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Seabird Concentrations in Late Summer Along the Coasts of Devon and Ellesmere Islands, N.W.T.

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ABSTRACT. The presence of large concentrations of northern fulmars and black-legged kittiwakes along coasts of Devon and Ellesmere islands was documented in 1976 and 1978 by aerial surveys. Fulmars were present along these coasts from late July until mid-September, with peaks in late August and early September along Devon Island, and mid-September along Ellesmere Island. Black-legged kittiwakes were abundant along Devon Island after mid-September, but common along Ellesmere Island from late August to late September. Densities of both species were significantly higher in front of glaciers than along coastlines.

Key words: northern fulmar, black-legged kittiwake, arctic distribution, late summer, glacier front, Devon Island, Ellesmere Island

RÉSUMÉ. Des relevés aériens en 1976 et 1978 ont permis de retracer de fortes concentrations de fulmars boréaux et de mouettes tridactyles le long des côtes des îles de Devon et Ellesmere. Les fulmars y étaient présents de la fin juillet à la mi-septembre, avec une concentration maximale à la fin août et début septembre près de Devon, et à la mi-septembre près d'Ellesmere. Les mouettes tridactyles étaient abondantes le long des côtes de Devon après la mi-septembre, mais courantes près d'Ellesmere de la fin août à la fin septembre. La densité des deux espèces étaient significativement plus à l'avant sur le front des glaciers que le long des côtes.

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INTRODUCTION

The northern fulmar (*Fulmarus glacialis*) and the black-legged kittiwake (*Rissa tridactyla*) are common seabirds in the Canadian High Arctic, and nest at several colonies in the Lancaster Sound-northwest Baffin Bay region (Brown *et al.*, 1975). The sizes of both the total population and the nesting population in the area are unknown, although the latter has been estimated at 350 000 pairs (Brown *et al.*, 1975; S.R. Johnson, pers. comm.). These species return in late April and May (McLaren, 1982); nesting by both species begins in June and young fledge in late August and September (Nettleship, 1977). Migration from the area is underway in October (pers. obs.). However, there are few data documenting distribution in late summer and early fall, during and after nesting, although Nettleship (1974) noted large numbers of fulmars and gulls along the south coast of Devon Island in early August 1972.

In 1976 and 1978 we conducted aerial surveys in eastern Lancaster Sound and northwest Baffin Bay from May to October to document seabird movements and distribution. During the course of these surveys, we observed large flocks of fulmars and kittiwakes along the coasts of Ellesmere and Devon islands between late July and mid-October. This paper summarizes these observations and provides new information concerning distribution and habitat use of these species at this time of year.

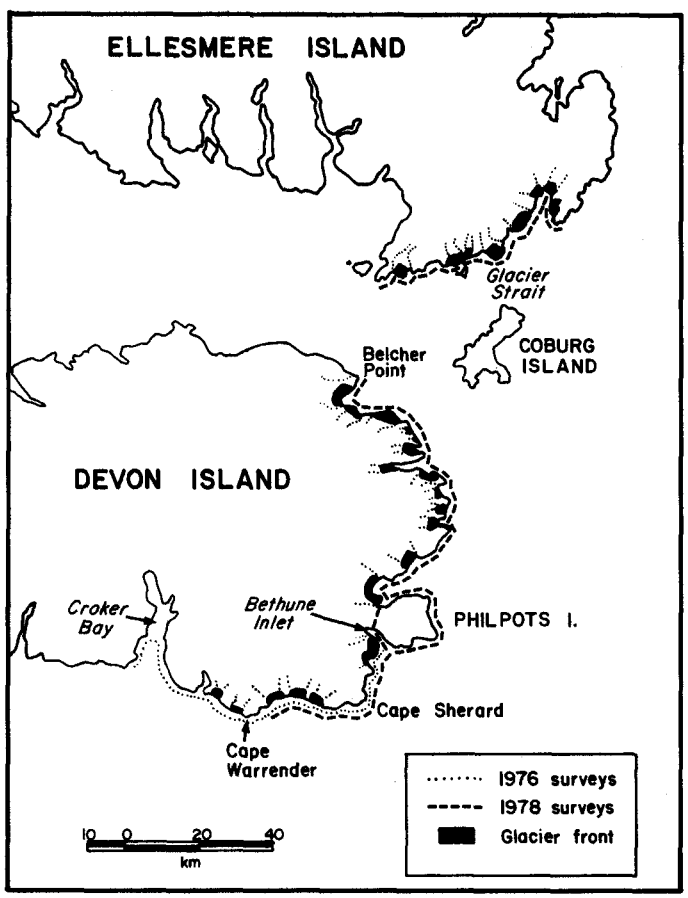

FIG. 1. Coasts of Ellesmere and Devon islands surveyed in 1976 and 1978.

METHODS

In 1976, weekly aerial surveys of marine birds and mammals were conducted along the southeast coast of Devon

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TABLE 1. Numbers of kilometres of survey along Ellesmere and Devon islands in the late summer of 1976 and 1978

		Devon I.			
	Ellesmere I.	Croker Bay-Cape Warrender	Cape Warrender-Philpots Island		Philpots Island-Belcher Point
Date	1978	1976	1976	1978	1978
28-30 Jul	33.8	62.8	99.8	78.0	167.6
1-3 Aug	—	74.0	112.6	—	—
8-10 Aug	—	80.0	107.0	—	—
11-17 Aug	103.8	98.2	127.1	84.9	181.0
22 Aug	99.0	—	—	98.2	159.4
26-30 Aug	117.5	98.2	112.6	102.5	170.5
3-9 Sep	108.6	98.2	112.6	145.3	190.9
10-13 Sep	113.9	98.2	112.6	129.7	144.4
19-21 Sep	115.1	98.2	112.6	124.7	56.0
23-27 Sep	115.1	98.2	112.6	115.3	149.3
30 Sep-3 Oct	115.9	—	—	144.0	168.8

Island from 25 July - 28 September. In 1978, eight surveys were conducted, generally at weekly intervals, along the southeast coast of Ellesmere Island and the east and southeast coasts of Devon Island from 11 August - 10 October. Figure 1 shows the general survey routes flown in each year; Table 1 shows the distances covered. In both years, the surveys were part of a more extensive series of surveys flown, usually at weekly intervals, in the eastern Lancaster Sound-northwest Baffin Bay region from May through October. Some of the additional coverage in 1978 is mapped on Figures 2 and 3.

All surveys were conducted from a deHavilland Twin Otter aircraft equipped with radar altimeter and a Global Navigation System for accurate navigation. They were conducted at altitude 45 m ASL, and at ground speed 160 km/h (1976) or 185 km/h (1978). Observers sat in the co-pilot's seat and in a left rear seat behind the pilot. Transect width was 400 m (200 m on either side of the aircraft), but birds seen off-transect were also recorded separately. In 1976, two parallel sets of transects were flown — a 'coastal' set was parallel to and centred 200 m from the coast, and a 'nearshore' set was 1200 m from the coast. In 1978, only the transects 200 m from shore were surveyed.

In addition to these surveys, high altitude reconnaissance surveys (90 m ASL) were conducted along portions of the Devon Island coast in September 1979. The surveys were designed primarily for observations of marine mammals and conducted at 225 km/h with 800 m wide transects. A detailed description of the survey procedures

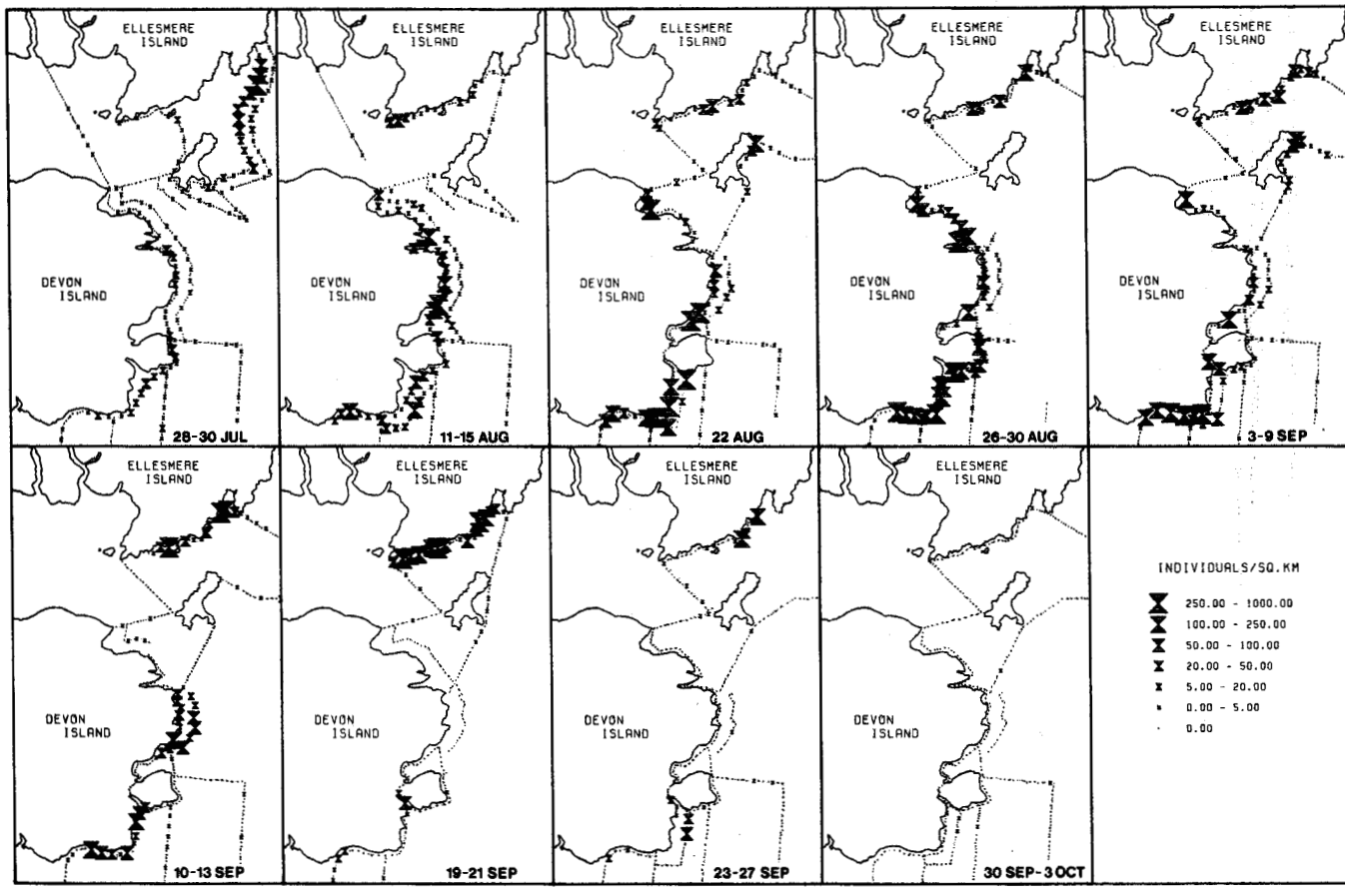

FIG. 2. Distribution of northern fulmars along coasts of east Devon and southeast Ellesmere islands, 28 July - 3 October 1978. Dotted lines indicate paths of survey. Symbols represent densities of fulmars in 2-min (about 6 km) segments of transect.

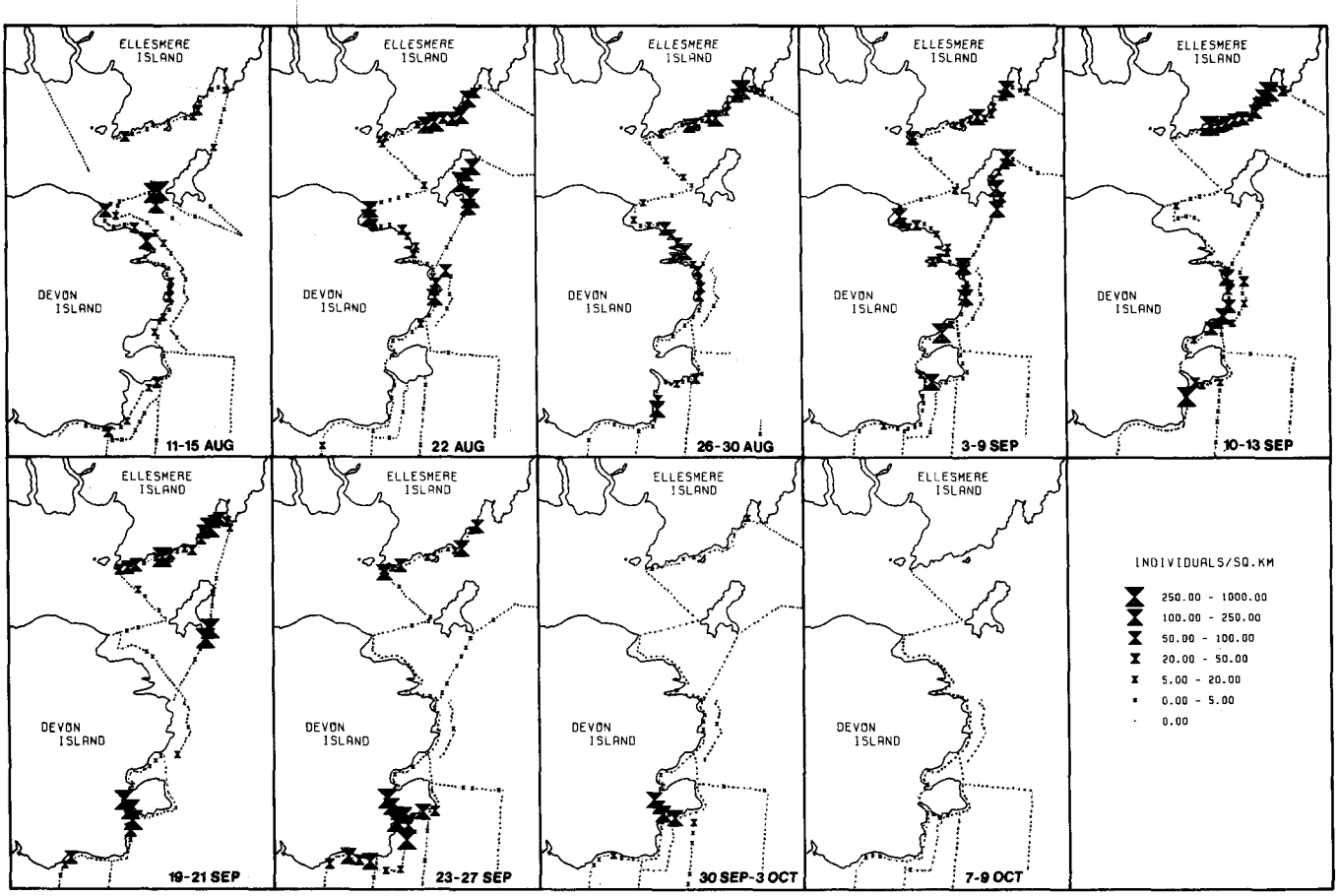

FIG. 3. Distribution of black-legged kittiwakes along coasts of east Devon and southeast Ellesmere islands, 11 August - 9 October 1978. Plotted as in Fig. 2.

used, methods of data analysis, and limitations and biases inherent in aerial surveys is provided in McLaren (1982).

For 1978, the estimated numbers of birds are simply the numbers recorded on-transect during the surveys flown 200 m from the shoreline. For 1976, however, the values include counts made on transects centred 200 and 1200 m from the shore plus an interpolation for the area 400-1000 m (0.6 km) from the coast. These interpolations have been derived from the numbers recorded by (A) the observer looking offshore on transects 200 m off the coast and (B) the observer looking towards the shore on transects 1200 m off the coast, as follows:

$$\frac{[\text{density of (A)} + \text{density of (B)}]}{2} \times \frac{[\text{length of (A)} + \text{length of (B)} \times 0.6]}{2}$$

It is important to note that the number of birds recorded is often an estimate and, generally, the larger the flock seen, the less accurate the estimate. Accuracy is further reduced when several hundreds (or thousands) of individuals of several species are in sight continuously (often simultaneously diving, flushing, swimming and flying) for a long period of time. Such a situation is typical along the coasts of Devon and Ellesmere islands in August and September. The counts presented here are the actual numbers recorded and have not been corrected for any biases or other factors.

RESULTS

Northern Fulmar

Ellesmere Island. Because Glacier Strait contained fast ice until August 1978, the icebound parts of the coast of southeast Ellesmere Island were not surveyed in late July. Northern fulmars were present here during the first late summer survey in mid-August, and high densities were recorded from then until late September (Table 2, Fig. 2). The average density during this period was 39.0 fulmars km^{-2}; densities increased steadily to a peak on 21 September (94.5 fulmars km^{-2}), when more than 5000 fulmars were counted. Virtually all fulmars had left this area by the beginning of October.

East Devon Island. In 1978, large concentrations of fulmars appeared along the coast between Belcher Point and Philpots Island in early August, and about 3000 fulmars were seen during each of three surveys there from 11-30 August. Numbers and densities decreased thereafter (Fig. 2, Table 2) and few remained in this area after mid-September.

South Devon Island. In 1976, large numbers of northern fulmars appeared along south Devon Island in late July. Estimated numbers more than doubled between surveys on 25-26 July and 1-3 August, to about 26 000 individuals.

TABLE 2. Numbers and densities of northern fulmars recorded during aerial surveys along coasts of Devon and Ellesmere islands, 28 July-3 October 1978

Date	Southeast Devon I. (Cape Warrender-Philpots I.) No.[a] recorded	Southeast Devon I. (Cape Warrender-Philpots I.) Density (birds/km^2)	East Devon I. (Philpots I.-Belcher Pt.) No.[a] recorded	East Devon I. (Philpots I.-Belcher Pt.) Density (birds/km^2)	SE Ellesmere I. No.[a] recorded	SE Ellesmere I. Density (birds/km^2)
28-30 Jul	247	7.9	391	5.8	—[b]	—[b]
11-15 Aug	727	24.3	2855	39.4	403	9.7
22 Aug	3237	127.4	3218	50.5	414	10.5
26-30 Aug	12 002	292.7	3225	47.3	877	18.6
3-9 Sep	4831	73.9	929	12.2	988	22.7
10-13 Sep	1397	31.9	856	14.9	2768	56.9
19-21 Sep	276	6.8	1	<0.1	4410	94.5
23-27 Sep	90	6.4	0	0	967	21.0
30 Sep-3 Oct	0	0	0	0	1	<0.1

[a]0-400 m from coastline.
[b](—) indicates area not surveyed.

An estimated 30 000-35 000 fulmars were present along the south coast throughout August and early September (Table 3). Numbers declined in mid-September and by the end of the month only a few hundred were still present. During the first half of August fulmars were common along the entire south coast east of Croker Bay; however, by the end of the month the vast majority were east of Cape Warrender.

In 1978, large numbers of fulmars appeared along southeast Devon Island in mid-August, or about 2-3 wk later than in 1976 (although the coast west of Cape Warrender was not surveyed in 1978). Peak densities were recorded during the last 10 days of August (Table 2). The largest flocks were regularly seen in Bethune Inlet, southwest of Philpots Island. Densities decreased sharply during September and few remained at the end of the month.

TABLE 3. Estimated numbers of northern fulmars along Devon Island, 25 July-28 September 1976

Distance from shore:	South Devon I. (Croker Bay-Cape Warrender) 0-1000 m	South Devon I. (Croker Bay-Cape Warrender) 1000-1400 m	Southeast Devon I. (Cape Warrender-Philpots Island) 0-1000 m	Southeast Devon I. (Cape Warrender-Philpots Island) 1000-1400 m	Total
25-26 Jul	4440	278	2990	2919	10 627
1-3 Aug	10 628	811	12 427	2296	26 162
9 Aug	11 611	1624	12 887	3448	29 570
16-17 Aug	17 853	2181	9016	1631	30 681
29-30 Aug	1770	565	20 851	6774	29 960
5-6 Sep	2439	129	26 656	5089	34 313
12-13 Sep	4075	264	9550	7263	21 152
19-21 Sep	39	30	634	158	861
26-28 Sep	383	144	447	183	1157

During a reconnaissance survey on 19 September 1979, more than 16 000 fulmars were seen along the coast of Devon Island between Croker Bay and Philpots Island. Most were in Bethune Inlet. Over 7500 were still present on 25 September but few were seen at the beginning of October.

Black-legged Kittiwake

Ellesmere Island. In 1978, large numbers of kittiwakes appeared in coastal areas of Ellesmere Island after mid-August. Numbers and densities increased further in mid-September, and peaked on 21 September when almost 8500 birds (180 kittiwakes km^{-2}) were counted (Table 4, Fig. 3). They were still common in this area on 27 September (2300 counted, mostly off transect) but few were seen thereafter.

TABLE 4. Numbers and densities of black-legged kittiwakes recorded during aerial surveys along coasts of Ellesmere and Devon islands, 28 July-3 October 1978

Date	Southeast Devon I. (Cape Warrender-Philpots I.) No.[a] recorded	Southeast Devon I. (Cape Warrender-Philpots I.) Density (birds/km^2)	East Devon I. (Philpots I.-Belcher Pt.) No.[a] recorded	East Devon I. (Philpots I.-Belcher Pt.) Density (birds/km^2)	SE Ellesmere I. No.[a] recorded	SE Ellesmere I. Density (birds/km^2)
28-30 Jul	33	1.1	493	7.4	—[b]	—
11-15 Aug	93	4.6	884	12.2	246	5.9
22 Aug	3	0.1	1444	22.7	2497	63.1
26-30 Aug	374	14.4	1268	18.6	2266	48.2
3-9 Sep	405	7.4	2705	35.4	1186	27.3
10-13 Sep	1421	38.4	1196	20.7	5303	116.4
19-21 Sep	25 641	725.1	8	0.4	8287	180.0
23-27 Sep	20 604	782.8	109	1.8	874	19.0
30 Sep -3 Oct	1263	30.5	11	0.2	27	0.6

[a] 0-400 m from coastline.
[b] (—) indicates area not surveyed.

East Devon Island. In 1978, concentrations of kittiwakes appeared along east Devon Island in early August. Numbers increased through late August and early September, to a peak of 2705 birds on 3 September. Few were seen along this coast after mid-September.

South Devon Island. In 1976, 200-2300 kittiwakes were present regularly along south Devon Island during surveys in August. Most were east of Cape Warrender. In early September, numbers increased to 11 275 on 5-6 September, and 4000-9000 kittiwakes were present regularly through the rest of September (Table 5).

In 1978, few kittiwakes were present along south Devon Island prior to mid-September. However, enormous numbers were present in and to the south of Bethune Inlet during the last half of September. An estimated 25 000-40 000 were present on 15 September (R.A. Davis, pers. comm.), 34 000 were seen on 21 September, and 21 000 were coun-

TABLE 5. Estimated numbers of black-legged kittiwakes along Devon Island, 25 July-28 September 1976

	South Devon I. (Croker Bay-Cape Warrender)		Southeast Devon I. (Cape Warrender-Philpots I.)		
Distance from shore:	0-1000 m	1000-1400 m	0-1000 m	1000-1400 m	Total
25-26 Jul	65	3	282	44	394
1-3 Aug	181	0	1380	97	1658
9 Aug	77	28	86	31	222
16-17 Aug	2	2	302	269	575
29-30 Aug	148	13	1684	359	2304
5-6 Sep	1092	45	9700	438	11 275
12-13 Sep	1916	281	1153	572	3922
19-21 Sep	600	69	4026	110	4805
26-28 Sep	2244	257	4873	1455	8829

ted on 27 September. Over 1200 were still present on 3 October, but most had disappeared by 9 October.

More than 28 000 kittiwakes were counted between Bethune Inlet and Cape Sherard during a survey at 90 m ASL on 19 September 1979, and another 15 000 were seen between Cape Sherard and Croker Bay. About 24 000 kittiwakes were counted in the same areas on 25 September — again most were east of Cape Warrender — and about 5500 were present on 29 September. Only 250 kittiwakes were seen on 5 October.

Habitat Use

In 1978, densities of birds were calculated for regular coastlines and for those sites along the coasts where glaciers reached the sea ('glacier fronts'). Each 2-min (~6 km) segment of coastal transect was classified as one or the other of these two habitat types, and the density in each segment was calculated. Densities of both fulmars and kittiwakes were significantly higher at glacier fronts than along regular coastlines (Table 6). This was especially evident for fulmars along Ellesmere Island, where glacier front densities (63.7 birds km^{-2}) were almost three times those in other coastal areas (23.6 birds km^{-2}).

TABLE 6. Densities of northern fulmars and black-legged kittiwakes at glacier fronts and in other coastal areas[a]

	Density (no./km^2)				
	Glacier front	Other coasts	χ^2	df	P
Northern fulmar	49.9	34.2	13.5	3	<0.01
Black-legged kittiwake	142.3	49.3	21.1	3	<0.001

[a]Chi-square tests are based on analysis of the numbers of transect segments in the two habitats that had densities of 0, 0.1-2.0, 2.1-21.5, and >21.5 birds/km^2.

DISCUSSION

Although large numbers of fulmars and kittiwakes were seen at many sites along the coasts of Devon and Ellesmere islands, densities were significantly higher at glacier fronts than in other coastal areas. This was especially so along the coast of Ellesmere Island. Besides fulmars and kittiwakes, over 4400 glaucous gulls (*Larus hyperboreus*) were seen along southeast Ellesmere Island, mostly at glacier fronts, on 21 September 1978 (pers. obs). As well, flocks of ivory gulls (*Pagophila eburnea*) were frequently seen at glacier fronts during the surveys in 1978 and 1979 (Renaud and McLaren, 1982). Marine mammals, especially walruses and bearded seals, were also common along the southeast coast of Devon and Ellesmere islands during surveys in August and September 1978, and occurred in higher densities along glacier fronts than in other coastal areas (pers. obs.). Similarly, Hartley and Fisher (1936) noted the presence of large concentrations of kittiwakes at glacier fronts in Spitsbergen. The reasons for the presence of large numbers of animals at glacier fronts are unknown. It is possible that these concentrations occur in response to a food resource that is either less abundant or less accessible elsewhere. Apollonio (1973) and Dunbar (1973) have found high levels of nutrients in waters in front of glaciers; these nutrients presumably promote phytoplankton production, which in turn results in a high level of production of crustaceans and other organisms used as foods by birds. The large concentrations of kittiwakes noted in Spitsbergen were feeding on crustaceans (Hartley and Fisher, 1936).

Nettleship (1974) noted the presence of "a continuous dense band" of northern fulmars along Devon Island between Cape Sherard and Cape Warrender on 1-2 August 1972, but did not quantify the numbers of birds present. He found them to be common west to Croker Bay, less so west of there. In our study, although thousands were also present in early August 1976, large numbers of fulmars did not appear along southeast Devon Island in 1978 until late August. The apparent 2-3 wk difference in timing of movement to this coast between 1978 and the earlier years may have been due to prevailing ice conditions. The fast ice in Bethune Inlet, where the densest concentrations of fulmars were noted, had disappeared by 25 July in 1976 but was present until about 15 August in 1978. No information concerning ice conditions in Bethune Inlet is available for 1972. It may be that fulmars move into Bethune Inlet, the site of an extensive glacier front, and to adjacent coasts as soon as they become free of ice. Large flocks of fulmars were present along the east coast of Devon Island earlier than elsewhere in 1978; this coast was also free of ice earlier than the coasts of south Devon Island and southeast Ellesmere Island.

The age composition of the fulmars that form these coastal concentrations is unknown. A large proportion of the fulmars seen along the south coast of Devon Island in August 1978 were molting birds (M.S.W. Bradstreet, pers. comm.), which suggests that they are either failed nesters or subadult birds. Nesting birds molt after the young have left the nest in mid-September (Nettleship, 1977), which is after the period when the large numbers of fulmars were seen along Devon Island. Where the fulmars came from is similarly unknown. Presumably, many, if not most, of the fulmars along Devon Island were part of the population that summers at colonies in Lancaster Sound; the fulmar concentrations along Ellesmere Island may have included birds from more northerly colonies at Coburg Island and Cape Vera, Devon Island, at the west end of Jones Sound.

Unlike fulmars, kittiwake concentrations first appear in coastal areas in mid-September, after most nesting is finished. Thus, the birds in these concentrations may include both adults and young from the colonies on Prince Leopold, Bylot, and Coburg islands, and possibly subadults as well. Coulson (1966) indicated that immature kittiwakes may form an important component of the large flocks that occur in coastal areas in the latter part of the nesting season.

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