

Ivory Gull (*Pagophila eburnea*) Distribution in Late Summer and Autumn in Eastern Lancaster Sound and Western Baffin Bay

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ABSTRACT. Ivory gulls in western Baffin Bay and eastern Lancaster Sound were studied in 1976, 1978 and 1979 using aerial surveys. During September and October concentrations of hundreds of ivory gulls occurred along glacier fronts on southeast Ellesmere and northeast and southeast Devon islands, and where offal was available near the settlements of Grise Fiord and Pond Inlet. Dispersal (= southward migration) from coastal to offshore areas proceeded as pan ice cover increased in offshore areas, usually in late September or early October in Lancaster Sound and in mid-October in Baffin Bay east of Baffin Island. Lancaster Sound and northwest Baffin Bay may be a major autumn migration route for ivory gulls that breed in the central and eastern High Arctic and winter in southern Davis Strait and areas to the south.

Key words: ivory gull, *Pagophila eburnea*, autumn status, migration, Baffin Bay, Lancaster Sound, glacier fronts, aerial surveys

RÉSUMÉ. Les mouettes blanches de la partie ouest de la baie de Baffin et la partie est du détroit de Lancaster furent étudiées en 1976, 1978 et 1979 en utilisant des relevés aériens. De septembre et octobre, les concentrations de centaines de mouettes blanches se trouvèrent le long des fronts glaciers dans le sud-est de l'île d'Ellesmere et au nord-est et sud-est de l'île de Devon; elles se retrouvèrent aussi près des villages de Grise Fiord et de Pond Inlet où les déchets sont présents. La dispersion (i.e. la migration vers le sud) des régions côtières aux régions au large des côtes s'effectua en correspondance avec l'augmentation de la couverture de glace flottante dans ces derniers endroits; ceci se produit normalement vers la fin de septembre et au début d'octobre dans le détroit de Lancaster et à la mi-octobre dans la baie de Baffin à l'est de la Terre de Baffin. Le détroit de Lancaster et la partie nord-ouest de la baie de Baffin pourraient constituer la route principale de migration automnale des mouettes blanches qui se reproduisent dans les régions centrale et orientale de l'Arctique et passent l'hiver dans la partie sud du détroit de Davis ainsi que dans les régions plus au sud.

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INTRODUCTION

The ivory gull (*Pagophila eburnea*) has a circumpolar breeding distribution, but is considered rare (MacDonald, 1979). Much of its apparent rarity, however, is a function of its remote northern range; during all times of the year most individuals occur in ice-rich arctic and subarctic areas where they are relatively difficult to census. Until 1977, when five small colonies were found on southeast Ellesmere Island (Frisch and Morgan, 1979), ivory gulls were known to have nested in the Canadian Arctic Archipelago and northwest Greenland at only five locations (Salomonsen, 1950; MacDonald and Macpherson, 1962; MacDonald, 1976). A colony at Seymour Island, north of Bathurst Island, N.W.T., has been studied in recent years (MacDonald, 1976, 1979).

In winter, ivory gulls disperse to pack ice areas, especially edges (pers. obs.; MacLaren Marex Inc., 1979a), often far south of their nesting localities. In eastern Canada, they occur over the pack ice off Labrador and Newfoundland (pers. obs.; Godfrey, 1966). There are apparent migratory movements between nesting localities and wintering areas in offshore pack ice. Hjort (1976) reported fall movement along the East Greenland Current, and Portenko (1973) mentioned fall migration at Wrangel Island, U.S.S.R. However, movements of the Canadian arctic and west Greenland populations are known only from casual observations along the west Greenland coast

(Salomonsen, 1950) and from a few banding recoveries. Two ivory gulls banded in winter off the northern tip of Labrador were recovered on Seymour Island (MacDonald, 1979).

In 1976, 1978 and 1979, we observed many ivory gulls during systematic aerial surveys between late August and mid-October in western Baffin Bay and eastern Lancaster Sound. This paper summarizes these data and relates them to current knowledge of migration.

METHODS

In 1976, weekly surveys of marine birds and mammals in eastern Lancaster Sound were conducted from 16 August-28 September. In 1978, eight surveys were conducted in eastern Lancaster Sound and northwest Baffin Bay from 21 August-10 October. In 1979, seven surveys were conducted in the same area from 11 September-17 October. In each of the three years, the surveys were part of a more extensive series of surveys flown, usually at 1-2 wk intervals, from May through October. Figure 1 shows the general survey routes flown in each year; Table 1 shows the distances covered. In addition, a high altitude (150 m ASL) reconnaissance survey was conducted along parts of the shoreline of Jones Sound on 14 September in each of 1978 and 1979.

All surveys were conducted from a deHavilland Twin Otter aircraft equipped with radar altimeter and a Global

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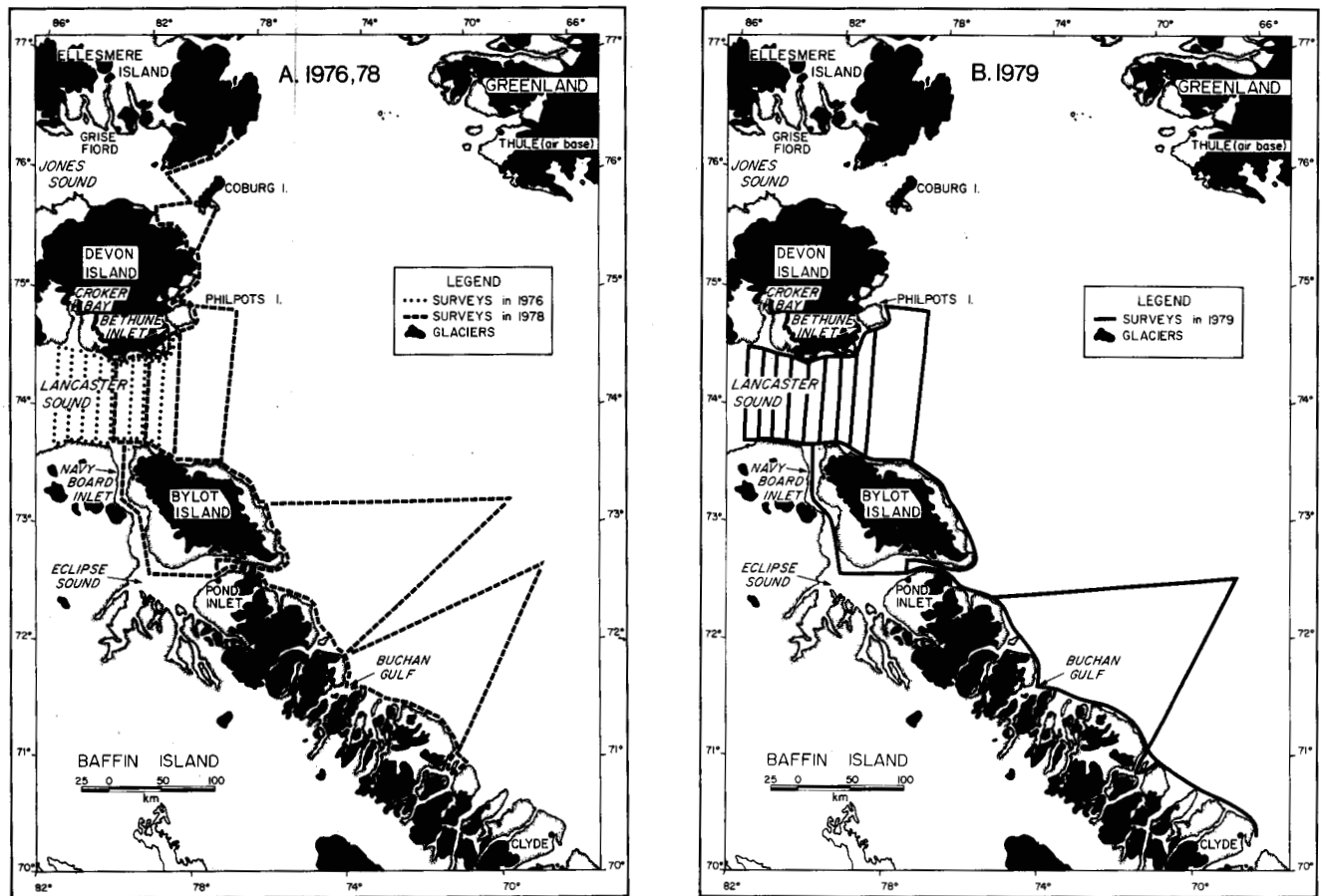


FIG. 1. Map of study area, showing places mentioned in the text and routes surveyed repeatedly in (A) 1976 and 1978, and (B) 1979.

TABLE 1. Densities (no. km⁻²)^a of ivory gulls recorded during aerial surveys in eastern Lancaster Sound and western Baffin Bay, 1976, 1978, 1979. Values in parentheses are numbers of kilometres of survey flown at each location^b.

Year		21 Aug - 9 Sept	10 - 27 Sept	28 Sept - 10 Oct	16 - 17 Oct
COASTS					
Ellesmere I.	1978	1.5 (325.1)	0.5 (344.1)	1.5 (115.9)	— ^c
Devon I.	1976	0.1 (646.8)	0.1 (632.3)	—	—
	1978	1.2 (845.9)	0.8 (720.1)	1.7 (624.8)	—
	1979	—	0.1 (804.2)	0.4 (489.7)	0.0 (31.9)
N Baffin I. & Bylot I.	1976	0 (477.9)	<0.1 (385.3)	—	—
	1978	0 (1197.9)	<0.1 (1405.7)	<0.1 (884.2)	—
	1979	—	0 (1116.9)	<0.1 (899.6)	<0.1 (29.6)
E. Baffin I.	1978	0 (1240.6)	<0.1 (1150.1)	0.0 (581.5)	—
	1979	—	0 (1246.3)	<0.1 (3145.2)	<0.1 (469.8)
OFFSHORE					
Jones Sound	1978	0 (358.9)	0.09 (378.3)	0.05 (209.3)	—
Lancaster Sound	1976	0.01 (2551.9)	0.01 (2358.0)	—	—
	1978	<0.01 (845.7)	0.02 (819.8)	0.05 (638.8)	—
	1979	—	0.03 (1295.9)	0.14 (620.2)	0.06 (477.6)
Baffin Bay	1978	0 (2833.2)	<0.01 (2592.5)	0.03 (2045.8)	—
	1979	—	0 (584.8)	<0.01 (804.5)	0.13 ^d (292.8)
Navy Board Inlet, Eclipse Sound & Pond Inlet	1978	0 (514.8)	0.03 (743.4)	0.04 (472.9)	—
	1979	—	0 (534.3)	0.03 (543.9)	—

^a Densities in 1976 and 1978 based on surveys flown at 45 m ASL; densities in 1979 based on surveys flown at 90 m ASL.

^b Excludes 'nearshore' surveys parallel to and centred 1.2 km from coasts and ice edges; such surveys were flown in 1976 and 1978 only.

^c (—) indicates area not surveyed.

^d Density based on survey flown at 150 m ASL.

Navigation System for accurate navigation. Surveys in 1976 and 1978 were conducted at altitude 45 m ASL, and at ground speed 160 km/h (1976) or 185 km/h (1978). In 1979 the surveys were designed primarily for marine mammals and conducted at 90 (or rarely 150) m ASL and 225 km/h. Transects along coasts were centred 200 m from the shoreline during low altitude (45 m) surveys with a transect width of 400 m, and 400 m and 800 m from the shoreline during high altitude (90 and 150 m, respectively) surveys. The survey procedures used, the methods of data analysis, and the limitations and biases inherent in aerial surveys are described in McLaren (1982).

ICE CONDITIONS

In 1976, eastern Lancaster Sound was mostly ice-free from 16 August-28 September, although a small amount of drift ice (5-8% cover) was present until 7 September. Refreezing had begun along the coast of Devon Island by 27 September, but average ice cover offshore at that time was estimated to be <1%.

In 1978, coastal areas of Ellesmere, Devon, Bylot and Baffin islands were generally ice-free during August and most of September. Fast ice began to form along the coasts of Bylot and Baffin islands during late September. By 7 October, ice had covered 90% of the transect area

along the Baffin and Bylot island coasts and about 60% of the area along Devon Island. There was little ice offshore in Lancaster Sound or in Baffin Bay east of Baffin Island until the end of September. By 10 October, Lancaster Sound was 75% ice-covered and surveyed portions of Baffin Bay were >90% ice-covered.

In 1979, the study area was generally free of ice during September. By 4 October the western and southern parts of Lancaster Sound were covered by new ice and pans. The east coast of Baffin Island was generally ice-free until mid-October. By 16-17 October, extensive ice cover was present on all surveyed portions of Lancaster Sound and adjacent Baffin Bay except the extreme northeast. Navy Board Inlet, Eclipse Sound and Pond Inlet were 90% covered with new ice by mid-October.

RESULTS

1976 — Ivory gulls were not numerous along the survey route in Lancaster Sound in 1976. Only 113 birds were counted during the seven surveys conducted from 16 August-28 September (total survey area 2821 km²). Of these, 89 were along the south coast of Devon Island (although only 18% of the total area surveyed was along that coast). Seventeen individuals were seen offshore (0.01 km⁻²); only six of these 17 were recorded after 30 August, and 16 of the 17 seen offshore were in the northern half of the sound. In addition, 386 ivory gulls (including 155 juveniles, none of which appeared to be banded) were seen feeding on the offal of white whales (*Delphinapterus leucas*) at Grise Fiord, Ellesmere Island, on 28 September.

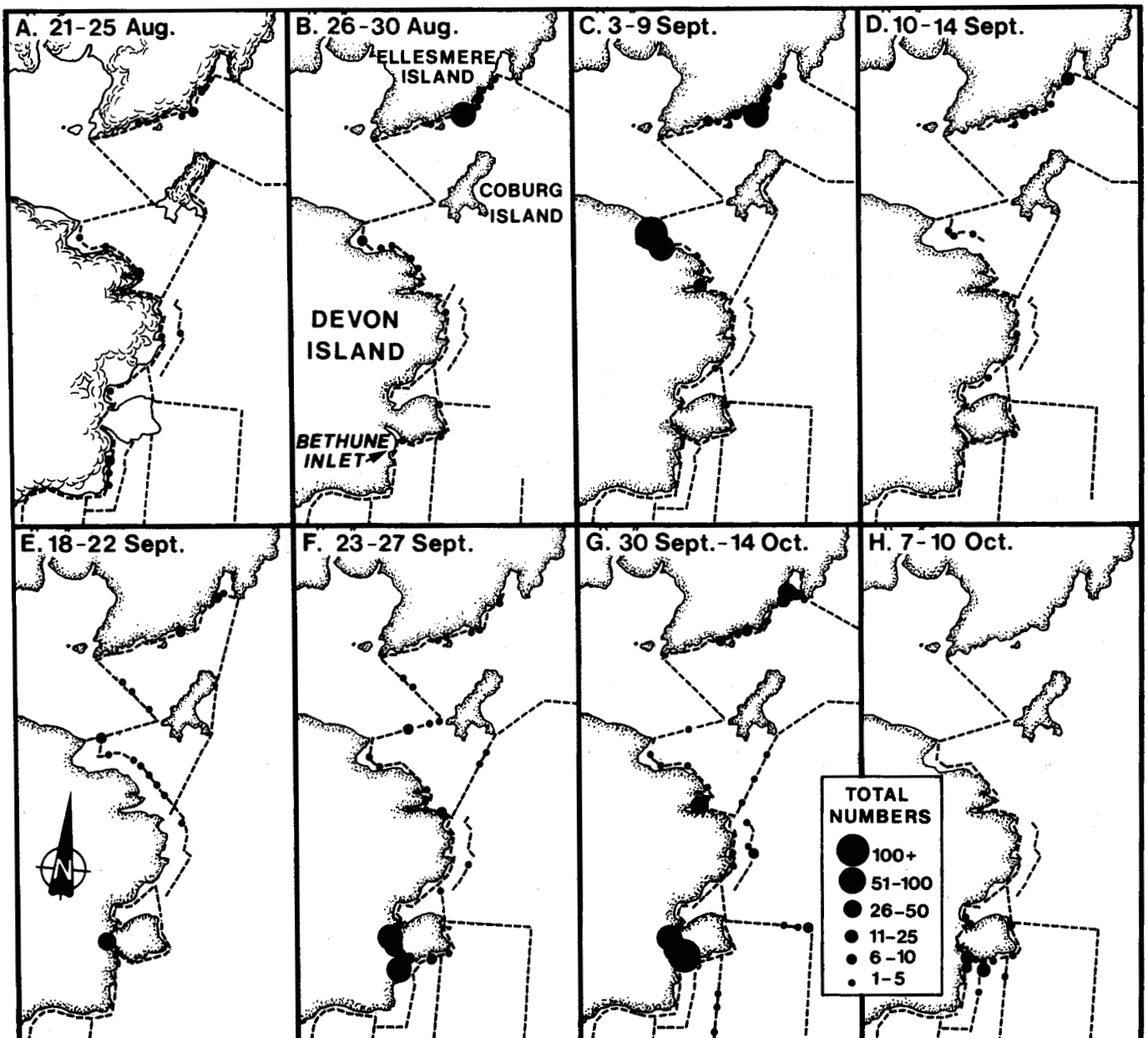


FIG. 2. Distribution of ivory gulls near southeast Ellesmere and east Devon islands, 21 August-10 October 1978. Dotted lines indicate path of survey.

1978 — Almost 1600 ivory gulls were recorded during the eight surveys from 21 August-10 October (total survey area 8756 km²). Densities in the various parts of the study area are presented in Table 1.

Ivory gulls were seen regularly during all surveys of the southeast coast of Ellesmere Island from 21 August-3 October. Almost 100 birds were counted during each of two surveys on 29 August and 3 September and more than 70 birds were still present during the last survey on 3 October (Fig. 2). Most of the gulls were at places where glaciers reach the sea (glacier fronts). Up to 40 ivory gulls were seen daily at the village of Grise Fiord from 24 August-2 September, and ~200 were there on 14 September.

Ivory gulls were present in offshore waters south and west of Coburg Island from 18 September until at least 4 October. On 14 September, 40 were seen during high altitude surveys in offshore Jones Sound.

Large flocks of ivory gulls first appeared along the coast of Devon Island in September. More than 350 were seen in front of a glacier along the northeast coast on 3 September. Strong winds prevented further surveys of that coast until 27 September, but a few dozen gulls were there from 27 September-3 October. Flocks of ivory gulls first appeared at Bethune Inlet, on the southeast coast, on 21 September, and hundreds of birds were seen in front of a large glacier there on 27 September and 3 October (Fig. 2). Over 75 were still present when this area was last surveyed on 9 October.

TABLE 2. Autumn concentrations of more than 100 ivory gulls in the Canadian Arctic Archipelago. Locations are mapped in Fig. 4.

Map No.	Location	Number observed	Date	General habitat	Source of record
1	Grise Fiord	386	28 Sept 1976	Offal	This study
		200	14 Sept 1979	Not recorded	This study
		640	14 Sept 1979	Not recorded	This study
		300	29 Sept 1979	Offal	This study
2	Resolute	200	7 Sept 1947	Coastline	Duvall and Handley (1948)
		112	4 Sept 1975	Offal	W.G. Alliston et al., LGL Ltd., pers. obs.
3	S Wellington Ch.	100	6 Sept 1946	Not recorded	Duvall and Handley (1946)
4	S Cornwallis I./ S Wellington Ch./ SW Devon I.	238 ^a	30 Sept 1976	Not recorded	K.J. Finley and W.G. Johnston, LGL Ltd., pers. obs.
5	unnamed bay SE of Belcher Pt., NE Devon I.	356	3 Sept 1978	Glacier front	This study
6	Bethune Inlet SE Devon I.	392	27 Sept 1978	Glacier front	This study
		164	3 Oct 1978	Glacier front	This study
7	Peel Sd./ Franklin Str.	138	28 Aug 1976	Not recorded	K.J. Finley and
		111	20 Sept 1976	Not recorded	W.G. Johnston, LGL Ltd.,
		414	24 Sept 1976	Not recorded	pers. obs.
8	Pond Inlet settlement	375	16 Oct 1979	Offal	This study
9	coast of Devon I., Bethune Inlet to Croker Bay	104	29 Sept 1979	Glacier front	This study

^a An additional 65 ivory gulls were also counted in Crozier Strait on the same day.

Ivory gulls were seen irregularly and in only small numbers along Bylot and Baffin islands from 10 September-4 October (Table 2). The maximum number seen during any one survey was 10 birds, nine of which were along the south coast of Bylot Island.

Up to 200 ivory gulls (0.01 km⁻²) were estimated to be in offshore Lancaster Sound and adjacent Baffin Bay from 21 August-23 September. On 3 October, an estimated 830 were present in the easternmost parts of the sound, but none were seen there on 9 October.

No ivory gulls were recorded in offshore areas of Baffin Bay east of Bylot and Baffin islands prior to 25 September, but an estimated 880 birds (0.03 km⁻²) were present between 30 September and 10 October.

1979 — Over 500 ivory gulls were seen during the seven medium-level (90 m) surveys from 11 September-17 October (total survey area 10 710 km²). Densities recorded in the various parts of the study area are presented in Table 1.

On 14 September, 862 ivory gulls were seen during a high altitude (150 m ASL) survey of the north and east coasts of Devon Island and the south coast of Ellesmere Island (Bear Head to Grise Fiord). Almost 98% were seen along Ellesmere Island, primarily in two large concentrations west of Grise Fiord. Although surveys were not repeated in this area, about 300 ivory gulls were seen at Grise Fiord on 29 September.

Ivory gulls were seen infrequently along the southeast coast of Devon Island between Bethune Inlet and Croker Bay. Flocks were first seen along glacier fronts on 25 September and peak numbers (104) were seen on 29 September, primarily in Croker Bay and Bethune Inlet.

Ivory gulls were scarce in areas south of Lancaster Sound prior to October. However, a few were seen in Navy Board Inlet and Eclipse Sound on 1-2 October and along the east coast of Baffin Island on 17 October. A flock of 375 birds were seen at the village of Pond Inlet on 16 October feeding on offal of ringed seals (*Phoca hispida*).

Densities offshore in eastern Lancaster Sound began to increase in late September (Fig. 3). Most ivory gulls seen on 25-26 September were in the westernmost portions of the sound, the only area where pan ice was present. The peak density was recorded on 29 September (0.20 birds km⁻², although only two cross-sound transects were surveyed). Densities in the sound were much lower by 16 October, although an estimated 1000 gulls were still present in the sound and adjacent Baffin Bay (Fig. 3). During a high level survey (150 m ASL) on 17 October more than 60 were counted (0.13 birds km⁻²) in offshore Baffin Bay east of Buchan Gulf, where the pack ice was extensive.

DISCUSSION

In all three years of study, ivory gull concentrations were observed consistently along the fronts of glaciers — in Croker Bay and Bethune Inlet in 1976, and in Bethune Inlet and along northeast Devon Island and southeast

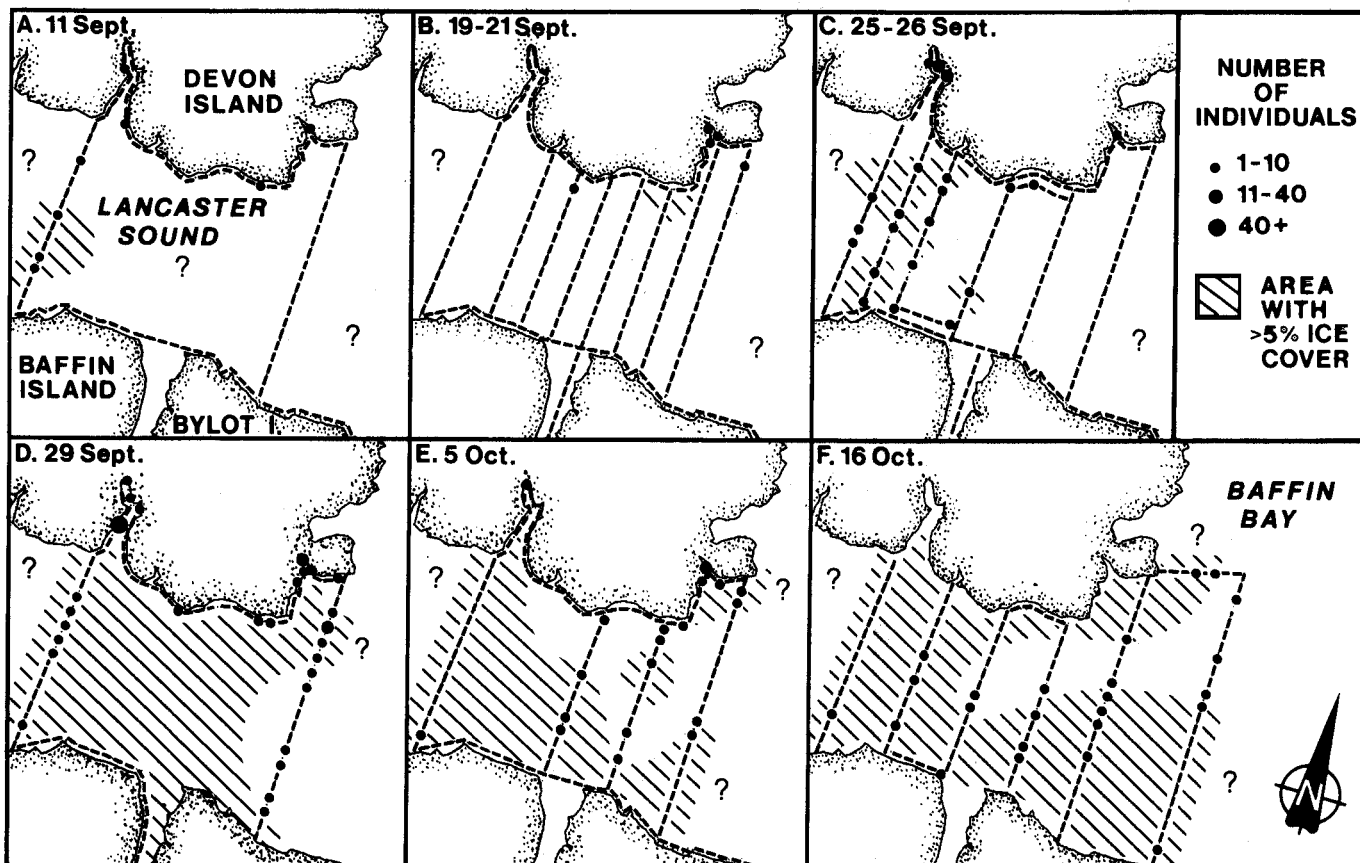


FIG. 3. Distribution of ivory gulls in eastern Lancaster Sound and adjacent Baffin Bay, 11 September-16 October 1979. Plotted as in Fig. 2.

Ellesmere Island in 1978. Although large concentrations were not observed in 1979, most individuals seen during surveys were in Croker Bay and/or Bethune Inlet. McLaren and Renaud (1982) noted that northern fulmars (*Fulmarus glacialis*), black-legged kittiwakes (*Rissa tridactyla*) and glaucous gulls (*Larus hyperboreus*) also occurred in large numbers in front of glaciers along Devon Island and Ellesmere Island during late summer and early autumn of 1976, 1978 and 1979. Hartley and Fisher (1936) and Hartley and Dunbar (1938) also observed large concentrations of gulls at glacier fronts in Spitsbergen and Greenland, respectively; the former authors noted that an ivory gull at a glacier front was feeding on euphausiids (Crustacea). Sampling of the food supply in waters in front of glaciers has not been conducted; however, Apollonio (1973) and Dunbar (1973) have found that such waters have high levels of nutrients which may promote phytoplankton production, and hence result in increased numbers of crustaceans and other organisms used as foods by the birds.

Large flocks of ivory gulls were also noted frequently near settlements, usually feeding at Inuit kills of whales and seals. We noted this habit on several occasions at Resolute, Cornwallis Island, in August and September of 1977-1979; there birds fed on refuse at the dump or on whale and seal offal in the harbour. Flocks of up to 50 ivory gulls were seen at kills of narwhals (*Monodon monoceros*), walrus

(*Odobenus rosmarus*) and seals at the floe edge of Pond Inlet from late May to early July in 1979. Scavenging behaviour was also observed offshore on the pack ice of Baffin Bay and Lancaster Sound during June 1978 and 1979, although groups rarely numbered more than 15-20 individuals (pers. obs.; K.J. Finley, LGL Ltd., pers. comm.). These data reinforce the view that scavenging is a regular feeding mode for ivory gulls (cf. Divoky, 1976).

Table 2 and Figure 4 summarize concentrations (>100 individuals) of ivory gulls reported in the Canadian arctic islands away from colonies. Most occurrences are near coasts during September. Part of the increase in numbers of ivory gulls along coasts in early September likely results from an influx of young-of-the-year that leave their nesting sites in late August (MacDonald, 1976). In 1978, the first juveniles were observed at Grise Fiord on 31 August.

Numbers of ivory gulls in offshore waters begin to increase as numbers seen along coasts decrease. There is apparently a movement in early October from coastal to offshore areas, presumably the initial stages of a migration southward to wintering areas. Although our sample sizes are small, the data strongly suggest that the movement is related to the amount of pan ice present offshore. In 1976, late summer densities in eastern Lancaster Sound were low (0.01 birds km⁻²); we never recorded more than four individuals offshore during any weekly survey. There was

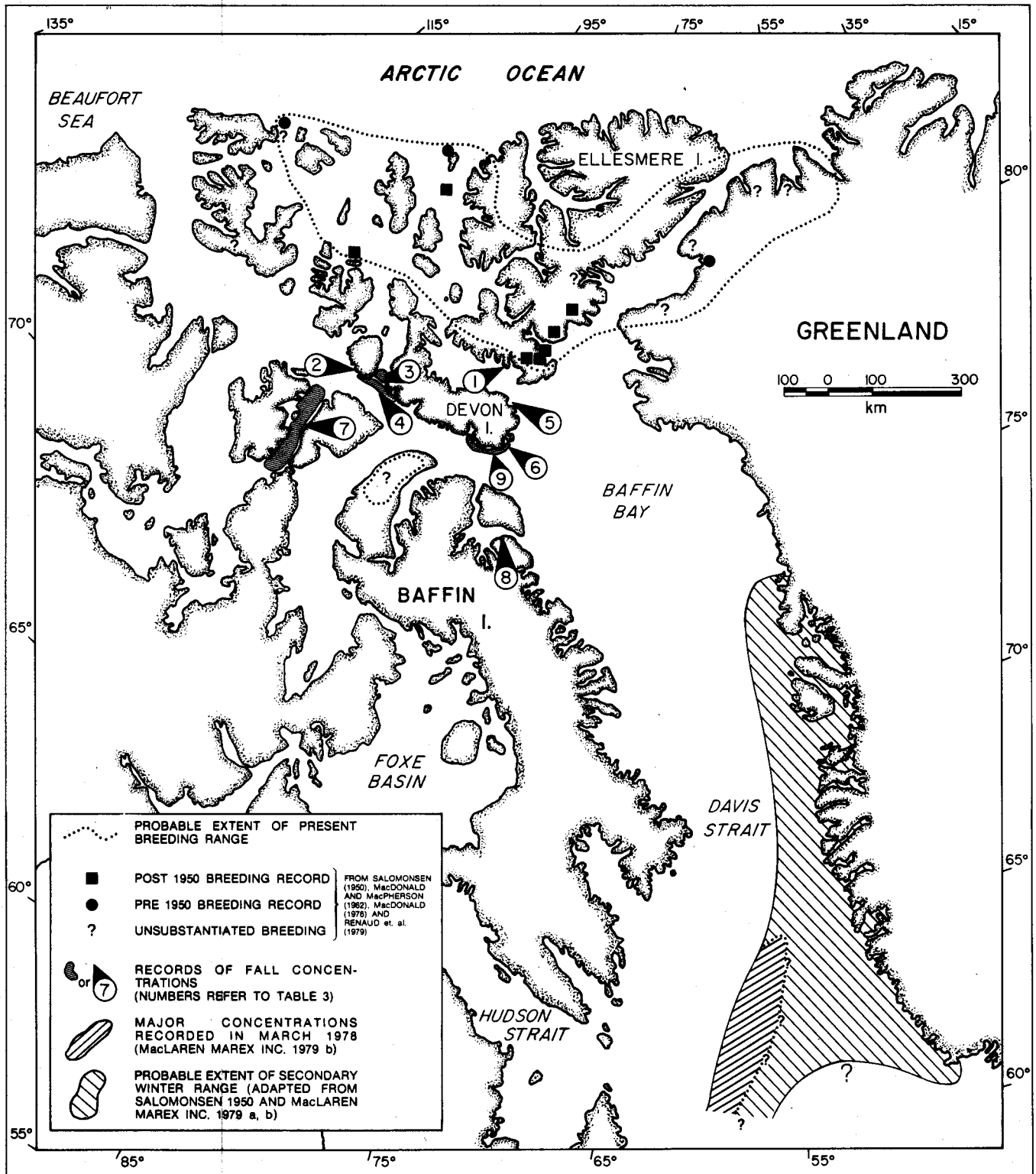


FIG. 4. Autumn concentrations of ivory gulls in relation to breeding distribution and winter range.

little or no ice in Lancaster Sound before 29 September, when surveys terminated. In 1978 there was an apparent movement of ivory gulls into Lancaster Sound concurrent with increasing ice cover: between 24 and 30 September pan ice cover increased from about 7% to 60% and the

density increased from 0.01 to 0.09 birds km^{-2} . Similarly, in the adjacent portion of Baffin Bay, the density increased from 0.01 to 0.08 birds km^{-2} as the ice cover gradually increased. By 9 October the density of ivory gulls had decreased to 0.02 km^{-2} in Lancaster Sound, suggesting

that migration into Baffin Bay had occurred. During a survey on 1-4 October, 10 of the 11 ivory gulls seen in Baffin Bay east of Baffin Island were seen along the only transect with ice cover >25%. In 1979, ivory gulls were first recorded in offshore Lancaster Sound in relatively large numbers with the first appearance of pan ice on 24-26 September, and were seen primarily on transects with pan ice (Fig. 3). As pan ice extended eastward, so did the distribution of ivory gulls (Fig. 3).

Numerous authorities have noted the close association between the presence of the pack ice and ivory gulls (e.g., Bailey, 1948; Salomonsen, 1950; Birkenmajer, 1968; Divoky, 1972; Watson and Divoky, 1972). Ivory gulls in the Chukchi and Beaufort seas feed by hovering and dipping, mostly within 2-3 m of the ice, or by picking up food items washed onto ice floes (Divoky, 1976). Divoky (1972, 1976) attributed the association of ivory gulls with ice to the presence of an under-ice fauna that included arctic cod (*Boreogadus saida*) and the amphipod *Apherusa glacialis*, which are important components of the ivory gull diet during fall (Divoky, 1976). Both arctic cod and *A. glacialis* associate with ice in our study area (Bradstreet, 1982; Cross, 1982). Thus the presence of pan ice is probably a prerequisite for offshore dispersal in Baffin Bay and Lancaster Sound.

Several observations suggest that ivory gulls noted in our study area include breeding birds from both the central arctic islands and northwest Greenland. One color-marked individual banded at the Seymour Island colony was seen 800 m off the Pond Inlet floe edge on 17 June 1978 (K.J. Finley, pers. comm.). In addition, 238 ivory gulls seen during an aerial survey in northern Barrow Strait on 30 September 1976 were migrating eastward toward Lancaster Sound (K.J. Finley and W.G. Johnston, LGL Ltd., pers. comm.). However, two birds banded at Grise Fiord in 1971 were recovered in the summer of 1974 at Thule, northwest Greenland (MacDonald, 1979). Most ivory gulls that nest in the Canadian High Arctic probably migrate southeast through Parry Channel and/or Baffin Bay, although the presence of a few in the southeast Beaufort Sea in autumn (Johnson *et al.*, 1975; Searing *et al.*, 1975) indicates that some may migrate southwest from the central Arctic. Ivory gulls are rare in Foxe Basin and Hudson Strait (Bray, 1943; Soper, 1946; Macpherson and McLaren, 1959; MacLaren Marex Inc., 1979 a, b), the only other possible route of marine passage between the Canadian nesting areas and eastern wintering grounds.

Ivory gulls probably leave northern Baffin Bay in winter (Renaud and Bradstreet, 1980); even the southern portions of Baffin Bay have only intermittent open leads and are probably unsuitable as wintering habitat (as observed from NOAA and LANDSAT imagery). The autumn exodus from Baffin Bay likely occurs with freeze-up in late October or November. In 1978, ivory gulls appeared in sizeable numbers off southeast Baffin Island between early October and early November (MacLaren Marex Inc., 1979b). The very high densities recorded during aerial surveys

along the edge of the pack ice in Davis Strait in March (0.32 birds km⁻² [MacLaren Marex Inc., 1979a]) suggest that many winter along this edge.

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