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# The Distribution of Larger Species of Birds Breeding on the Coasts of Foxe Basin and Northern Hudson Bay, Canada

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ABSTRACT. Aerial surveys of large birds on the coasts of Foxe Basin and northern Hudson Bay were carried out in late June and early July in 1979, 1983 and 1984. Greatest numbers of birds were seen along low-lying coasts backed by wet lowland tundra, particularly where these merged into extensive inter-tidal flats. These areas have emerged from the sea only during the past 2000 years. Even in areas of wet lowland tundra, all species except jaegers appeared to be patchy in their distribution, the patches being unrelated to obvious features of the habitat. We suggest that breeding habitat for many species is not completely occupied, at least in normal breeding seasons. We propose that statutory protection be extended to all or parts of Prince Charles and Air Force islands, which support high numbers of several species and are currently unprotected.

Key words: arctic birds, coastal breeding, aerial surveys, Foxe Basin, Hudson Bay

RÉSUMÉ. On effectua des inventaires aériens des oiseaux de grande taille sur les côtes du bassin Foxe et du nord de la baie d'Hudson en fin-juin et début-juillet, en 1979, 1983 et 1984. De grandes populations d'oiseaux furent observées dans les terres basses côtières longées par la toundra mouillée, surtout lorsque les terres basses et la toundra formaient de longues plaines intertidales. Ces régions n'ont été soulevées de la mer qu'au cours des deux derniers millénaires. Toutes les espèces sauf les labbes semblent présenter une distribution irrégulière même dans les terres basses à toundra mouillée, leur distribution ne semblant pas relever des caractéristiques de leur habitat. Nous suggérons que l'habitat de nidification de plusieurs espèces n'est pas complètement occupé, tout au moins au cours des saisons normales de nidification. Nous proposons qu'une protection statutaire totale ou partielle soit accordée à l'île Prince-Charles et à l'île de l'Aviation, où se trouvent d'importantes populations de plusieurs espèces actuellement sans aucune protection.

Mots clés: oiseaux arctiques, nidification côtière, inventaires aériens, bassin Foxe, baie d'Hudson

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## INTRODUCTION

Foxe Basin is one of the least known areas of the Canadian North. Because the pack ice does not completely clear until September or October (Markham, in press), summer navigation in the basin is beset by the problems of drifting pack, sometimes including multi-year ice (Canada, 1974, 1978, 1979). The lack of open water means that during the summer travel by local people is restricted. The basin is, in any case, sparsely populated compared to Hudson Bay, with only two permanent communities at present, at Igloolik and Hall Beach (Fig. 1). In addition there has been none of the activity related to oil exploration that has precipitated exploration and surveys along the coasts of the western Arctic and the arctic archipelago.

Ornithologically, the islands of northern Hudson Bay (Coats, Southampton) can be considered adequately surveyed through the efforts of Halkette (1904), Sutton (1932a,b), Bray and Manning (Bray, 1943), Parker and Ross (1973) and Abraham and Ankney (1986). The lowland coasts of western Baffin Island have also received considerable attention (Soper, 1928; Macpherson and McLaren, 1959; Kerbes, 1975). However, the birds of the large islands of Foxe Basin (Prince Charles, Air Force, Bray, Rowley, etc.) remain almost unknown except for the work of Ellis and Evans (1960). In this paper we combine information from aerial surveys carried out in 1979 (Reed *et al.*, 1980), 1983 and 1984 to provide an overview of distributions and comparative abundance of large, readily identified coastal birds in northern Hudson Bay and Foxe Basin. Our intention is to identify the coastal areas of greatest importance to each species and those that can be considered most outstanding in terms of the density and variety of birds.

## COASTAL TOPOGRAPHY AND REGIONAL CLIMATE

Foxe Basin and northern Hudson Bay include areas in which there has been great isostatic uplift since the disappearance of the Pleistocene ice sheets (Innes *et al.*, 1968). Consequently much of the coastal zone has only recently emerged from the sea and raised-beach features are very common, particularly on northeast Melville Peninsula and Coats, Southampton and Mansel islands.

From the point of view of the avifauna, coasts can be divided into those that are low lying and backed by marshy tundra and those that are elevated, rocky and without extensive wet tundra (Fig. 2). Low-lying coasts occur extensively on Coats, Mansel, Prince Charles and Air Force islands, on the south and west coasts of Southampton Island and on the west coast of Baffin Island from Foxe Peninsula north to Taverner Bay. Elsewhere they tend to be confined to bays and river mouths.

An important feature determining the numbers and species of birds was the presence or absence of extensive inter-tidal mud flats. The distribution of such broad inter-tidal areas coincides roughly with the distribution of low-lying coasts (Fig. 2). They are particularly well developed at East Bay and Bay of God's Mercy on Southampton Island, along the coasts of the Great Plains of the Koukdjuak and on the south coasts of Prince Charles and Air Force islands.

Climate is fairly uniform over the area surveyed. Mean annual air temperatures are –10° to –15°C, except for Coats and Mansel islands, which are slightly warmer. In July the warmest areas are west and southwest Southampton Island (mean daily temperature 7.5-10°C). All other areas have mean daily temperatures of 5-7.5°C, except small areas of northeast

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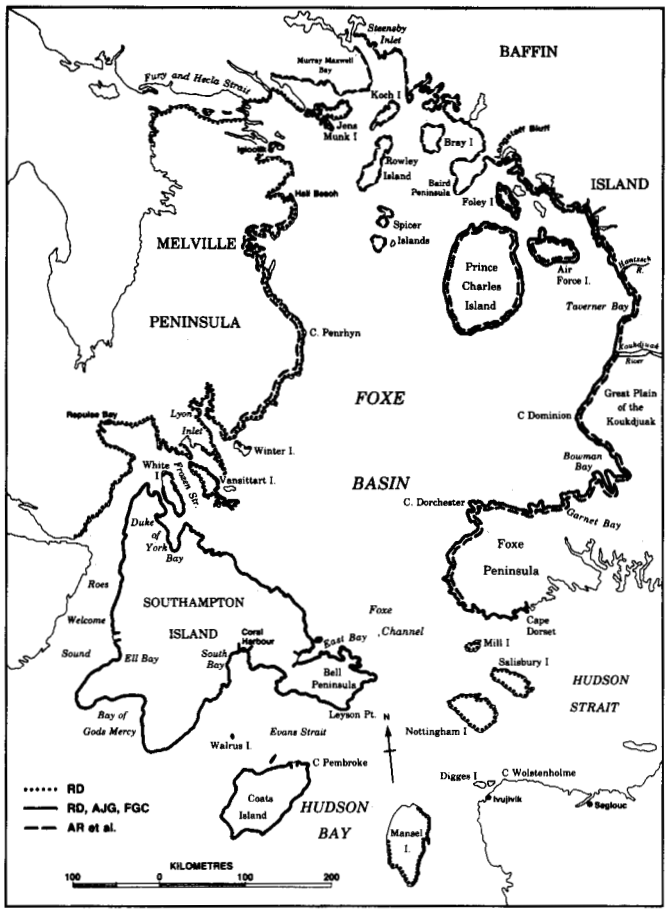


FIG. 1. Routes of survey flights carried out in 1979, 1983 and 1984.

Southampton Island and northwest Prince Charles Island, which fall below 5°C (Canada, 1974; Maxwell, 1981). Lakes and rivers on Southampton, Coats and Mansel islands are ice free on average by 15 July. Elsewhere the average date is between 15 July and 1 August, except between Hall Beach and Steensby Inlet, where the average date is later than 1 August. Freeze-up of lakes throughout the area begins after 15 September on average. Annual precipitation is in the range 200-400 mm, decreasing from SE to NW. The entire region falls within the zone of continuous permafrost (Canada, 1978).

## METHODS

Surveys in 1979 were carried out using a De Havilland Twin Otter aircraft. In 1983 and 1984 a Cessna 337 was used. Ground speed varied with wind speed and direction but was in the range 150-200 km $h^{-1}$ throughout, averaging about 165 km $h^{-1}$. Altitude was 50 m above the ground in 1979 and approximately 60 m in 1983 and 1984. Dates and times of all surveys used in this analysis are given in Table 1 and routes on Figure 1.

The flight path was maintained as nearly as possible parallel to the high tide line and 200-500 m inland. Where coasts were steep the aircraft flew 100-200 m offshore. We visited most offshore islands, flying out directly from the closest point on the shore and then resuming the coastal survey at the point where we had broken off. Where offshore islands were numerous, we surveyed only a sample. Where necessary to confirm identifications or counts, the plane circled for a second pass.

In addition to the coastal routes a few transects were flown inland from the coast on Coats, Southampton, Prince Charles and Air Force islands and on the Great Plains the Koukdjuak, West Baffin Island. Because these transects were neither random nor systematic their representativeness is unknown. We have therefore omitted them for any numerical analysis. However, data recorded are on file with the Canadian Wildlife Service.

No attempt was made to define a transect width, and we counted all birds seen, irrespective of their distance from the flight path. In 1979 two observers on each side of the aircraft recorded the birds seen by five-minute periods. In 1983, when two or three observers were used, observations were recorded by two-minute periods (Table 1). Where only a single observer was involved in 1983 and for all observations in 1984, we recorded each sighting separately by number, and the pilot marked them on a 1:250 000 or 1:500 000 map as they were called out. All observations were made on tape recorders and later transcribed by hand.

Procedures for eliminating duplicate observations by observers on the same side of the aircraft in 1979 were described by Reed *et al.* (1980). In 1983, when two observers were recording on the same side of the aircraft we used the larger of the two counts for each two-minute period. In 1984 the system of numbering each observation allowed duplicate observations to

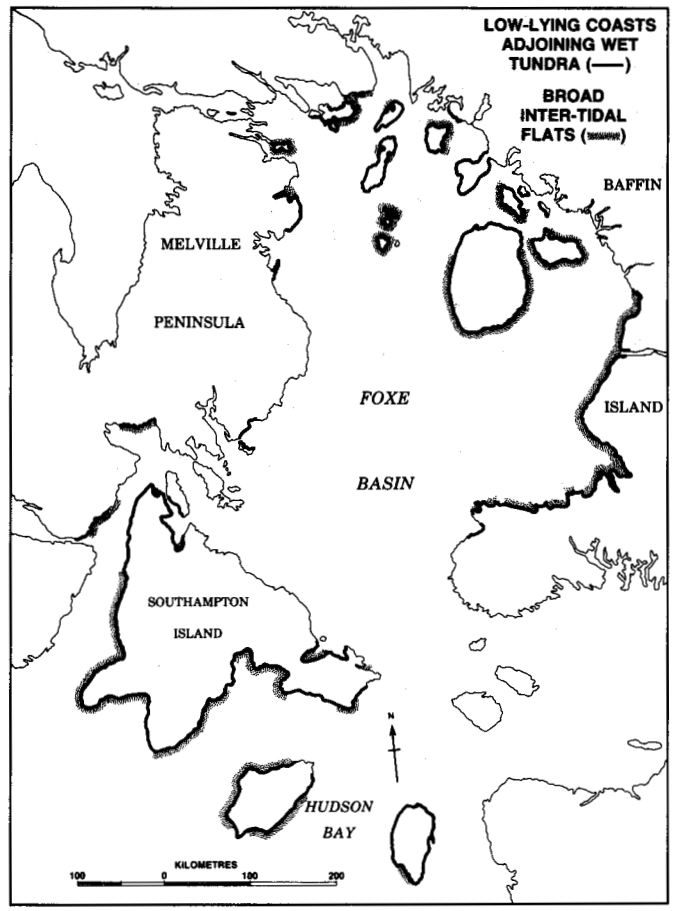


FIG. 2. Distribution of low-lying coasts backed by lowland tundra (solid line) and extensive inter-tidal flats (broken line).

TABLE 1. Dates and times of survey flights on the coasts of northern Hudson Bay and Foxe Basin used in our analysis

| Flight #[1] | Date | Time | Route | Observers |
|---|---|---|---|---|
| 1 | 25 June 1983 | 1005-1245 | Southampton Island: Coral Harbour to Ell Bay | FGC, RD, AJG |
| 2 | 25 June 1983 | 1625-1915 | Southampton Island: Coral Harbour to East Bay | FGC, RD, AJG |
| 3 | 27 June 1983 | 0928-1412 | Southampton Island: East Bay to Ell Bay via north coast, including White Island | FGC, RD, AJG |
| 4 | 28 June 1983 | 1010-1300 | Coats Island | RD, AJG |
| 5 | 1 July 1983 | 1048-1800 | Vansittart Island, east coast of Melville Peninsula to Hall Bay | RD |
| 6 | 2 July 1983 | 0949-1800 | Hall Beach — Igloolik Island — Jens Munk Island — Fury and Hecla Strait | RD |
| 7 | 4 July 1983 | 0800-1600 | Repulse Bay to Wager Bay | RD |
| 8 | 8 July 1984 | 1130-1495 | Bowman Bay to Cape Dorset | FGC, RD, AJG |
| 9 | 8 July 1984 | 1900-2107 | Bowman Bay to Longstaff Bluff | FGC, RD, AJG |
| 10 | 9 July 1984 | 1135-1715 | Foley Island, Prince Charles Island, Air Force Island | FGC, RD, AJG |
| 11 | 8 July 1979 | 1415-1710 | Longstaff Bluff — Bray Island — Steensby Inlet | AR, P. Dupuis, K. Fischer, J. Moser |
| 12 | 9 July 1979 | 1340-1600 | Murray Maxwell Bay — Koch Island — Rowley Island — North and South Spicer Island | AR, P. Dupuis, K. Fischer, J. Moser |
| 13 | 12 July 1984 | 1935-2145 | Mansel Island | RD |
| 14 | 13 July 1984 | 1020-1420 | Mill, Salisbury and Nottingham islands | RD |

[1]See Figure 1.

be identified, and where there was disagreement we used the larger estimate.

When only a single observer was present he sat in the front seat of the Cessna and scanned both sides of the aircraft. Much of the coast surveyed with only a single observer was steep and rocky so that the flight path was offshore and observations could therefore be made effectively only on one side of the aircraft. Where the coast was flat the flight line was 200-400 m inland and the observer was on the side closest to the sea. In 1983 some gull, eider and goose colonies on Southampton and Coats islands were visited by helicopter after the initial survey and estimates and species identifications were improved by counts on the ground.

Surveys in 1983 and 1984 duplicated some of the areas covered in 1979 (Fig. 1). Where this occurred we have used the figures for 1983 and 1984 because the Cessna 337 provides much better visibility than the Twin Otter. Comparison of counts made over the same stretches of coast showed that those made from the Cessna were generally higher, particularly for less conspicuous species, such as Arctic Tern *Sterna paradisaea* or Oldsquaw *Clangula hyemalis*. However, observations made in duplicated areas on the 1979 surveys are referred to where they involve species not recorded in 1983 and 1984.

We tried to carry out surveys during the period when the majority of species were incubating so that the distributions observed would correspond as nearly as possible to those of breeding areas. However, flocks of presumed non-breeding individuals were also seen in some areas, and these are noted in the individual species accounts. Our flights were too early for more than a small number of post-breeding males to be present.

King Eider (*Somateria spectabilis*) males remain in the breeding area for only a short time at the start of the season. Females are harder to see and impossible to separate from Common Eiders (*S. mollissima*) from the air. In 1983, a late year for breeding, many King Eiders were seen in pairs in June. In 1984, an earlier season, our surveys in early July revealed very few, probably because of the later date. Consequently our 1979 and 1984 surveys probably underestimated densities of breeding King Eiders relative to those in 1983.

Where birds were very numerous but did not form compact flocks, particularly Sabine's Gull (*Xema sabini*) and Atlantic Brant (*Branta bernicla*), it was difficult to count rapidly enough to keep up with them. Consequently our counts in the areas of highest density (>10 birds $km^{-1}$) probably included a smaller proportion of birds within our potential range of vision than those made in areas of lower density. Likewise, very large numbers of Snow Geese (*Anser caerulescens*) on their breeding grounds tended to distract observers, and in these areas other species were certainly under-counted.

Because large, pale species such as Tundra Swan (*Cygnus columbianus*) and Snowy Owl (*Nyctaea scandiaca*) are much easier to pick out than small, dark ones such as Oldsquaw and Black Guillemot (*Cephus grylle*), it is not possible to compare the abundance of different species. We have therefore confined ourselves to describing the relative densities of each species in different areas. We made no attempt to deal with the smaller birds, such as shorebirds and passerines, which were present in large numbers in some areas.

Although our methods were not uniform and we used two different types of aircraft, we believe that the observed variation in the density of most species was sufficient to overide differences caused by differences in methods or aircraft. However, our results should be treated with caution and we present them only because of the general lack of information on the distribution of birds in the area. In analyzing our observations we assumed a uniform speed of 165 km $h^{-1}$ and expressed all densities in terms of birds seen per unit distance.

## WEATHER AND SNOW CONDITIONS

Weather conditions throughout the surveys were good, with light winds and no fog or precipitation. Snow cover was absent over practically all lowland tundra. In 1979 and 1984 the breeding season for geese in our area was considered normal or perhaps earlier than normal, with breeding grounds clear of snow by mid-June (FGC). In 1983, surveys of the Great Plain of the Koukdjuak on 21 June showed almost 100% snow cover (AJG, FGC). At Boas River on Southampton Island snow cover was also late, the melt causing extensive flooding of Snow Goose nesting areas in early July. Probably the season was 2-3 weeks later in 1983 than in the other two years over the area surveyed. No broods of goslings were seen in any year so all surveys were completed before the majority of geese had completed incubation, although in 1984 some goslings were seen on 10 July on the Great Plain of the Koukdjuak on a flight not included in this analysis.

SPECIES ACCOUNTS

*Loons* (Gavia *spp.*)

We recorded loons in small numbers on most of our surveys, but only a few could be identified to species, the majority being Red-throated Loons (*Gavia stellata*). A few Arctic Loons (*Gavia arctica*) were also seen. Large numbers of loons, mainly Red-throated, were recorded at the edge of land-fast ice in South Bay, Southampton Island, on 28 June 1983 while en route for Coats Island.

*Tundra Swan* (Cygnus columbianus)

Swans, probably all *C. columbianus* (Godfrey, 1966), were widespread in small numbers on the south and west coasts of Southampton Island, on Coats Island and on Mansel Island, averaging at least 0.15 birds km$^{-1}$ (Fig. 3). The majority were in pairs and in many cases one bird was sitting on a nest. Densities were lower on west Baffin Island and the Foxe Basin islands. Elsewhere there were only scattered sightings.

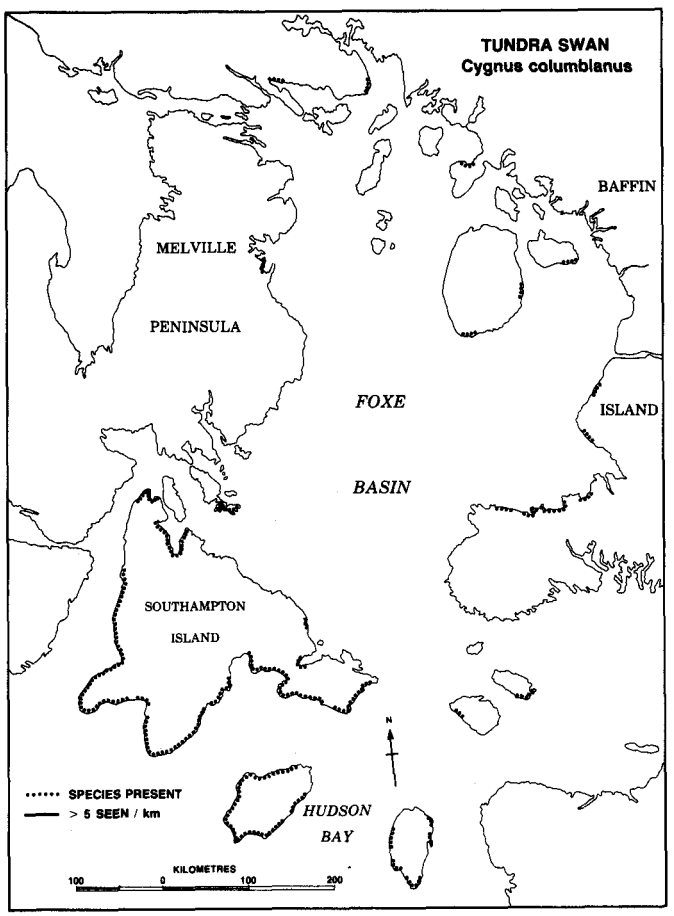


FIG. 3. Distribution of sightings of Tundra Swans (*Cygnus columbianus*).

*Atlantic Brant* (Branta bernicla)

Highest densities of brant occurred along the south coasts of Bell Peninsula and around East Bay on Southampton Island, on western Baffin Island around Cape Dominion, on North Spicer Island and on the south coasts of Prince Charles and Air Force islands (Fig. 4). Numbers at East Bay, in particular, were much

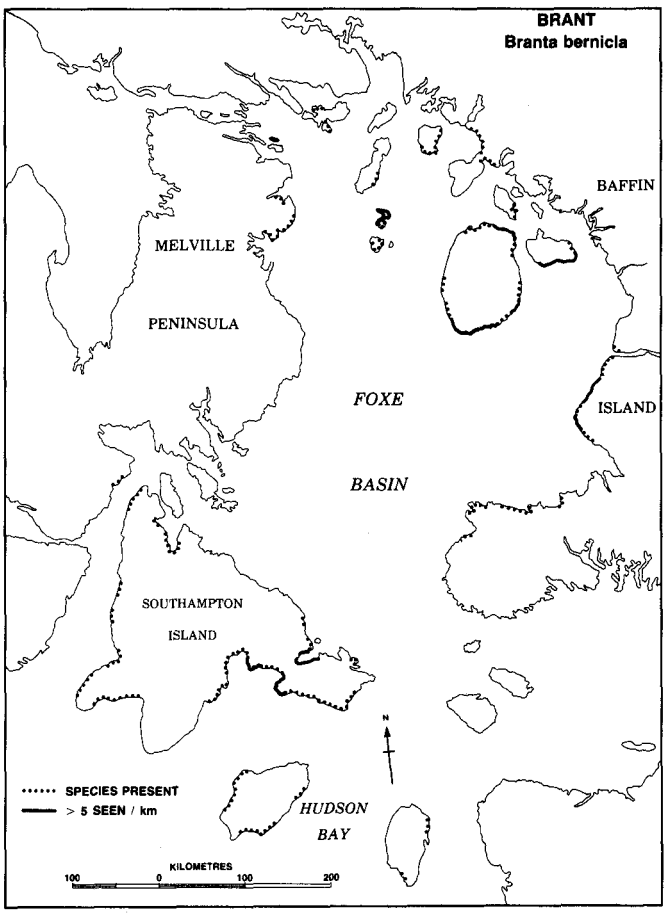


FIG. 4. Distribution of sightings of Brant (*Branta bernicla*).

too large for any accurate counts to be made and the recorded average of 15.7 birds km$^{-1}$ certainly underestimated the number within sight of the aircraft. Moderate numbers were also seen on Coats Island, around Bay of God's Mercy, Ell Bay and Duke of York Bay on Southampton Island, along the north coast of Foxe Peninsula, south of Hall Beach on Melville Peninsula and on Bray and Rowley islands and Baird Peninsula. The few seen on Mansel Island were in a single flock and probably not breeding. Detailed distribution maps for this species in Foxe Basin were given by Reed *et al.* (1980). All areas where large numbers were seen coincided with low-lying coasts and extensive inter-tidal flats.

*Snow Goose* (Anser caerulescens)

In areas where both blue and white phase birds occurred intermingled we assumed that the race represented was the Lesser Snow Goose (*A.c. caerulescens*). Elsewhere large flocks (> 100) comprising entirely white phase birds were considered to be Greater Snow Geese (*A.c. atlanticus*). Both races were recorded in Foxe Basin, the former nesting principally to the south of 68°N and the latter to the north (Reed *et al.*, 1980). An area of range overlap is believed to occur in the area of Longstaff Bluff, Baffin Island (AR).

Most Lesser Snow Geese were encountered in large, dense breeding colonies, which have been described in detail by Kerbes (1975), Boyd *et al.* (1982) and Reed *et al.* (1986); most Greater Snow Geese nested in looser aggregations. Breeding

areas shown with single hatching in Figure 5 are those given by Kerbes (1975) for Lesser Snow Geese. The cross-hatched areas were described by Reed *et al.* (1980) or located on the present surveys.

Our observations north of the Koukdjuak River suggest that the breeding area of Snow Geese there has extended considerably since the aerial surveys of Kerbes (1975). However, this area may be occupied only intermittently. A second transect parallel to the coast and about 10 km inland from the coast did not reveal any birds nesting north of the river. Hence this extension of the colony appears to be confined to the coastal strip. Ross's Geese (*Anser Rossii*) were identified at Boas River and Cape Kendall.

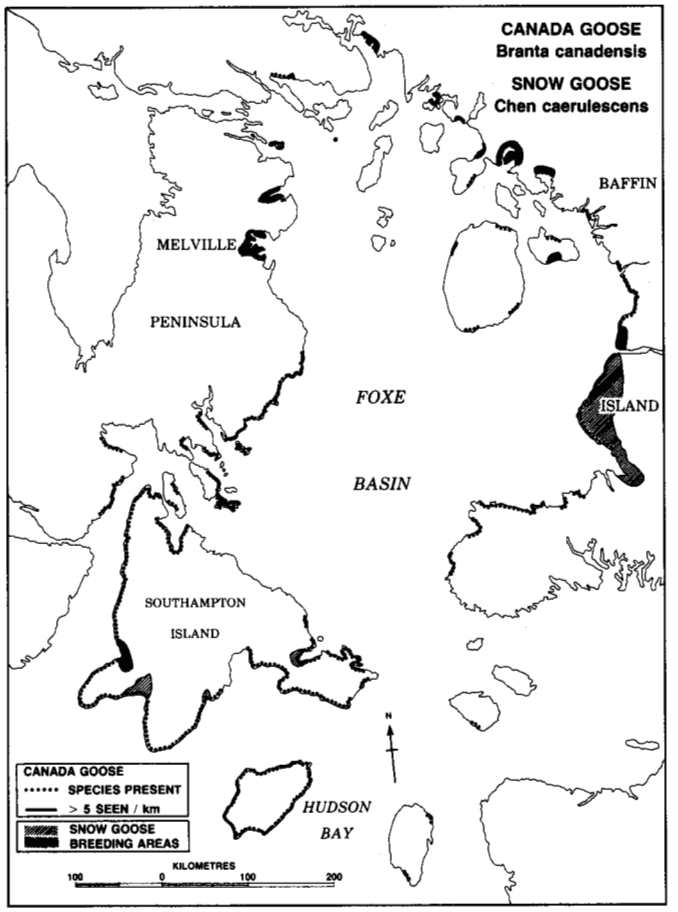


FIG. 5. Distribution of sightings of Canada Geese (*Branta canadensis*) and distribution of major Snow Goose (*Anser caerulescens*) breeding areas. For explanation of different types of hatching see text.

### *Northern Pintail* (Anas acuta)

Flocks of up to 100 Pintails were recorded on Southampton, Coats and Mansel islands and smaller numbers as far north as Prince Charles Island. The species breeds as far north as Baker Lake on the west coast of Hudson Bay and occasionally in the High Arctic islands (Godfrey, 1966; Maher and Nettleship, 1968). Breeding has been reported on eastern Southampton Island (Palmer, 1976) and suspected elsewhere on the island (Parker and Ross, 1973). Probably the majority of birds that we saw were non-breeders.

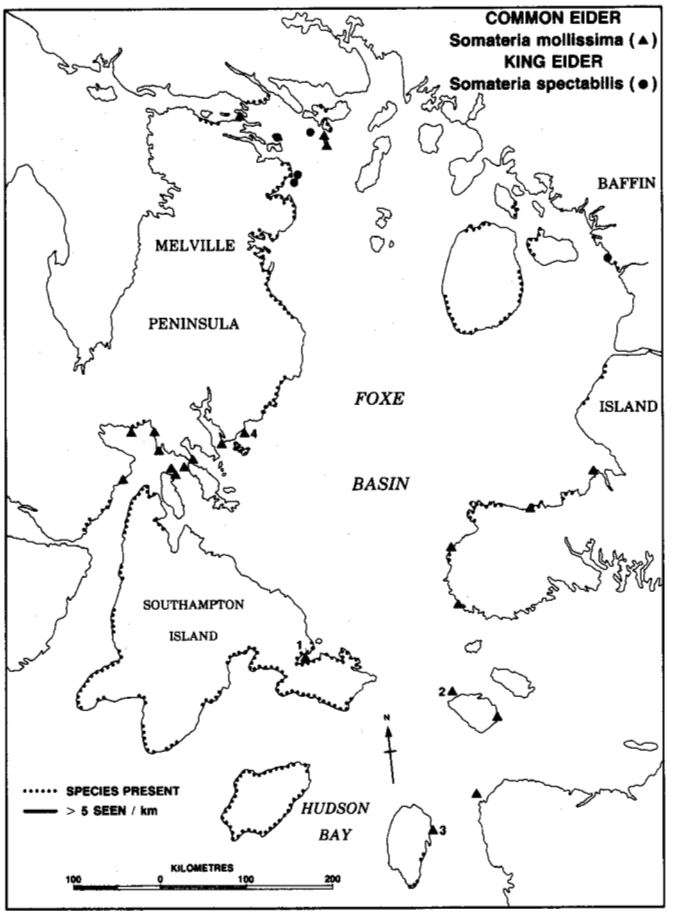


FIG. 6. Distribution of major concentrations of breeding Common Eiders (*Somateria mollissima*) (triangles) and of large flocks (>1000) of King Eiders (*Somateria spectabilis*) offshore (large dots). Small dots show the distribution of breeding King Eiders. For details of numbered colonies see text.

### *Common Eider* (Somateria mollissima)

The majority of the Common Eiders seen were associated with colonies on small offshore islands. The largest were those in East Bay, Southampton Island (Fig. 6:1), estimated to hold *c.* 5000 pairs in 1979-80 (Abraham and Ankney, 1986), off the northwest tip of Nottingham Island (Fig. 6:2, 1000-3000 pairs), off the east coast of Mansel Island (Fig. 6:3, *c.* 1000 pairs), and on Turton Island, just north of Winter Island (Fig. 6:4, several thousand birds present). Our estimate for the East Bay colony from the air was "several thousand birds." Hence, by comparison with Abraham and Ankney's ground count our aerial counts are likely to be considerable underestimates of the actual numbers present.

None of the other colonies located was estimated to hold more than 750 pairs. A few small colonies occurred on islands in lakes close to the shore, particularly on Southampton and Coats islands, but these did not exceed 25 pairs each.

### *King Eider* (Somateria spectabilis)

In contrast to the foregoing species, King Eiders nest well inland from the sea beside freshwater lakes and ponds as well as on the coast (Godfrey, 1966; Palmer, 1976). We saw birds in pairs on land most frequently on Southampton and Coats islands (Fig. 6), but this was in the late-breeding year of 1983 and our

observations in other years were probably not comparable. Many flocks, often numbering more than 100 non- or post-breeding birds, predominantly males, were seen in northwestern Foxe Basin. Smaller flocks occurred throughout the area. Northern Foxe Basin appears to be a major staging area for male King Eiders, which then cross Baffin Island to moult along the coast of Greenland (Wynne-Edwards, 1952; Ellis and Evans, 1960; Salomonsen, 1968).

*Oldsquaw* (Clangula hyemalis)

Like King Eiders, Oldsquaws are not confined to the coastal zone when breeding. They were seen throughout the survey area and were particularly well distributed in the northern part of Foxe Basin, being common on the coast of Baffin Island from Longstaff Bluff to Fury and Hecla Strait and on the islands in that area (Fig. 7). Highest densities were observed on Prince Charles Island, around South Bay, Southampton Island and near the southern tip of Mansel Island. The majority of birds seen were in flocks on the sea and they may therefore have been non-breeders. The Oldsquaw was probably the mostly generally distributed of the birds recorded, being seen practically everywhere except the precipitous northeast coast of Southampton Island.

*Sandhill Crane* (Grus canadensis)

Only small numbers of Sandhill Cranes were seen, the greatest frequency being on western Southampton Island, where we recorded 18 (0.06 birds km$^{-1}$). None was seen on Mansel Island, western Baffin Island, Air Force Island or Melville Peninsula, and only three were seen on the coast of Prince Charles Island (0.01 birds km$^{-1}$) in 1984. However, the 1979 survey recorded one on Foxe Peninsula, one on the east coast of Melville Peninsula and one just east of Steensby Inlet on the northeast coast of Foxe Basin. On 9 August 1985, H. Boyd (pers. comm.) saw a party of nine near the neck of the Baird Peninsula.

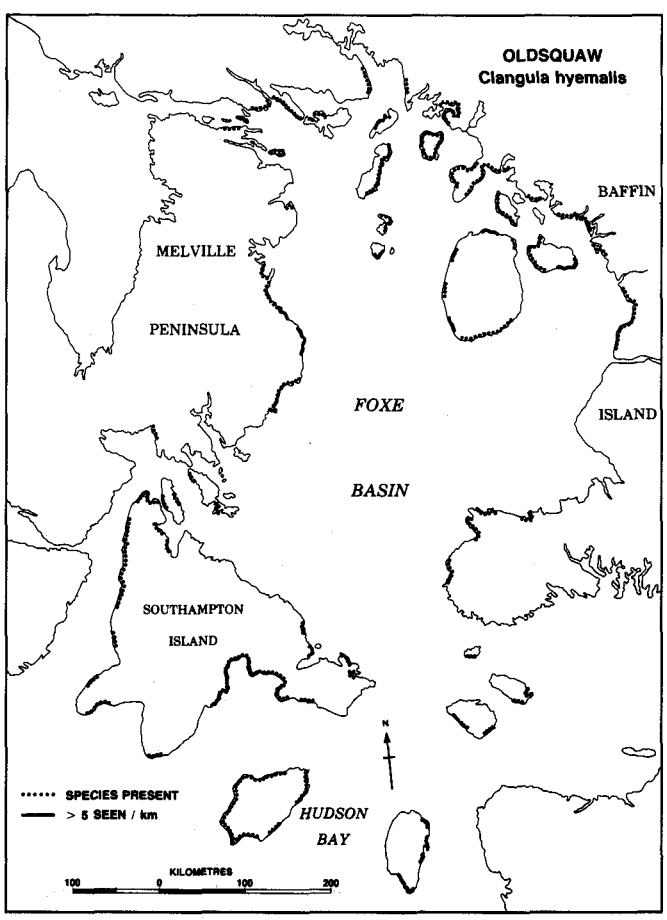


FIG. 7. Distribution of sightings of Oldsquaw (*Clangula hyemalis*).

*Jaegers* (Stercorarius *spp.*)

We saw jaegers in small numbers wherever there was lowland tundra. Highest frequencies (0.16 birds km$^{-1}$) occurred on Prince Charles and Air Force islands and western Baffin Island (Fig. 8). Most birds could not be identified to species, but among those that were the majority were Parasitic Jaegers (*Stercorarius parasiticus*). Concentrations of jaegers often occur within goose colonies (FGC) and we probably underestimated numbers in those areas.

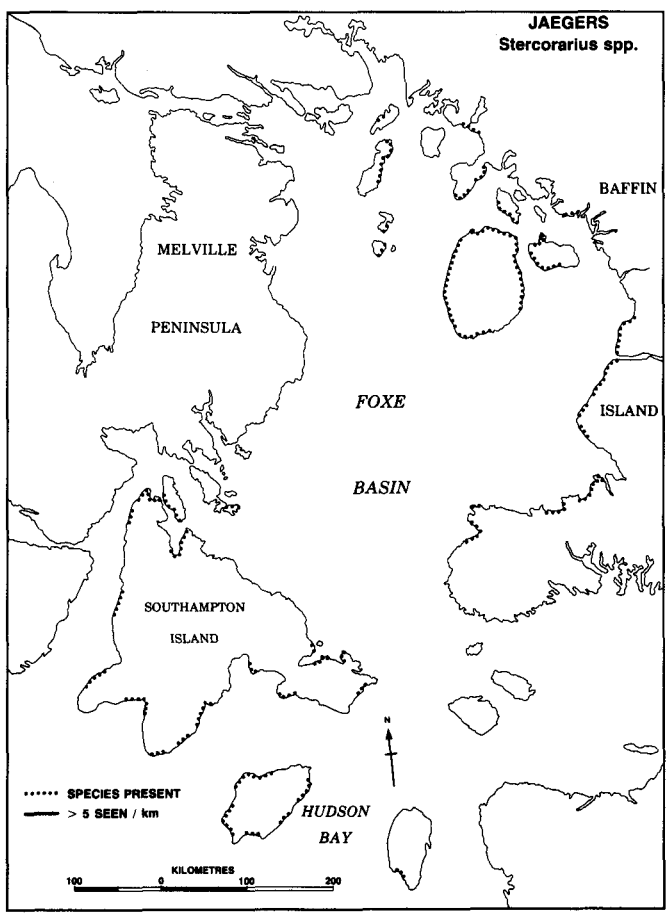


FIG. 8. Distribution of sightings of jaegers (*Stercorarius* spp.).

*Large Gulls* (Larus *spp.*)

The large *Larus* gulls present problems of identification from the air. Herring Gulls (*Larus argentatus*) can be distinguished from Glaucous Gulls (*Larus hyperboreus*) by their black wing tips, but against a dark background these are frequently invisible. Consequently many large gulls remained unidentified. It is

even more difficult to separate Herring Gulls from Thayer's Gull (*Larus thayeri*), and quite impossible from the air. However, in the Arctic practically all Herring Gulls nest on flat ground, usually on islands in lakes, whereas, being largely marine feeders, practically all Thayer's Gulls nest on cliffs, usually within 0.5 km of the sea (Macpherson, 1961; Smith, 1966a, b; AJG). We therefore assumed that all large gulls with black wing tips seen over flat coasts or tundra were Herring Gulls and all those seen on cliffs were Thayer's Gulls.

On Southampton Island a limited amount of ground observation confirmed that the birds in cliff colonies were Thayer's Gulls, but the generalization may not be reliable for eastern Melville Peninsula (RD).

Thayer's Gull intergrades with the Kumlien's race of the Iceland Gull (*Larus glaucoides kumlieni*) on Bell Peninsula, Southampton Island (Gaston and Decker, 1985) and on Coats Islands (RD; R.D. Elliot and A.J. Erskine, pers. comm.). Kumlien's Gull also breeds on cliffs (Macpherson, 1961; Smith, 1966b). However, most Kumlien's Gulls have pale wing tips, like Glaucous Gulls. Where we saw large colonies (>10 pairs) of gulls with pale wing tips within the range of Kumlien's Gull we assumed that the majority were of that species. However, all colonies of Kumlien's or Thayer's Gulls inspected on the ground also contained small number of Glaucous Gulls, and that may have been true of all colonies.

Herring Gulls were widespread on Southampton, Coats and Mansel islands, West Baffin Island north to Longstaff Bluff, Prince Charles and Air Force islands and the Spicer Islands (Fig. 9). Godfrey (1966) gives their northern limit on the west side of Hudson Bay as Roes Welcome Sound, and consequently ground-nesting gulls with dark wing tips north of there were considered unidentified and were not mapped. However, few were seen on the east coast of Melville Peninsula. Montgomerie *et al.* (1983) reported a single Herring Gull mated to a Glaucous Gull at Sarcpa Lake (68°33'N near the east coast of the peninsula) but noted Thayer's Gull as an uncommon visitor.

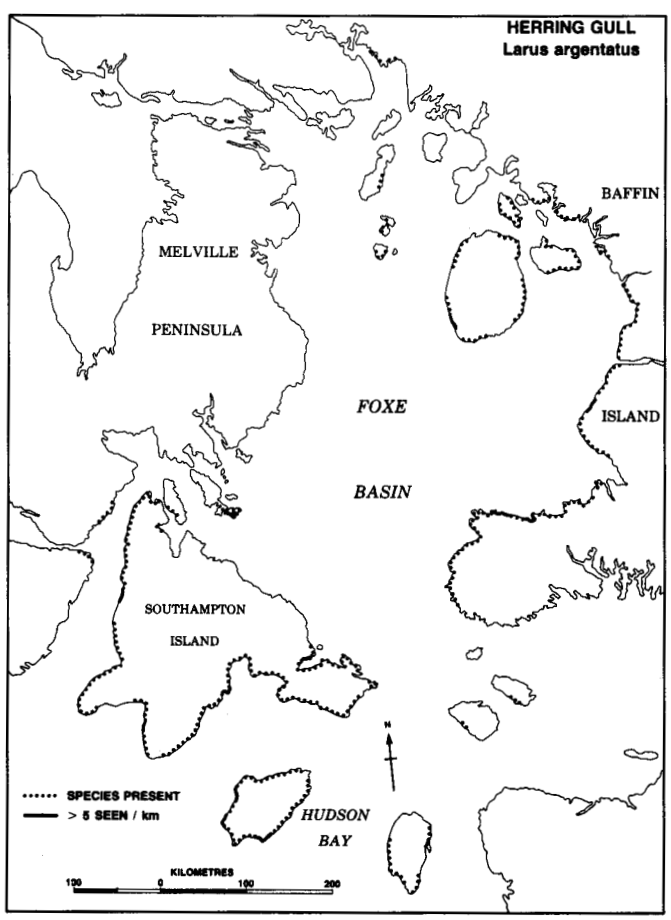


FIG. 9. Distribution of sightings of Herring Gulls (*Larus argentatus*).

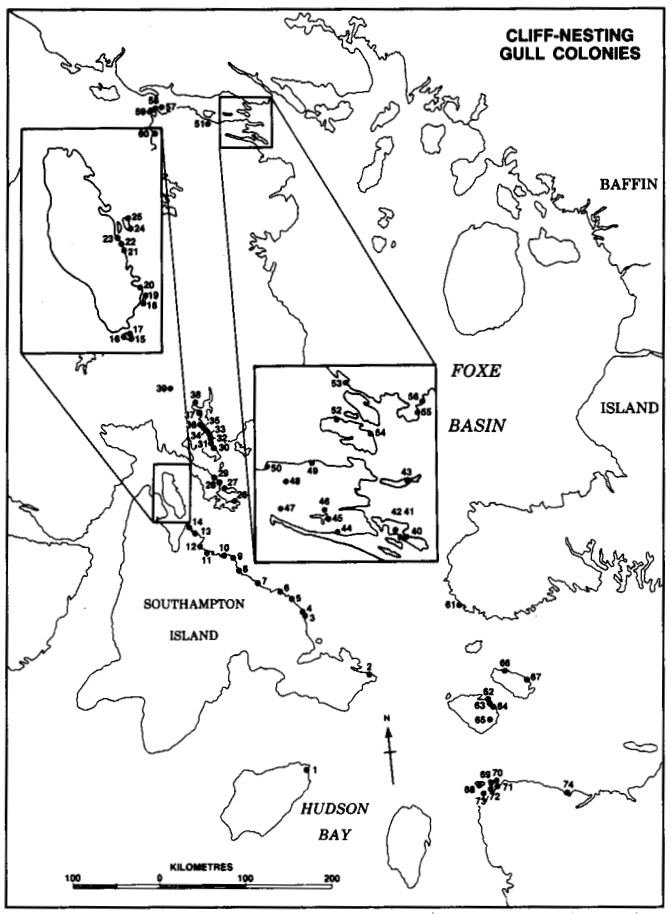


FIG. 10. Distribution of colonies of cliff-nesting gulls (*Larus thayeri, L. glaucoides* and *L. hyperboreus*).

The positions of Thayer's and Kumlien's Gull colonies are shown in Figure 10. Estimated sizes ranged from 20-300 pairs. Colonies 1-6 comprised both Kumlien's and Thayer's Gulls and colony 1 included mixed pairs. There were few or no Kumlien's Gulls in colonies 7-60, whereas Thayer's Gulls were absent from colonies 61-74.

Numbers of cliff-nesting gulls were highest on the northeast coast of Southampton Island (*c.* 900-1000 pairs), White Island (600-700 pairs), Lyon Inlet (650-750 pairs) and around Fury and Hecla Strait (1600-2000 pairs). These numbers undoubtedly included a proportion of Glaucous Gulls, which formed 10-20% of the birds at colonies inspected on the ground. A few pairs of Herring Gulls bred with 75-100 pairs of Kumlien's Gulls at colony 61, which was visited on the ground. The cliff here is low, forming a series of rocky steps and hence apparently suitable for Herring Gulls. Elsewhere all cliff-nesting colonies were on more or less vertical rock faces.

Glaucous Gulls were seen in small numbers on flat tundra on western Baffin Island (0.03 $km^{-1}$), Prince Charles (0.12 $km^{-1}$) and Air Force islands (0.15 $km^{-1}$) and the smaller islands of

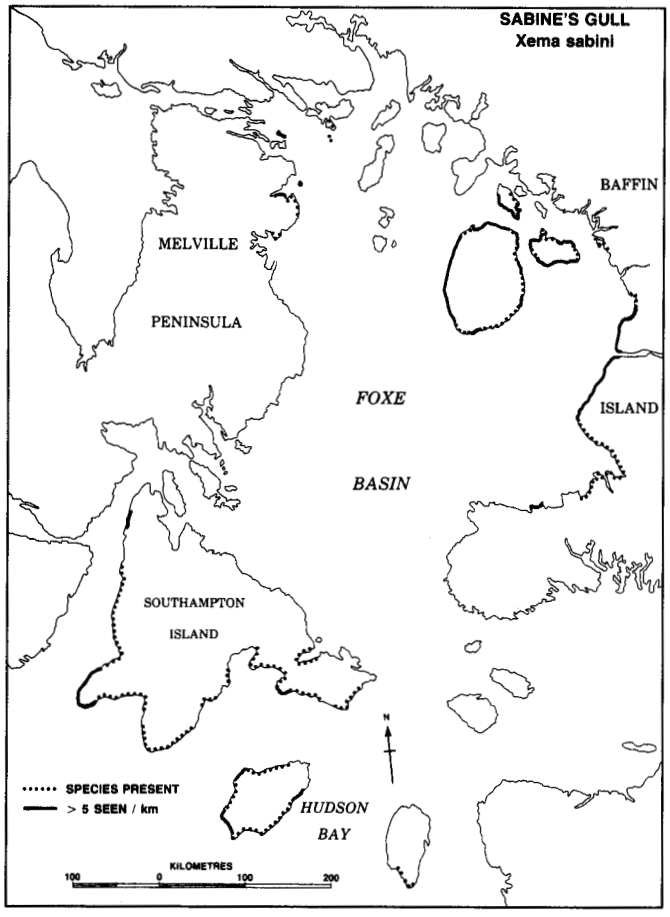


FIG. 11. Distribution of sightings of Sabine's Gulls (*Xema sabini*).

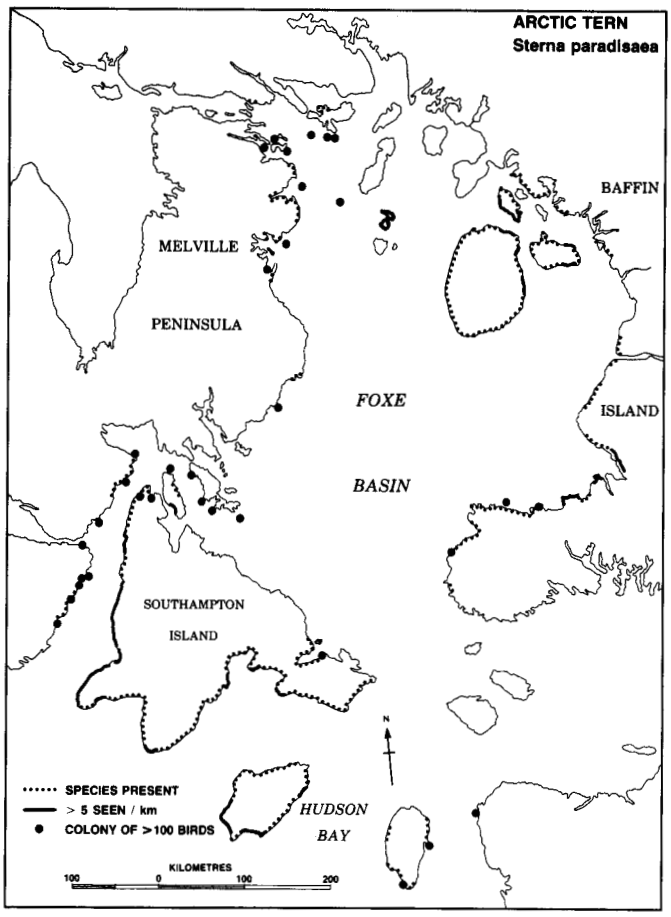


FIG. 12. Distribution of sightings of Arctic Terns (*Sterna paradisaea*).

northern Foxe Basin (0.1 km$^{-1}$). On Southampton and Coats islands sightings were even fewer, only ten being seen on Southampton Island, apart from those associated with cliff colonies, and only two on Coats Island (both *c.* 0.01 birds km$^{-1}$). This confirms the observations of Sutton (1932a) and Parker and Ross (1973) that Glaucous Gulls are uncommon on Southampton Island away from the cliffs of the northeast coasts.

In addition to the colonies marked, 10-20 pairs of Glaucous Gulls nest in association with the Thick-billed Murre (*Uria lomvia*) colony just west of Cape Pembroke, Coats Island, and a similar number on Walrus Island in Evans Strait (AJG, RD).

*Sabine's Gull* (Xema sabini)

Sabine's Gulls were confined to areas of lowland tundra. Observations on several inland transects over Prince Charles and Coats islands and the Great Plain of the Koukdjuak showed that practically all birds occurred within a few kilometres of the coast. Hence our surveys probably sampled the main breeding concentrations of the species.

As with brant, sightings in the highest density areas were too numerous for observers to be able to count all of the birds within range. Maximum counts certainly underestimated the total numbers present. We recorded more Sabine's Gulls on our surveys than any other species apart from Snow Goose. This is in accordance with one of the few breeding density estimates for the area made by Soper (1940), who found Sabine's Gull to be the commonest bird other than Snow Goose, small shorebirds and passerines on Blue Goose Prairie, just south of the Great Plain of the Koukdjuak.

Maximum counts were made on western Baffin Island between the Koukdjuak River and Taverner Bay (average 11.26 birds km$^{-1}$), on Air Force Island (9.60 km$^{-1}$) and on Prince Charles Island (6.12 km$^{-1}$). Numbers on Southampton, Coats and Mansel islands were in the range 0.1-2.0 birds km$^{-1}$, but those areas also included stretches of coast where counts exceeded 6 birds km$^{-1}$, particularly around Cape Kendall on southwest Southampton Island (Fig. 11).

*Arctic Tern* (Sterna paradisaea)

Arctic Terns occupy very similar habitat to Sabine's Gulls, occurring particularly on wet coastal tundra with numerous ponds (Abraham and Ankney, 1984). They also occur in smaller numbers along rocky coasts where they concentrate on small offshore islets, forming colonies of as many as several thousand birds. We have marked such concentrations where they comprised more than 100 birds (Fig. 12). Several evident breeding colonies were on small grassy islets in lakes just inland of the shore, but at most of these fewer than 50 birds were present.

Maximum numbers of Arctic Terns on wet tundra were seen on the south and west coasts of Southampton Island (Fig. 12), where sightings averaged more than 5 birds km$^{-1}$. Average numbers seen also exceeded 1 bird km$^{-1}$ on the north coast of Foxe Peninsula, on the south coast of Bell Peninsula and on Coats, Mansel, Air Force, Prince Charles and the Spicer islands.

Strangely, between Koukdjuak River and Taverner Bay, where numbers of Sabine's Gulls were highest, numbers of Arctic Terns were low, averaging 0.5 birds km$^{-1}$. It is possible that terns were overlooked in this area because observers were "swamped" by Snow Geese and Sabine's Gulls, more eye-catching species.

Offshore island colonies were most numerous on the west coast of Roes Welcome Sound in the northwest corner of Foxe Basin. The northwestern colonies were generally larger than those farther south, several being estimated at more than 500 birds.

*Black Guillemot* (Cepphus grylle)

Experience with aerial surveys in Hudson Strait suggested that Black Guillemots are particularly difficult to detect from the air (Gaston *et al.*, 1985). Where they were present in small numbers we may have frequently overlooked them, particularly where the flight path was inland of the shore. Most sightings were on the sea close to rocky shores and none was seen off West Baffin Island. The majority of sightings of more than ten birds were in the Frozen Strait area or off Mill, Salisbury and Nottingham islands in Western Hudson Strait (Fig. 13).

*Thick-billed Murre* (Uria lomvia)

Figure 13 marks the position of the two large colonies of Thick-billed Murres in the area, on Coats Island (25 000 pairs) and at Digges Sound (300 000 pairs) (Gaston, unpubl. data; Gaston *et al.*, 1985). The numbers and distribution of this species have been described elsewhere (Gaston, 1980, 1982).

*Snowy Owl* (Nyctaea scandiaca)

Small numbers of Snowy Owls were recorded throughout the survey area, particularly on lowland tundra. Highest counts were on Prince Charles Island (18; 0.04 birds km$^{-1}$) and on the transect from Hall Beach to Igloolik, Jens Munk Island, and Fury and Hecla Strait (15; 0.03 birds km$^{-1}$). An inland transect on Prince Charles Island also revealed high densities. None was seen on Coats Island and only one on Southampton Island. However, these variations probably tell us little about the preferences of Snowy Owls for different parts of the area. Instead they probably reflect variations in the local abundance of lemmings (*Lemmus, Dicrostonyx*) (Pitelka *et al.*, 1955a; Watson, 1957). Parker and Ross (1973) noted that Snowy Owls were abundant inland on Southampton Island in 1970 but were not seen in 1971 following a crash of the local lemming population.

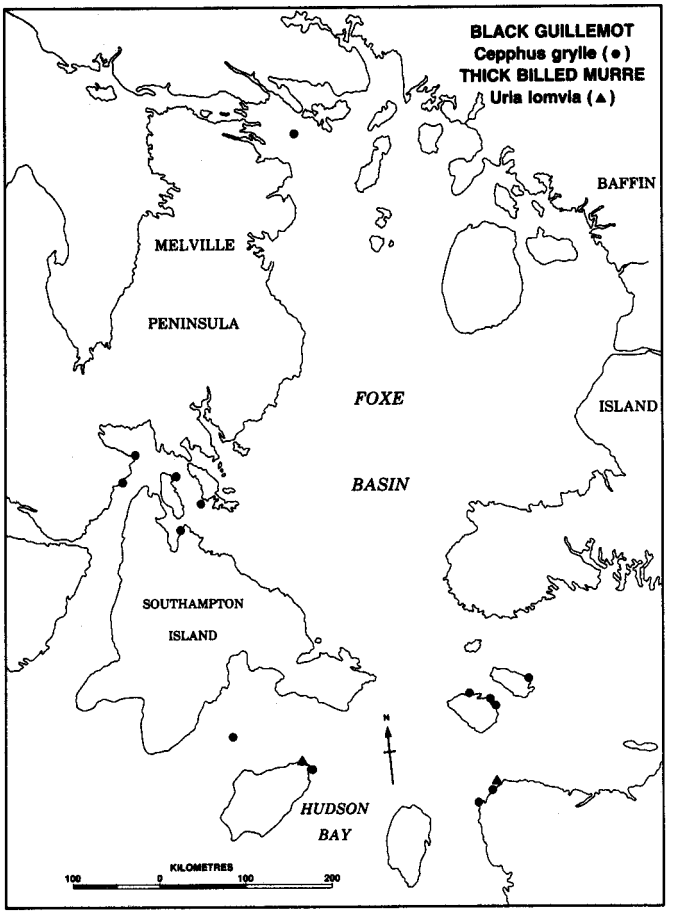


FIG. 13. Distribution of sightings of groups of more than 50 Black Guillemots (*Cepphus grylle*), and position of Thick-billed Murre (*Uria lomvia*) colonies.

## DISCUSSION

The frequencies with which birds were seen on different areas of lowland tundra are summarized in Table 2. Although the avifauna of northern Hudson Bay and Foxe Basin is substantially similar throughout the area, some trends are apparent.

TABLE 2. Comparison of sighting frequencies for selected species in areas of lowland tundra, based only on surveys included in Table 1

| | Sighting frequency (birds km$^{-1}$) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Area | Tundra Swan | Canada Goose | Brant | King Eider | Oldsquaw | Sandhill Crane | Sabine's Gull | Arctic Tern | Jaeger spp. |
| Cape Dorchester — Bowman Bay (260)[1] | .08 | .06 | .21 | .15 | .06 | 0 | .54 | 1.46 | .16 |
| Bowman Bay — Koukdjuak River (180) | .01 | 9.80 | 4.06 | .01 | 0 | 0 | 3.66 | .19 | .04 |
| Koukdjuak River — Taverner Bay (80) | 0 | .36 | 0 | 0 | .32 | 0 | 11.26 | .01 | .10 |
| Air Force Island (180) | .03 | .07 | 6.56 | .02 | .35 | 0 | 9.60 | 1.88 | .10 |
| Prince Charles Island (320) | .01 | .44[2] | 3.62 | .05 | 2.98[2] | .01 | 6.12 | 1.30 | .16 |
| East Bay, Southampton Island (70) | .03 | .24 | 15.70 | .88 | .07 | 0 | .48 | .30 | .06 |
| Coral Harbour — Leyson Point (150) | .18 | 1.01 | 3.08 | .51 | .68 | .01 | .68 | 1.47 | .02 |
| Coral Harbour — Ell Bay (410) | .28 | .80 | .33 | .18 | .30 | .02 | 1.46 | 3.11 | .04 |
| Ell Bay — Duke of York Bay (300) | .22 | 1.28 | .30 | .20 | .24 | .06 | .35 | 3.22 | .07 |
| Coats Island (280) | .40 | 1.92 | .64 | .47 | .15 | .03 | 1.25 | 1.77 | .05 |
| Mansel Island (340) | .21 | .02 | .12 | .10 | 5.45[2] | 0 | .14 | 1.30 | .01 |

[1]Numbers in brackets in first column give total distance flown (km) along low-lying shore backed by wet tundra.
[2]Numbers composed mainly of flocks of apparent non-breeders.

Species such as Canada Goose, Sandhill Crane and Tundra Swan decrease in numbers from southwest to northeast across the area. These trends parallel the slight decline in summer temperature that occurs from SW to NE across the area. Perhaps more importantly, they coincide with a reduction in the ice-free period for freshwater lakes.

Atlantic Brant are common in certain areas of Southampton Island but much less so on other, superficially similar, areas of Southampton, Coats and Mansel islands. Canada Geese are common on Southampton and Coats islands but patchy on western Baffin Island, with very high numbers around Cape Dominion but rather low numbers elsewhere. North of the Arctic Circle they are generally sparse. The northern and northeastern boundary of the species' range may well be set by causes related to summer temperatures. However, within the boundary, the variation in numbers is not clearly related to any obvious aspect of their habitat.

Distributions of Oldsquaws, King Eiders, Arctic Terns and Sabine's Gulls also appear to be patchy relative to the availability of suitable habitat, although differences are less striking for these species. Only the jaegers, which nowhere occurred at high densities, appear to be more or less uniformly distributed throughout suitable habitat.

Although we saw only a narrow strip along the coast, the overall impression created by comparisons of counts for different areas is that most species breeding in northern Hudson Bay and Foxe Basin are unlikely to be limited by the availability of suitable breeding habitat. In a good summer, at least, there seems to be plenty of room for expansions. Giroux *et al.* (1984) arrived at the same conclusion for Greater Snow Geese (*Anser caerulescens atlanticus*) breeding on northern Baffin Island, and Kerbes (1975) expressed a similar opinion for Lesser Snow Geese (*A.c. caerulescens*) on western Baffin Island.

Arctic breeding geese are known to experience seasons when they are unable to breed or have much reduced success (Barry, 1962; Newton, 1977; McLaren and Alliston, 1985). In such years the availability of suitable nesting areas is limited by persistent snow cover. The energetics of egg formation in the geese makes them particularly liable to this predicament (MacInnes *et al.*, 1974; Newton, 1977). Late break-up of ice or adverse weather during the breeding season also has a considerable impact on King Eiders breeding in the High Arctic (Barry, 1968; Palmer, 1976). Seasons when reproduction is severely curtailed may play a role in keeping populations below the level at which their breeding habitat might be saturated. However, there may be other factors involved.

Much of the area presently supporting lowland tundra ecosystems has only recently emerged from the sea as a result of isostatic uplift (Andrews, 1966, 1970, 1973). Figure 14 shows the extent of land that has probably emerged during the past 2000 years, assuming approximately a 30 m fall in sea level on Coats, Mansel and Southampton islands and a 15 m fall on western Baffin Island (Andrews, 1966, 1973). This newly emerged land comprises practically the entire area presently occupied at high density by geese, cranes, King Eiders and Sabine's Gulls.

In addition, the advance of the Baffin Island ice caps during the little ice age 100-350 years ago suggests a period of much greater snow accumulation than at present (Falconer, 1966; Locke and Locke, 1977). Permanent snow cover then extended down to 450 m above sea level in northeast Foxe Basin (Locke and Locke, 1977), and we must assume that areas of lowland

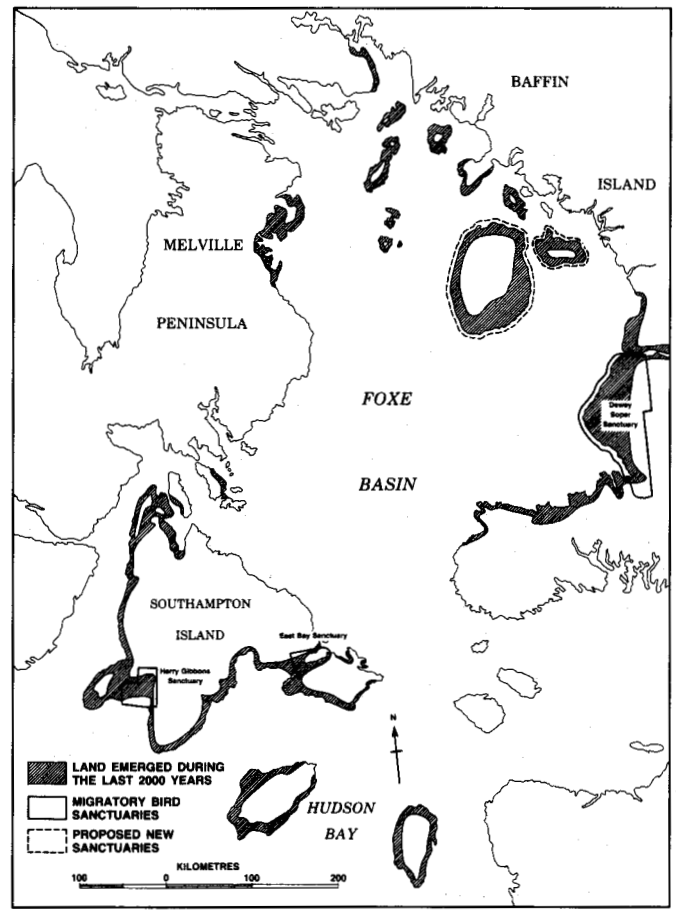


FIG. 14. Distribution of land that has emerged from the sea over the past 2000 years, and current migratory bird sanctuaries.

tundra would probably have experienced a much shorter snow-free season than at present. This may have made breeding difficult or impossible for many species.

The probable recovery of breeding habitats in Foxe Basin following the little ice age coincided with enormous changes to the non-breeding habitats of the geese, swans and cranes, which winter in continental North America, as a result of the expansion of the human population and the spread of firearms. Consequently, while we could speculate about the role of environmental factors operating on the breeding grounds in determining the degree to which potential habitats are saturated, any interpretation may be confounded by events that have taken place on the wintering grounds. This may be true even for Sabine's Gull, which winters far out at sea off southwest Africa (Zootendyk, 1965, 1968; Cramp, 1983) in areas where overfishing has affected some populations of resident seabirds (Burger and Cooper, 1984).

If habitat for lowland tundra nesting birds in Foxe Basin is not completely occupied, this is likely to create a very dynamic situation in which birds can shift between different areas in response to local conditions. This is known to be true for some arctic-nesting birds, such as Snowy Owls, jaegers and Rough-legged Hawks (*Buteo lagopus*), which prey mainly on lemmings (Pitelka *et al.*, 1955a, b). It is not true for most colonially nesting geese, many of which do not breed when conditions are unsuitable (Newton, 1977). However, in the Canadian High Arctic islands brant may shift their breeding grounds in response

to local conditions (Boyd and Maltby, 1979). What the situation is for species such as Sandhill Cranes, Oldsquaws, Sabine's Gulls and Arctic Terns is not known.

The possibility of shifts in breeding concentrations occurring from year to year must be considered in assessing the potential value of different areas to migratory birds. Because the results presented here are based on only a single year's survey for each area, we have no way to evaluate this inter-year variation. Also, any judgement concerning the availability of "surplus" habitat needs to be viewed in light of possible breeding area rotation and the demands of climatically exceptional years. Research on these topics would be desirable.

Comparison of the relative numbers shown in Table 2 and the species maps suggests that the most important breeding areas for the species dealt with are on Southampton, Coats, Prince Charles and Air Force islands and on western Baffin Island between Bowman Bay and the Koukdjuak River. Substantial portions of these areas are already protected as migratory bird sanctuaries (Harry Gibbons and East Bay sanctuaries on Southampton Island and the Dewey Soper Sanctuary on western Baffin Island; Fig. 14).

The composition of the Coats Island avifauna is very similar to that found on Southampton Island, and consequently we can consider this type of community adequately protected by the existing sanctuaries on the latter. However, the avifauna of Prince Charles and Air Force islands, with a much greater predominance of Sabine's Gull and large numbers of brant, is somewhat different. We saw very large numbers of shorebirds on these islands, many more than elsewhere. This applied not only to the coast transect, but also to several brief flights over the interior. Sabine's Gull has a rather restricted breeding distribution (Blomqvist and Elander, 1981), and Foxe Basin probably supports an important segment of the total population. In view of the great importance of Prince Charles and Air Force islands to migratory birds, consideration should be given to extending statutory protection of some kind to either or both islands, particularly the south coastal regions, where the majority of geese occur.

## ACKNOWLEDGEMENTS

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