ARCTIC
VOL. 45, NO. 2 (JUNE 1992) P. 111-114

Breeding Distribution and Numbers of Black Guillemots in Jones Sound, N.W.T.

RAYMOND W. PRACH[1] and ALAN R. SMITH[2]

(Received 15 August 1988; accepted in revised form 17 June 1991)

ABSTRACT. Aerial surveys of Jones Sound, N.W.T., reveal a highly clumped distribution of black guillemots in the early spring and throughout the breeding season. Black guillemots are uncommon throughout much of Jones Sound except at its mouth and in the western portion. By September, most guillemots have left the area. Both early spring and breeding distributions appear to be influenced by the Hell Gate and Cardigan Strait polynya located in western Jones Sound between Ellesmere and Devon islands. Evidence presented suggests that annual variation in the distribution of ice edges in Jones Sound may influence distribution of breeding birds among suitable breeding sites.

Key words: black guillemot, *Cepphus grylle*, breeding distribution, Jones Sound, aerial surveys

RÉSUMÉ. Des relevés aériens effectués dans le détroit de Jones (T.N.-O.) indiquent une distribution très regroupée de guillemots à miroir au début du printemps et durant toute la saison de reproduction. On ne trouve pas beaucoup de guillemots à miroir dans l'ensemble du détroit de Jones, sauf à son embouchure et dans la partie occidentale. Quand arrive septembre, la plupart des guillemots ont quitté la région. Les distributions du début du printemps et de la saison de reproduction semblent être influencées par les polynias de Hell Gate et de Cardigan Strait situées dans la partie occidentale du détroit de Jones, entre les îles Devon et Ellesmere. Les faits présentés suggèrent que la variation annuelle dans la distribution des lisières de glaces du détroit de Jones pourrait influencer la distribution des oiseaux reproducteurs aux divers sites qui se prêtent à la nidification.

Mots clés: guillemot à miroir, *Cepphus grylle*, distribution de la nidification, détroit de Jones, relevés aériens

INTRODUCTION

There are several reported observations of black guillemots (*Cepphus grylle*) in western Jones Sound and in the Hell Gate and Cardigan Strait polynya. Sverdrup (1904[1]:340) observed "myriads of seabirds, mostly black guillemots . . . " in Hell Gate and Cardigan Strait during March 1900; in July 1901 (1904[2]:313) he reported "thousands upon thousands" of black guillemots nesting in the cliffs near Boat Point on northern Devon Island. As an appendix to his report on seabird colonies around Devon Island, Nettleship (1974) included observations made on 5-6 August 1973 of guillemot colonies along the north coast of Devon Island and on the islands in Hell Gate and Cardigan Strait. Renaud and Bradstreet (1980) observed six guillemots in Cardigan Strait while conducting marine mammal surveys in the polynya on 17 March 1978. Thus, except for surveys by Nettleship to locate major concentrations of colonially nesting birds, a detailed examination of the distribution of black guillemots in western Jones Sound had not been made. The purpose of this paper is threefold: to report the results of more extensive surveys of black guillemots in western Jones Sound, Hell Gate, and Cardigan Strait done as part of a detailed ecological study of the associated polynya; to compare the distribution and density of guillemots found in that study with previous reports; and to examine possible explanations for the differences reported among them.

STUDY LOCATION AND METHODS

The study area and the locations of places named in the text are presented in Figure 1. The polynya is usually established in December as the surrounding sea freezes and a variable portion of Hell Gate and Cardigan Strait remains open. The polynya is kept open through winter by a combination of set (permanent) and tidal currents (Smith and Rigby, 1981). The amount of open water in the polynya increases with the advancing season to about 1000 km^2 by April and about 2500 km^2 by mid-July. After break-up of the surrounding sea ice, usually in September, the polynya ceases to exist. Currents and wind bring ice from Norwegian Bay and Jones Sound to clog the area with varying amounts of unconsolidated, moving pack ice through late summer and fall. This condition persists until freeze-up, when the current re-establishes the polynya (Smith and Rigby, 1981).

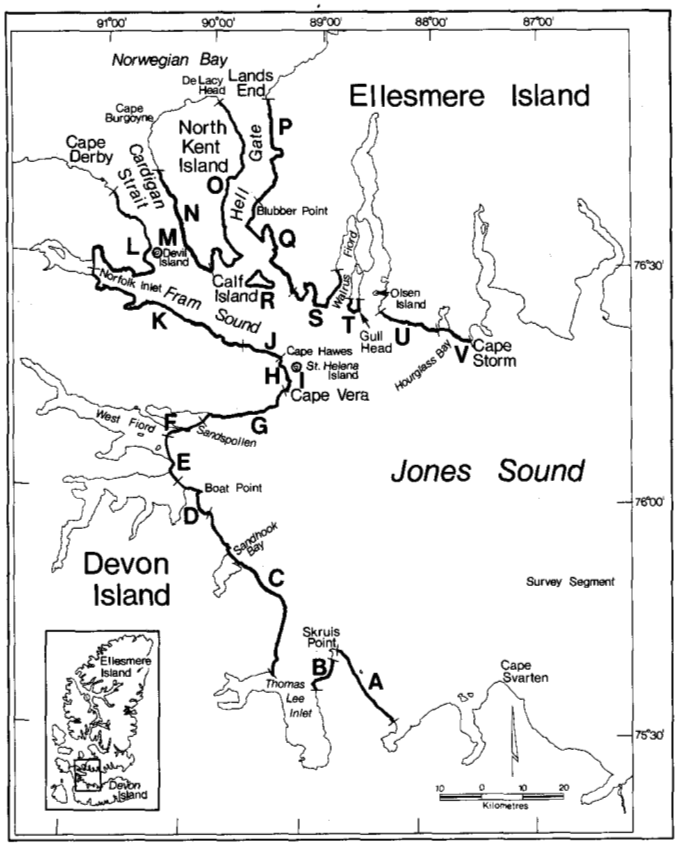

FIG. 1. Map of the study area.

Surveys from fixed-wing aircraft were conducted during June, July, and August in each year from 1980 to 1982.

[1]Environmental Services International, 1108 Lancaster Road, Suite 1B, Takoma Park, Maryland 20912, U.S.A.
[2]Canadian Wildlife Service, 115 Perimeter Road, Saskatoon, Saskatchewan, Canada S7N 0X4

Additional surveys were flown in April 1980, April and May 1982, and May 1983. Surveys included all ice-free coastlines and ice edges from Cape Derby (Devon Island) and Land's End (Ellesmere Island) on the northern boundary of the polynya to Cape Vera (Devon Island) and Cape Storm (Ellesmere Island) along its southern boundary. All islands were circumnavigated. Additional surveys were flown down the centres of Fram Sound, Cardigan Strait, and Hell Gate. The duration of the surveys increased as the polynya expanded, but they rarely exceeded four hours. In addition, the coastline of Jones Sound was surveyed by fixed-wing aircraft on 19 August 1980, 3 August 1981, and 2-3 September 1982; and the polynya was surveyed by helicopter in March 1982.

The fixed-wing aircraft, a DeHaviland Twin Otter, was flown at a ground speed of 100 knots (185 km/h) at 50 m above the water surface 200 m seaward from the coastline whenever conditions permitted. Two observers, one on each side of the aircraft in the passenger compartment, counted all birds and mammals within 200 m of the aircraft. Thus a strip approximately 400 m wide was covered. Data were recorded on portable tape recorders and included whenever possible species, number, age, sex, habitat type, and behaviour for all sightings.

In order to obtain estimates of guillemots, each colony was surveyed using a Bell 206B helicopter on 1-2 August 1984. This survey included the cliffs surrounding the polynya as far southwest as Skruis Point on northern Devon Island. It was timed to coincide with peak attendance at the colonies as determined by 24 h counts at a small colony (segment H) located near Cape Vera (Fig. 1).

Air speed averaged 60 km/h during the helicopter survey. Altitude varied according to the height of the cliffs and the position of the nest sites on the cliffs. All cliff faces were surveyed such that the side opposite the pilot (left side) was closer to the cliff. Three observers were used, two on the side nearer the cliff and a third on the pilot's side. The front observer counted all black guillemots flushed from the cliffs ahead of the aircraft. The rear observer counted all birds flushed from the cliffs after the helicopter passed. The third observer, seated behind the pilot, counted all birds that were flushed from or dove into the water. Only the birds flushed from the cliffs were used in density calculations; birds on the water were assumed to be either mates of birds already flushed or non-breeders.

Aerial surveys from fixed-wing aircraft have a number of inherent limitations, which are discussed by McLaren (1982) and summarized here. Not all birds that are present in an area are detected, and the numbers recorded are only estimates of actual numbers seen. In general, the more individuals in an aggregation, the less accurate the estimate. The ability of an observer to detect individuals is affected by weather-related variables such as sun glare, fog, precipitation, and sea state; the colour, size, and behaviour of the animals; the seating arrangements on the aircraft; and the stamina, visual acuity, and mental attitude of the observer. Many of these variables change during the course of a single survey. Thus large variation among surveys in the numbers of birds recorded is not entirely unexpected.

In order to reduce survey inaccuracies to a minimum, observers attended an aerial survey workshop to sensitize them to the sources of survey bias and how to correct for them. As often as possible, survey personnel were allowed to gain experience as extra observers on survey flights with more experienced observers. Finally, surveys were flown only in acceptable weather conditions.

Three people were used for most surveys, one in the co-pilot's seat (navigator) and one on either side of the aircraft in the rear passenger cabin (observers). The numbers recorded by the observers on each side of the aircraft were combined to compute the number of birds observed for each segment. This permitted the navigator to navigate, record ice conditions, and mark the location of avian colonies. Observers exchanged positions approximately every 20 minutes to attempt to correct for inaccuracies related to seating arrangements on the aircraft and the stamina, visual acuity, and mental attitude of observers. In order to compare our data with those of Nettleship (1974), an order of magnitude estimate, described in Table 1, was made for each colony. It was based on the number of birds flushed from the cliffs and talus slopes.

TABLE 1. Comparison of estimates of size of black guillemot colonies (Nettleship, 1974; this study)

		Size (order of magnitude)[1]	
Fig. 1	Survey segment	1973	This study
A,C	Skruis Point, Sandhook	4	4
B	Thomas Lee Inlet	NS[2]	2
D,E	Boat Point, West Fjord	0	1
F	Sandspollen	present	2
G	Cape Vera	0	3
H	Cape Hawes	0	2
I	St. Helena Island	3	2
J	Hawes Glacier	0	3
K	Norfolk Inlet	0	3
L	Cape Derby	0	2
N	Cape Bargoyne	0	3
O_0	De Lacy Head segment 1	0	2
O^1	De Lacy Head segment 2	0	2
O^2	De Lacy Head segment 3	3	2
O^3	De Lacy Head segment 4	0	2
O^4	De Lacy Head segment 5	3	2
O^5	De Lacy Head segment 6	3	2
P^6	Lands End	0	1
Q	Blubber Point	0	3
R	Calf Island	4	3
S	Walrus Fjord	NS	2
T	Gull Head	NS	2
U	Olsen Island	NS	2
V	Cape Storm	NS	0

[1]Order 2 = 11 to 100 pairs; order 3 = 101 to 1000; order 4 = 1001 to 10 000.
[2] Not surveyed.

RESULTS

Numbers of black guillemots observed during the fixed-wing surveys are shown in Figures 2, 3, and 4. Black guillemots were observed during each survey of the polynya. However, there were large changes between some successive surveys, and more guillemots were counted in 1981 than in 1980. In addition, very few guillemots were recorded not only in the study area but throughout Jones Sound in both September surveys. During the early survey of the polynya by helicopter on 14 March 1982, 207 black guillemots were recorded (Fig. 4).

The results of the August colony survey by helicopter are presented in Table 2. All of the colonies described by Nettleship (1974) on North Kent Island had declined from order three in 1973 to order two in this study. The colony on Calf Island had declined from order four to order three and the one on St. Helena Island had declined from order three to

order two. Other colonies detected by us on survey segments G, H, and J through N were not reported by Nettleship even though he surveyed these areas.

During this study, 1398 pairs were counted at the Skruis Point colony (about the same size as estimated in 1973). We counted 264 pairs (an order three colony) between Sandhook Bay and Thomas Lee Inlet (segment C). The colony was not recorded by Nettleship. We also recorded 12 pairs (an order two colony) on the east side of Thomas Lee Inlet (segment B), an area not investigated by Nettleship. A colony at Sandspollen (segment F) was reported by Nettleship, but he gave no estimate of the size of that colony; we counted 32 pairs of guillemots (order two).

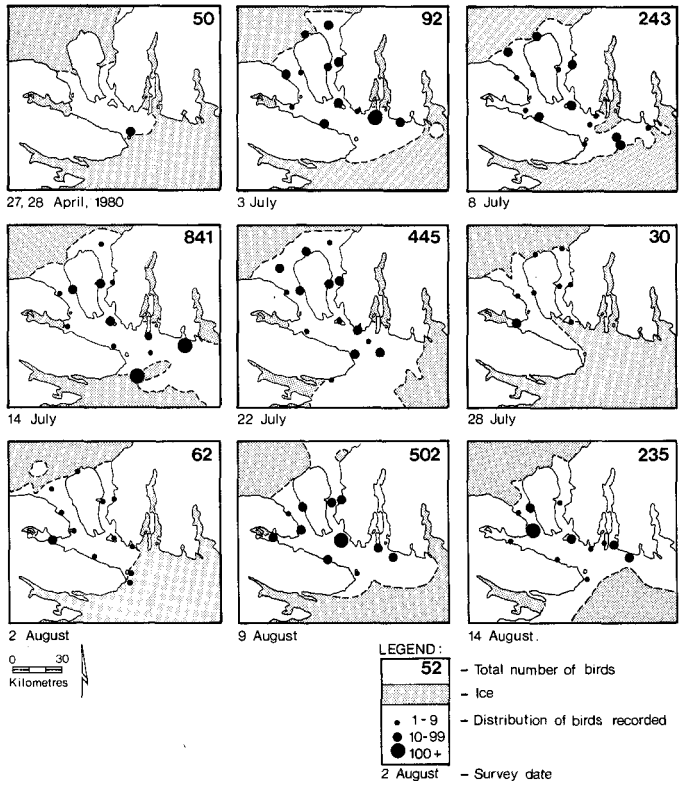

FIG. 2. Distribution and abundance of black guillemots in 1980.

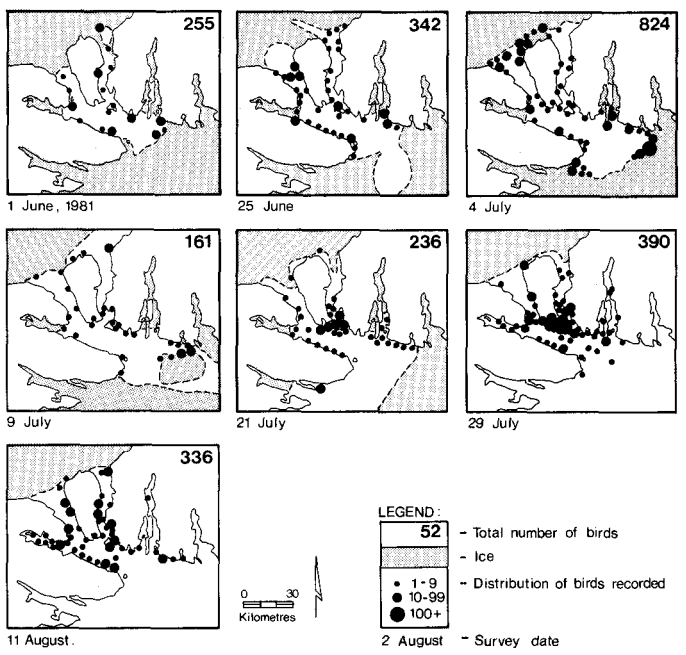

FIG. 3. Distribution and abundance of black guillemots in 1981.

DISCUSSION

A striking feature of the distribution of the black guillemot is its apparent absence from much of eastern Jones Sound. No black guillemots occupy apparently suitable cliffs on Devon

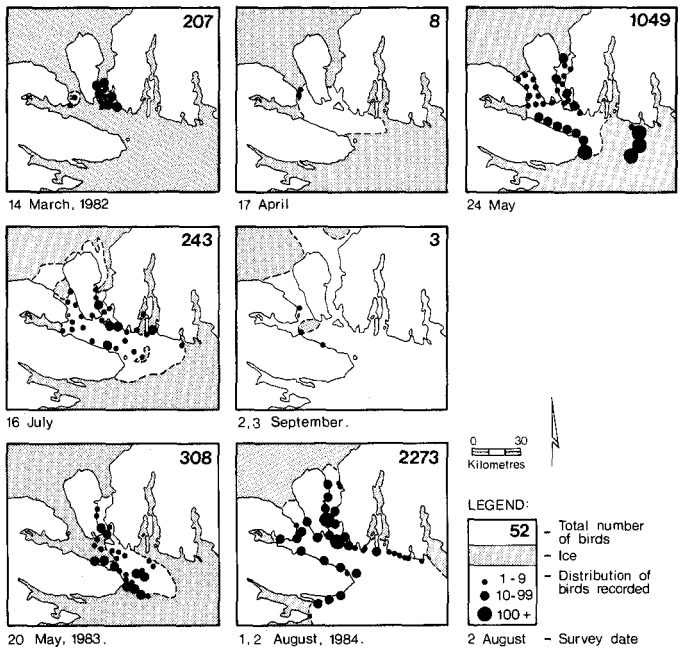

FIG. 4. Distribution and abundance of black guillemots in 1982-84.

TABLE 2. Numbers and density of black guillemots observed during aerial surveys in August 1984

Fig. 1	Survey segment	Number observed on cliff	Number observed on water	Length of cliff segment/ occupied cliff (km)	Density of occupied cliff: pairs/km
A	Skruis Point	1398	187	16.0	87.4
B	Thomas Lee Inlet	12	12	2.2	5.5
C	Sandhook	264	222	27.5/12.8	20.6
D	Boat Point	7	0	3.0	2.3
E	West Fjord	0	0	3.0/0	0.0
F	Sandspollen	32	1	0.6	53.3
G	Cape Vera	238	2	10.8/7.0	34.0
H	Cape Hawes	22	0	9.3/3.5	6.3
I	St. Helena Island	33	0	2.0	16.5
J	Hawes Glacier	200	7	6.1	32.8
K	Norfolk Inlet	119	22	20.2/6.3	18.9
L	Cape Derby	35	0	10.3/7.7	4.5
M	Devil Island	55	2	2.0	27.5
N	Cape Bargoyne	121	0	12.5/7.4	16.4
O	DeLacy Head	398	41	18.6	21.4
P	Lands End	6	0	4.3/3.0	2.0
Q	Blubber Point	210	36	15.3/12.1	17.4
R	Calf Island	598	48	18.6	32.2
S	Walrus Fjord	53	27	6.1/3.9	13.6
T	Gull Head	70	15	3.8	18.4
U	Olsen Island	83	0	7.4/7.0	11.9
V	Cape Storm	0	0	3.8/0	0.0
Totals		3954	622	203.4/143.6	27.5

Island east of Cape Svarten (Nettleship, 1974; Hussel and Holroyd, 1974; this study). Except for three small (order one) colonies, no black guillemots occupy cliffs east of Hourglass Bay (88°W) on the south coast of Ellesmere Island.

The probable explanation for the absence of guillemots in eastern Jones Sound is that it is virtually ice covered throughout the normal breeding season for black guillemots in the High Arctic. Black guillemots are uncommon throughout most of Jones Sound except at its mouth (at Coburg Island), where breeding colonies have been reported by McLaren (1982) and open water is present in early spring. The observed distribution of guillemots in March, April, and May is coincident with the location of open water and the associated ice edges. Thereafter, as the ice margin recedes and shoreleads open, the distribution of guillemots tends to reflect the location of breeding colonies. The helicopter survey revealed the presence of guillemots on cliffs in western Jones Sound that are near open water before break-up, even though densities varied considerably. Apparently, guillemots will only occupy sites that are near open water in the spring.

The general breeding distribution of black guillemot colonies in western Jones Sound appears to be influenced by the Hell Gate and Cardigan Strait polynya. Although there are many apparently suitable colony sites throughout western Jones Sound, most are inactive; the active sites are adjacent to the open water and ice edges generated by the polynya.

The colony at Skruis Point is an apparent exception (Brown and Nettleship, 1981); it is some 50 km from the open water in the Hell Gate and Cardigan Strait polynya. However, currents that give rise to the polynya seem to maintain shore leads near Skruis Point that support the black guillemots found nesting there. We assume that open water of the polynya and of the shore leads at Skruis Point allows the guillemots access to food resources that are part of the food chain supported by the ice edge ecotone.

The very low numbers recorded during the September surveys are particularly interesting, suggesting that the birds leave the area as soon as breeding is finished. The results from Nettleship and Gaston (1978) from Barrow Strait and Johnson *et al.* (1976) from Lancaster Sound document the same phenomenon. McLaren (1982) emphasized the importance of ice edges to black guillemot distribution in Lancaster Sound, suggesting that prey may be more concentrated there. Briggs *et al.* (1987) suggest that when prey is concentrated by physical phenomena such as thermoclines, sub-surface foraging birds should be able to capture prey more readily than when a similar abundance of prey is dispersed throughout an unstratified water column. It is possible that after the ice breaks up in Jones Sound, prey species are more uniformly dispersed throughout the much larger area of Jones Sound, making it physiologically uneconomical for guillemots to remain.

A comparison of our results with those of Nettleship (1974) suggests that some changes have occurred in the polynya and the surrounding area since 1973, when those surveys were conducted (Table 1). Evidence presented in this report suggests that the distribution of birds among suitable breeding sites adjacent to the polynya is determined by local ice conditions early in the season, such as the development of leads and the location of open water. Each of three observers has found large numbers of guillemots in the same general area and yet the distribution of the birds among the available breeding sites has apparently varied. Annual variations in ice distribution may explain the differences in distribution of black guillemots among suitable breeding sites found between 1973 and this study and among years of this study. This variation may also explain why Sverdrup (1904) found "thousands upon thousands" of black guillemots at Boat Point, whereas Nettleship found a major concentration east of Skruis Point and we found concentrations between Sandhook Bay and Thomas Lee Inlet. Differences in methodology among studies — for example, using helicopters instead of fixed-wing aircraft as a survey vehicle — as well as the inherent variation of results among aerial surveys from similar vehicles can explain minor differences in numbers and lead to a difference in the reported size of an individual colony. However, it is unlikely that in any of the studies the location of the observed colonies was inaccurately reported, and the differences in the location of occupied colonies are real.

ACKNOWLEDGEMENTS

We gratefully acknowledge the continuing support from Polar Continental Shelf Support (Energy, Mines, and Resources) and the Canadian Wildlife Service (Environment Canada), the agencies which provided the resources to undertake the project. We are indebted to Susan Popowich, who designed and prepared the figures, and John Chardine, A.J. Gaston, and D.N. Nettleship, who reviewed the manuscript, providing valuable insight and criticism.

REFERENCES

BRIGGS, K.T., TYLER, W.B., LEWIS, D.B., and CARLSON, D.R. 1987. Bird communities at sea off California: 1975-1983. Studies in Avian Biology 11. San Diego: Cooper Ornithological Society. 74 p.

BROWN, R.G.B., and NETTLESHIP, D.N. 1981. The biological significance of polynyas to arctic colonial seabirds. In: Stirling, I., and Cleator, H., eds. Polynyas in the Canadian Arctic. Occasional Paper No. 45. Ottawa: Canadian Wildlife Service. 59-65.

HUSSEL, D.J.T., and HOLROYD, G.L. 1974. Birds of the Truelove Lowland and adjacent areas of northeastern Devon Island, NWT. Canadian Field-Naturalist 88:197-212.

JOHNSON, S.R., RENAUD, W.E., RICHARDSON, W.J., DAVIS, R.A., HOLDSWORTH, C., and HOLLINGDALE, P.D. 1976. Aerial surveys of birds in eastern Lancaster Sound. Unpubl. report by LGL Ltd. for Norlands Petroleums Ltd. 365 p. Available at Canadian Wildlife Service Library, Environment Canada, 4999 - 98 Avenue, Edmonton, Alberta T6B 2X3.

McLAREN, P.L. 1982. Spring migration and habitat use by seabirds in eastern Lancaster Sound and western Baffin Bay. Arctic 35:88-111.

NETTLESHIP, D.N. 1974. Seabird colonies and distributions around Devon Island and vicinity. Arctic 27:95-103.

NETTLESHIP, D.N., and GASTON, A.J. 1978. Patterns of pelagic distribution of seabirds in western Lancaster Sound and Barrow Strait, Northwest Territories, in August and September 1976. Ottawa: Canadian Wildlife Service. 40 p.

RENAUD, W.E., and BRADSTREET, M.S.W. 1980. Late winter distribution of black guillemots in northern Baffin Bay and the Canadian High Arctic. Canadian Field-Naturalist 94(4):421-425.

SMITH, M., and RIGBY, B. 1981. Distribution of polynyas in the Canadian Arctic. In: Stirling, I., and Cleator, H., eds. Polynyas in the Canadian Arctic. Occasional Paper No. 45. Ottawa: Canadian Wildlife Service. 7-28.

SVERDRUP, O. 1904. New land: Four years in the arctic regions. 2 vols. London: Longmans and Green. Vol. I, 496 p., Vol. II, 504 p.