growth and maintain eiderdown quality, it is important to minimize disturbance at eider nest colonies. By developing an understanding of the response of eiders to disturbance, we can learn how best to minimize its negative effects. Subsequent to each nest check on islands 52, 53 and 100/101, we documented the return rate of eiders to the nest island. In this way, we hoped to document changes in response to disturbance (colony visits) at different stages of the breeding cycle.

Nest checks were carried out at intervals of one to 10 days, with a mean interval of 4.7 days. The time of arrival upon and departure from the colony islands was recorded. Time spent on the island varied between 40 and 180 minutes. Upon departure from the island, we moved to a point at least 150 metres away from the island and periodically recorded the number of males and females present on the island and the time. These counts were compared to a count made immediately prior to each nest check. Thus the number of eiders on the nest island at different times subsequent to the disturbance was expressed as a percentage of the number present before the nest check. These results are presented in Table VI and Figure 4.

Casual observations of eider behaviour revealed to us that during the egg-laying and early incubation period all eiders left the island during our approach and took much longer to return than during the mid and late incubation period. By the end of June, some female eiders had become so reluctant to leave their nests that they would remain on the nest island well after we had begun the nest check. On June 28, female eiders had returned to the nest island within 4 minutes of our departure. After June 30 we noted that females were returning to the nest islands even while we were still on the island.

Table VI

The response of nesting elders to disturbance:
numbers present at the nest colony before,
and at various time intervals after nest checks

OBSERVATION DATE	NO. OF EIDERS PRIOR TO DISTURBANCE	TIME INTERVAL AFTER DISTURBANCE (MINUTES)														
		3	4	5	6	7	8	9	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49
		NO. OF EIDERS PRESENT AFTER DISTURBANCE (% OF EIDER NUMBERS PRIOR TO DISTURBANCE)														
June 16[1]	23	-	-	-	-	-	-	-	-	2 (8.9)	7 (30.4)	-	6 (26.1)	-	-	-
June 18[1]	2	-	-	-	8 (400)	-	-	-	3 (150)	4 (200)	6 (300)	-	4 (200)	-	-	-
June 22[1]	143	2 (1.4)	-	-	-	-	-	-	24 (16.8)	50 (35.0)	50 (35.0)	-	-	-	-	-
June 23[2]	46	-	2 (4.3)	3 (6.5)	-	-	-	-	15 (32.6)	23 (50.0)	-	24 (52.2)	26 (56.5)	-	-	-
June 24[2]	41	3 (7.3)	-	18 (43.9)	-	-	-	28 (68.3)	28 (68.3)	-	43 (105.0)	-	-	-	-	46 (112.0)
June 28[1]	180	-	-	-	-	-	-	-	-	92 (51.1)	-	122 (67.8)	117 (65.0)	-	121 (67.2)	-

1. Observations made on Island 53.
2. Observations made on Island 52.

Although our casual observations revealed striking differences in eider behaviour, our attempt to quantify these changes by documentation of return rates met with limited success. Considering islands 52 and 53, counts on June 16, 22, 23, 24 and 28* revealed that the maximum numbers of eiders returning to the island within 30 minutes of our departure was 30.4%, 35%, 56.5%, 105% and 65%, respectively, of our pre-disturbance counts. The increasing slopes of the plotted lines in Figure 4 demonstrate this increase in return rate over time. Unfortunately, the breakup of ice around islands 52 and 53 prevented us from continuing these observations as it was not possible to make counts using a spotting scope in a floating boat.

Return rate observations for island 100/101 began later (June 25) and were too sporadic to be of use. Nevertheless, casual observations suggest to us that these eiders behaved in a similar manner to those on islands 52 and 53. By June 30, the eiders of island 100/101 were exhibiting a strong attachment to their nest sites. Prior to the nest check, on that date, 80 Common Eiders (49 ♀♀ and 31 ♂♂) were present. Within seven minutes of our departure from the island, 76 eiders (54♀♀ and 22 ♂♂) had returned.

At the beginning of the nesting period, females and drakes returned to the nest island at about the same rate as most females were continually accompanied by one or more males. As the season progressed and the time of the drake moult approached, the return rate of drakes diminished while that of females remained high.

The increase in nest site tenacity as the breeding season progresses is a generally accepted fact for all duck species, including the Common Eider. It is important to take this factor into consideration when developing a strategy for eiderdown exploitation. Population increase (either by growth or immigration) is desirable as a means of increasing down production. One means of accomplishing this increase is

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* The data for island 53 on June 18 is excluded as only two eiders were present on the island before the nest check.

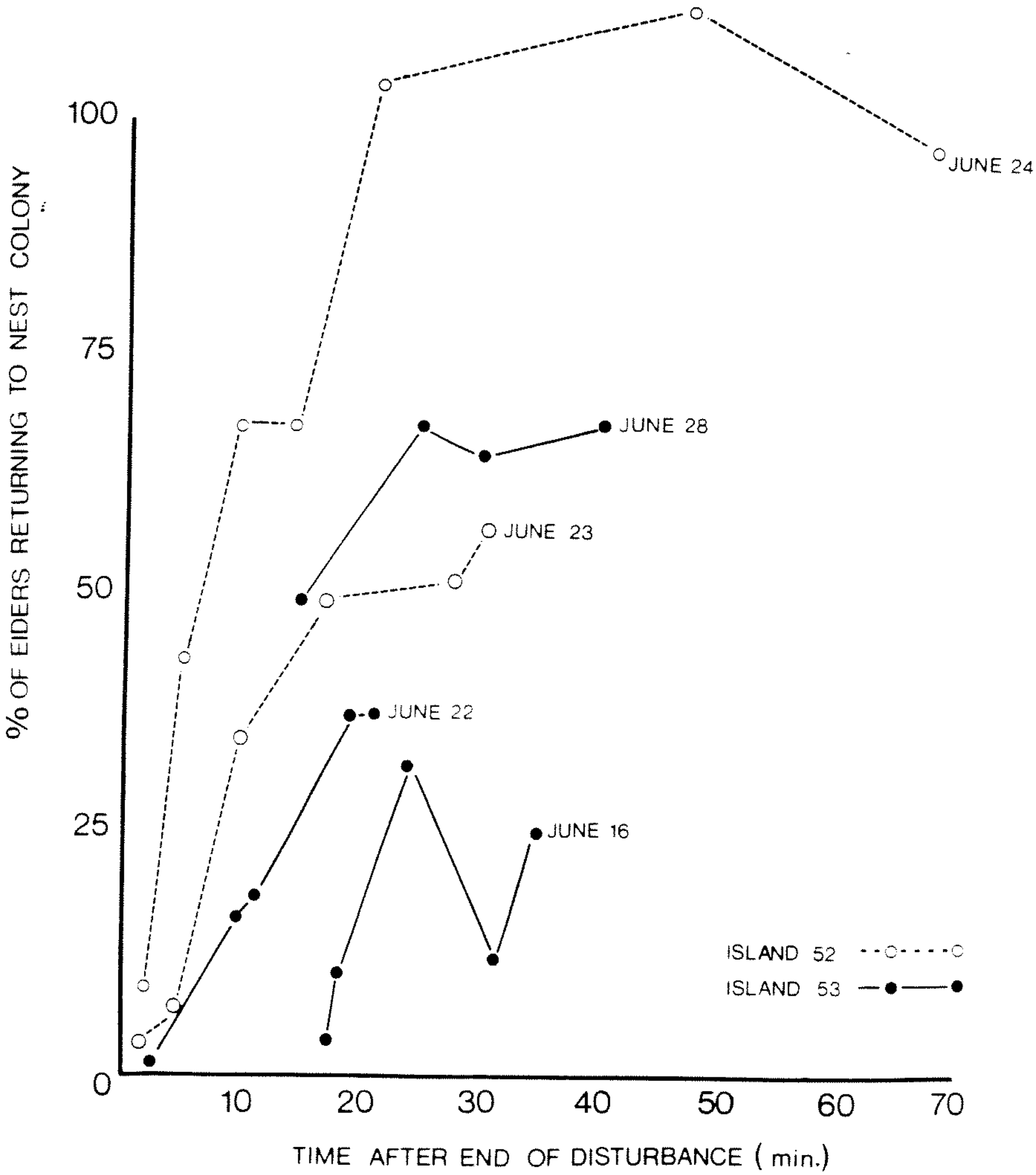

Figure 4 - Changes in the return rate of eider to the nest colony after disturbance

by minimizing colony disturbance. The above data demonstrates that the later in the incubation period that a visit to the nest island occurs, the more quickly the female returns to the nest. Reducing the time that eggs are exposed reduces the likelood of predation and the possibility of egg mortality by chilling. Therefore, the planning of a down collecting procedure must consider amongst other factors, the timing of the visit(s) to the colony.

SECTION VI - THE DISTRIBUTION AND ABUNDANCE OF HERRING GULLS

Gulls were probably the major predator on Common Eider eggs at Tasirqjuarosik and Qamanialuk this past summer. The three species of gulls seen in the study area in order of abundance are the Herring Gull (*Larus argentatus*), the Glaucous Gull (*L. hyperboreus*) and the Great Black-backed Gull (*L. marinus*). Only the Herring Gull was observed consuming eider eggs. The only other predator observed taking eggs was the Parasitic Jaeger (*Stercorarias parasiticus*). Although fresh tracks indicated that fox (*Alopex lagopus*, *Vulpes fulva*) were in the area, none was seen and no evidence was found of fox destroying eider nests.

The Herring Gull was by far the most common of the three larid species, and the only one that we found nesting in the study area. A total of 67 nests were found during our survey, 58 (86.6%) of which occured in Qamanialuk (see Table 1). The relative scarcity of nests in Tasirqjuarosik cannot be explained by the lateness of the survey date. We speculate that food availability may be the critical factor. The proximity of Qamanialuk to the seacoast may substantially increase the number of Herring Gull pairs that the area can support. Gulls nesting further from the coast (e.g. Tasirqjuarosik) may be much more dependent upon local resources such as Common Eider eggs and ducklings. Consequently it may be necessary for them to maintain a larger territory, encompassing a greater proportion of an eider colony, and thereby limiting gull density.

In Tasirqjuarosik, there was never more than one gull nest per eider island. The Hump Islet group (#169 to 171), a chain of three islets in close proximity to each other, supported two Herring Gull territories. But even in this case, the nests were located on different islets. Together, the three islets supported 208 Common Eiders nests.

In Qamanialuk, on the other hand, seven islands had two or more Herring Gull nests upon them. Of these seven, islands # 26 and 27 had

17 and 12 Herring Gull nests, respectively, half of the total Qamanialuk breeding population. The number of Common Eider nests for these islands was 306 and 36, respectively.

The issue of breeding dispersion in birds has received much attention in the scientific literature. It would be interesting to investigate further into the determinants of solitary or colonial breeding strategies in Herring Gulls at Tasirqjuarosik and Qamanialuk. The area is ideal for such a study, as gulls pursuing both strategies co-occur in the same area, and behavioural observations are relatively easy to collect.

SECTION VII - OBSERVATIONS ON GULL PREDATION

The following known predators of Common Eider (listed in order of frequency of observation) were seen in the study area: Herring Gull, Parasitic Jaeger, Peregrine Falcon (Falco peregrinus), Glaucous Gull, Great Black-backed Gull, and Raven (Corvus corax). Tracks of fox were seen on occasion but no evidence was found of fox predation. The only observed source of adult mortality was an abandoned leg-hold trap that had been set for fox and investigated by an overly-curious female.

Parasitic Jaegers were seen on nine separate occasions from June 12 to July 22. Successful predation by jaegers was only observed on one occasion. On June 18, a pair of jaegers and 7 Herring Gulls were responsible for the destruction of four Common Eider eggs. On three other occasions jaegers landed upon eider nest islands, but each time they were driven off by gulls or female eiders. Herring Gulls were responsible for all other incidences of predation.

i) Methods

An attempt was made to quantify the rate of gull predation, and their success per unit of effort. Gulls were easily observed due to the lack of view-obstructing vegetation, and the extremely flat topography of the nest islands. Island 100/101, in Qamanialuk, proved particularly useful in this respect, as an elevated promontory, on an adjacent island (nicknamed the Egg) provided an excellent observation point. Thus, the majority of timed gull predation observations were made on Island 100/101.

The observations were performed in the following fashion. An individual gull was selected as the primary subject of observation. This individual was continuously watched for a period of time, the length of which varied. The length of time that the gull devoted to various behaviours was recorded. We paid particular attention to the following activities, as they related directly to the act of predation: a) time spent on the nest island, b) time spent searching for eggs and/or ducklings, c) time spent consuming eggs or young, d) the source and the number of eggs or young which are consumed, and e) time spent in territorial defence.

(ii) Results

During the study period, we observed the predation of 46 eider eggs and 2 ducklings. Twenty-nine of the 46 eggs were observed consumed during a period of timed gull observation, allowing us to calculate a predation rate. Unfortunately fourteen of these predation incidents (those occurring on island 52 on July 22 and 23) must be excluded as it is suspected that the erecting of an observation blind caused female eiders to abandon their nests, and resulted in an exaggerated predation rate. Over 80% of our observation time was concentrated between 1200 and 1800 hours. During this 6-hour period, egg consumption at a rate of 0.48 eggs per hour (15 eggs consumed ÷ 31.5 hours) would result in the destruction of 2.88 eggs per day. At this daily rate, total egg loss over the 37 days of the nest check period (June 25 to July 31) amounts to about 106 eggs. The actual egg loss recorded from nest check data was 101 eggs.

Our calculated egg loss, however, only considers predation during 6 hours of a day with over 18 hours of daylight. Certainly the calculated predation rate is too high if we wish to consider the entire 6 weeks of the nest check period. We cannot, however, conclude that it is too high for any single week within this period, as we do not have sufficient data to measure how the rate of predation changes throughout the nesting period. We are confident that this change is considerable from our casual observations of the variation in female eider nest attentiveness during the nesting period.

(iii) Discussion

Although gulls were responsible for most of the observed predation of eider eggs, their interaction with eiders may not always be negative. Some Inuit have pointed out that eiders nesting within the territory of a gull, benefit from the latter's territoriality. The gull's defence inadvertently reduces predation on eider nests, as well as its own (Nakashima, in prep.). Schamel (1977) has documented this phenomenon at eider colonies in Alaska. Eiders nesting between 50 and 100 m from a gull nest had significantly higher hatching success than nests closer or farther away.

It is therefore possible that eiders sharing an island with one or more breeding pairs of gulls, may benefit from the latter's territorial defence of the colony. From our own observations, we have frequently seen gulls which we judged to be resident, driving off intruding gulls and jaegers which flew close by or attempted to settle in or near eider nests within the resident's territory. It seems clear to us that the eider benefit from such exchanges. However these eiders must also sustain the cost of eggs predated by resident gulls (although this cost is not borne equally by all individuals in the colony). If the objective is to maximize eider production, the critical question is whether the cost, in eggs lost to resident gulls, exceeds the benefits, in eggs saved by the latter's territorial defence.

This is not an easy question to answer, and certainly each situtation must be treated separately. At one extreme, a severe reduction of gull numbers would probably result in a marked increase in eider hatching success. At least in some local areas in Iceland, such as around eider farms, gull and other predator numbers have been substantially reduced to the mutual benefit of eiders and down collectors. Such a strategy may not be tenable in northern Québec, where eider colonies are not closely tended and gulls may be greater in number, or more dispersed, and thus more difficult to control. One can imagine that in some areas, gulls may be so numerous or so mobile that great effort may be expended to control the population with only miniscule gains in eider egg or duckling survival rates.

Gulls may also be a deterrent to other predators such as fox, raven or jaegers, which, although less common, may be much more devastating. The presence of a fox that kills several females and destroys the clutches of others may be a severe set-back to a tended eider colony that has been gradually built up over a period of years.

Finally, a poorly-managed gull control program may result in more devastation than benefit. The resident gulls of an eider colony selected for management, would be the most susceptible to elimination, as they generally remain in the area when people are present. The elimination of the resident gulls would leave the colony accessible to any intruder until such time as another pair of gulls could establish dominance. These new residents would once again be most susceptible to elimination, and the cycle would repeat itself. Repeated elimination of territorial gulls would not be good if residents consume fewer eggs than would intruders, if the residents were absent. We thus return to the original question. The issue of gull control is not a straightforward one. To conclude that the killing of gulls means more eiders is simplistic and irresponsible. The results of actions based upon such a premise may prove futile or even damaging to the local eider population. We must also be conscious of effects it may have on the local ecosystem, as gulls play an important role as carrion eaters.

Fortunately, the issue lends itself well to study. It would not be unfeasible to set up a series of experiments with appropriate sets of controls, in order to answer questions such as those posed above. Certainly, further research should be completed before any decisions are made about gull control in northern Québec.

SECTION VIII - THE DAILY PATTERN OF COMMUTING MOVEMENTS OF COMMON EIDERS NESTING IN TASIRQJUAROSIK AND QAMANIALUK

(i) Methods

The Common Eider colonies of Tasirqjuarosik and Qamanialuk are on freshwater lakes. Common Eiders are not known to feed in freshwater. Inuit have described for this and other freshwater areas a characteristic behaviour of commuting between freshwater breeding sites and marine littoral feeding sites.

Observations of eider movements were collected in order to document and describe this behaviour. Continuous watches were set up during which time the observer(s) would document all eider movements visible from the look-out. Whenever possible, the eiders were detected during their approach to the observation point, and followed past this point until lost from sight. These observations clarified the flight route and provided some safeguard against circling birds. For all flocks, the following data was collected: the time, the direction of movement, the flight path (if known), and the number and sex of the flock members. Weather data, such as wind speed and direction, temperature, precipitation, and cloud cover were collected at the time of the watch.

Observations were primarily taken from three locations. These are, in order of importance: 1) Base Camp (B.C.), 2) along a north-south transect over the ice from B.C. to the Cape, and 3) at the southeast tip of South Ridge at the Narrows (see Figure 2).

(ii) Results and Discussion

The commuting of Common Eiders between inland nest sites and marine littoral feeding areas was first described by Inuit familiar with inland eider colonies on Diana River and Nephijee lakes in southern Ungava Bay. Since then further inquiries have revealed that this local pattern of movement is common at other localities, including Tasirqjuarosik and Qamanialuk.

Observations in the study area allowed us to confirm and document the commuting phenomenon. The general movement is between Kyak Bay and the nest islands via the low and broad valley of ponds and intersecting streams that drains southwards from the south end of Qamanialuk. This is the lowest point of access to the sea, and the only route that we observed used by eiders. Groups of eiders could be seen flying to and from the sea along this route. The exact location of feeding areas used by these eiders is not known.

In commuting between Qamanialuk and Tasirqjuarosik, some eiders flew overland over an area of ponds and bogs just west of Inuksuk Hill. The majority of eiders however, passed east of Inuksuk Hill, either through the Narrows, or over part of the low-lying peninsula east of the Narrows.

Eiders nesting in the Tasirqjuarosik South region, west of Maine Island, often passed over or along the shore in front of Base Camp, providing an excellent opportunity for observations. Eiders nesting in the North region remained further away from the B.C. shore, flying either east of Ile Bizard or, as quite frequently observed, passing between Ile Bizard and Maine Island, continuing along (or coming from) the latter's East shore.

From B.C., groups of eiders could be seen approaching from the vicinity of island #53. These eiders would continue south past B.C., usually passing within 50 yds of our tent, and could be followed south to the North Narrows. From the area of the Cape, north of island #52, Common Eiders can be seen moving North and South around the east and the west sides of the Cape. The majority of these birds are flying to and from the Hump Islets colony (islands #169 to 171). The distance from this colony to the sea is approximately 8 km.

Table VII - Numbers of Common Eiders moving inland or seaward relative to the state of the tide. Qamanialuk and Tasirqjuarosik, 1982.

		HIGH TIDE						LOW TIDE						TOTAL
		Hours before				Hours after		Hours before				Hours after		
		-3	-2	-1	+1	+2	+3	-3	-2	-1	+1	+2	+3	
a	MOVEMENT INLAND (#birds)	28	245	76	77	58	27	95	116	71	38	66	26	923
b	MOVEMENT SEAWARD (#birds)	0	20	8	25	3	20	65	138	130	69	44	27	549
c	OBSERVATION TIME (minutes)	59	147	111	140	83	50	133	286	186	184	218	152	1,749
d	RATE OF MOVEMENT INLAND (#birds/min x 10^{-1})	4.75	16.67	6.85	5.50	6.99	5.40	7.14	4.06	3.82	2.07	3.03	1.71	5.28
e	RATE OF MOVEMENT SEAWARD (#birds/min x 10^{-1})	0	1.36	0.72	1.79	0.36	4.00	4.89	4.83	6.99	3.75	2.02	1.78	3.14
f	NET MOVEMENT INLAND (col.d-col.e)	+4.75	+15.31	+6.13	+3.71	+6.63	+1.40	+2.25	-0.77	-3.17	-1.68	+1.01	-0.07	

Eiders commuted either alone or in groups of up to 15 individuals. In most cases, the sex ratio in groups was close to 1:1, with a very slight tendency towards a preponderance of females. For the period of intense movement observation (June 12 to July 9), no change in the composition of the flocks was noticeable.

Data were collected on the movements of 1,472 eiders in 1,749 minutes of continuous observation, distributed amongst 20 days. On average, 50 ducks were seen for every hour of observation. Inland flying eiders constituted 62.7% (923 eiders) of the total number of ducks sighted. Seaward-flying ducks accounted for the other 37.3% (549 eiders) of the movements.

The Inuit describe a pattern of movement that corresponds with the tidal cycle. On the falling tide, Common Eiders are said to fly seaward (in this case southward) in order to feed, and subsequently return to their nest sites on the rising tide (a movement northward). If we correct for minutes of observation, we obtain birds seen moving inland or seaward per unit of time. This allows us to make comparisons between inland and seaward movements at different stages of the tidal cycle.

These data are presented for each hour of the tidal cycle, in Table VII, and illustrated in Figure 5A. The greatest rate of seaward movement occurs during the hour before the low tide. Six distinct observation periods totaling 186 minutes of observation, provided a count of 130 seaward-flying eiders during this hour (0.7 eiders per minute). Over 50% of the total number of eiders flying towards the sea were observed during the three hours preceding the low tide. The lowest rate of seaward movement occurs during the third hour before the high tide, when no eiders were seen during 59 minutes of observation.

Inland movement peaks during the second hour before the high tide at a rate of 1.7 birds per minute. With the exception of this single burst of inland commuting the rate of eider movement inland is much more evenly distributed with time. Rates of greater than 0.5 eiders per

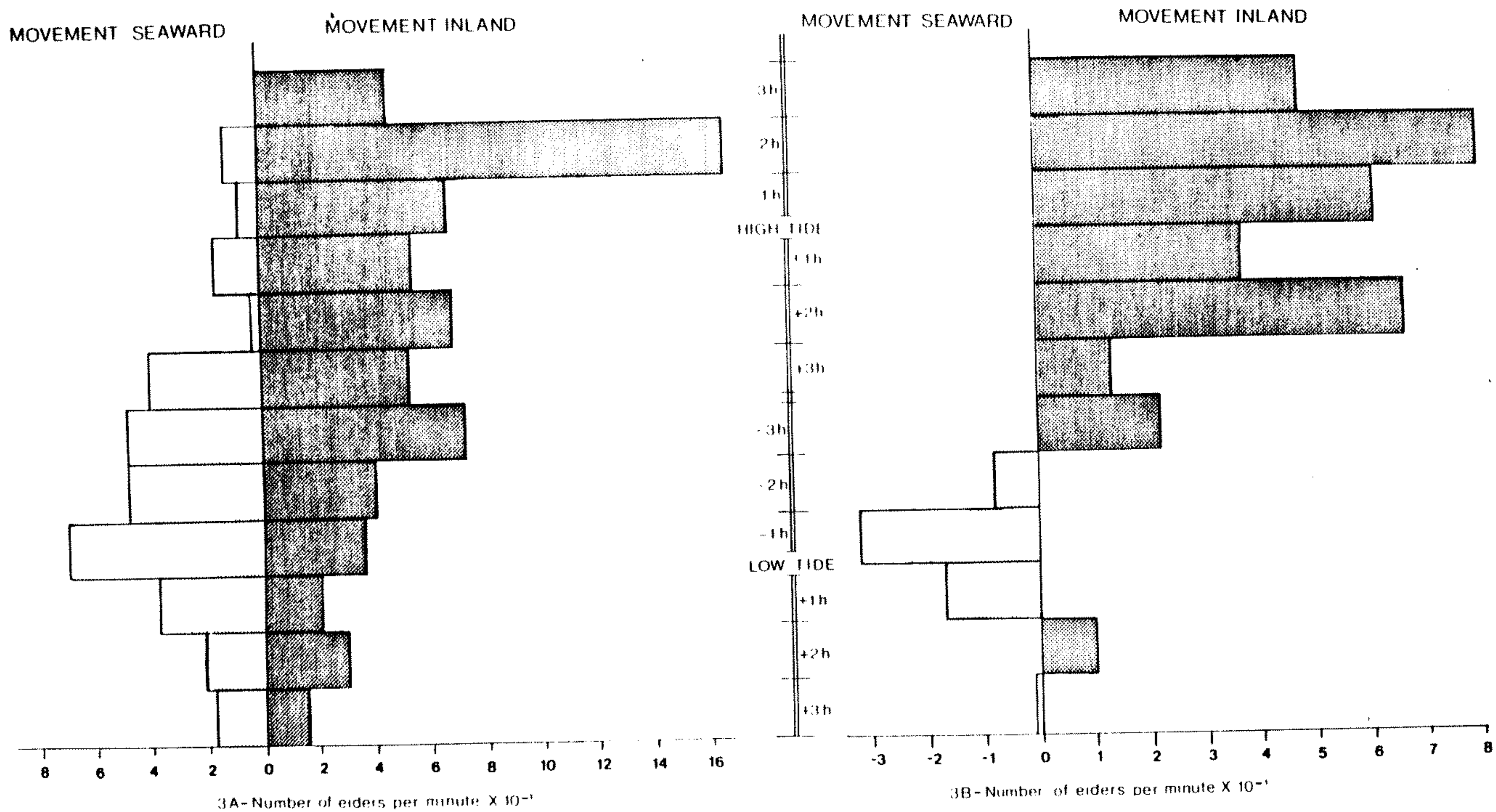

Figure 5 -A Number of eiders flying inland and seaward relative to the state of the tide;
B Net movement of eiders flying inland and seaward relative to the state of the tide.

minute are maintained for the two hours before and four hours after the high tide. The lowest inland movement was observed during the first and third hours after the low tide.

This trend of inland movement during the rising and high tides, and seaward movement during the falling and low tides, is best illustrated by determining the net hourly movement. These data are illustrated in Figure 5B. A net inland movement was evident for virtually all hours of the tidal cycle except for a period of three hours at the low tide (two hours before and one hour after) during which time the net movement became seaward.

The disparity between the total number of eiders observed flying inland and the number flying seaward, is unexpected and remains unexplained. There is no evidence to suggest whether or not this may be due to a) seaward-flying eiders using different routes, some of which remained unknown to us, b) seaward-flying eiders being more difficult to see due to the local conditions at the observation points and/or c) sampling error.

Commuting observations were terminated before mid-July due to shifting work priorities. As a result, we do not have data for the late incubation and hatching period, when drakes were largely absent. Casual observations indicate that commuting continued throughout this period. Commuting flocks were composed entirely of females. It is believed that average flock size increased. Most likely, the majority of these commuters were either non-breeding females or females that had lost their clutch earlier in the season. It is believed that a large number of commuting females were also involved in accompanying females with ducklings from the nest sites to the sea. On numerous occasions northward-flying flocks of eider females were observed to land in order to accompany swimming flocks of adult females and ducklings, seawards.

SECTION IX - SUMMARY AND CONCLUSION

An inland-nesting population of the Common Eider (*Somateria mollissima borealis*) was studied in its breeding area on Qamanialuk and Tasirqjuarosik. These freshwater lakes are located along the west coast of Ungava Bay, northern Québec, near the mouth of the Payne River. The field study (June 10 to August 5, 1982) dealt with a number of different subjects. An attempt was made to address several issues, including the local potential for commercial exploitation of eiderdown, the productivity of the eider population, the influence of gull predation upon this productivity, and the establishment of a breeding population count for the future monitoring of local population size.

Qamanialuk, Tasirqjuarosik and some of the adjoining lakes and drainage systems, were surveyed in order to obtain a total count of the number of Common Eiders breeding in the study area, and their distribution. A total of 1,886 nests were found on 68 islands. Eighty one percent of these nests were located in Qamanialuk and the south half of Tasirqjuarosik, the areas closest to the southern outlet to the sea. Of the 1,886 nests, 1,531 nests contained either eggs or young, or evidence of having successfully hatched at the time that they were surveyed. Thus, the minimum number of nesting pairs in the study area is 1,531.

During the survey, the amount and quality of the eiderdown of each nest was qualitatively estimated. Each nest was placed in one of 6 classes of down volume and one of 3 classes of down purity. Three-quarters of the surveyed nests were classified in the upper three categories of down volume (1,427 nests) and of these, 75.1% were judged to be in the upper two classes of down purity. Using an estimate of 9 gm for clean down production per nest in the upper three volume classes, we obtain a yield of 12.7 kg of cleaned down for the study area. The market value of this product would be in the neighbourhood of $5,000 at a price of $400 per kilogram.

Nest success and egg hatching success were examined for three eider colonies in the study area. Of a total of 407 nests that were initiated, 269 nests (66.1%) were judged to have successfully hatched at least one young. Of 1,486 eggs laid, 916 eggs (61.6%) successfully hatched. Total egg production for the study area was estimated at 6,601 eggs. Duckling production from these eggs was estimated as 3,891 ducklings.

Herring Gulls (Larus argentatus) were believed to be the greatest source of eider egg loss. Sixty-seven Herring Gull nests were counted in the vicinity of eider nest colonies. Qamanialuk supported 86.6% of these nests. Predation rate observations of gulls indicated that an average of 0.48 eggs were consumed per hour between 1200 and 1800 hours.

The commuting behaviour of the Common Eider population between their inland nest colonies and offshore feeding areas, was described and quantified. As described by Inuit, there is a net movement inland during the rising and high tide and a net seaward movement preceding and during the low tide. Seaward movements varied between a low of zero eiders seen flying south in 1 hour of observation at mid rising tide, to a high of 42 eiders per hour during the hour preceding the low tide. Movement inland peaked at 102 eiders per hour, two hours before the high tide.

In conclusion, we feel that this study has provided a more concrete understanding of the dynamics of the eider population at Qamanialuk and Tasirqjuarosik. It has provided some answers regarding population size and distribution, and the potential for eiderdown harvesting. It has also raised some issues worthy of subsequent investigation, such as further quantification of predation rates by gulls, and the possibility of a gull removal study to assess the costs and benefits of a gull control program.

In addition, the detailed survey data that has been collected will now allow us to monitor change in the local population. This will in turn allow us to assess the validity of Inuit observations that offshore-nesting eiders are shifting inland in response to increasing coastal disturbance. Survey data will also provide us with a baseline against which we can judge the effectiveness of a local population enhancement project, if such a program is attempted.

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