

Breeding Densities, Biogeography, and Nest Depredation of Birds on Igloolik Island, N.W.T.

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ABSTRACT. The avifauna of Igloolik Island and immediate vicinity was studied during two breeding seasons in 1985-86. This is the first study to compile an intensive record of avifaunal migration patterns and nesting activity, density and success for Igloolik Island. Data for these years are supplemented by the observations of earlier explorers and researchers. During our two seasons of survey, we recorded 40 species of birds, of which 25 nested on the island. Combining our records with previously published data, a total of 48 species have been recorded, with 30 species nesting. Several interspecies matings of gulls and the first confirmed breeding record of purple sandpiper (*Calidris maritima*) for the Melville Peninsula area were recorded. The density of breeding birds on Igloolik Island (28.5 pairs·km⁻²) is similar to other eastern high arctic sites at that latitude. Issues related to the biogeographic comparisons of arctic sites are discussed. In late August, the eastern end of the island acts as a significant staging area for gull species, oldsquaw (*Clangula hyemalis*) and arctic tern (*Sterna paradisaea*). A combined average of 58.3% of the nests of six species were depredated. As many as 73% of red-throated loon (*Gavia stellata*) and 93% of arctic tern nests suffered mainly human-related egg predation.

Key words: Arctic, Igloolik Island, breeding avifauna, density, interspecies matings, biogeography

RÉSUMÉ. On a étudié l'avifaune de l'île Igloolik et de son voisinage immédiat au cours de deux saisons de reproduction, en 1985 et 1986. Cette étude est la première à compiler un dossier en profondeur du comportement migratoire de l'avifaune ainsi que de l'activité, de la densité et du taux de réussite de la nidification dans l'île Igloolik. Des observations faites antérieurement par des explorateurs et des chercheurs viennent compléter les données recueillies durant l'étude. Au cours des deux années de l'étude, on a relevé 40 espèces d'oiseaux, dont 25 se reproduisaient sur l'île. Si l'on combine nos relevés avec des données publiées précédemment, 48 espèces au total ont été enregistrées, dont 30 se reproduisent sur l'île. On a observé l'accouplement de plusieurs mouettes d'espèces différentes et enregistré la première occurrence de nidification du bécasseau violet (*Calidris maritima*) pour la péninsule de Melville. La densité des oiseaux nicheurs sur l'île Igloolik (28,5 paires·km⁻²) est semblable à celle d'autres sites de l'Extrême-Arctique oriental à la même latitude. On discute de questions relatives aux comparaisons biogéographiques de sites arctiques. À la fin du mois d'août, la portion orientale de l'île fait office d'importante aire de repos pour les espèces de mouettes, le canard kakawi (*Clangula hyemalis*) et la sterne arctique (*Sterna paradisaea*). Une moyenne combinée de 58,3 p. cent des nids de six espèces ont été pillés. La prédation des oeufs, principalement par l'homme, a affecté un nombre aussi élevé que 73 p. cent des nids de huarts à gorge rousse (*Gavia stellata*) et 93 p. cent des nids de sternes arctiques.

Mots clés: Arctique, île Igloolik, avifaune reproductrice, densité, accouplements d'espèces différentes, biogéographie

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INTRODUCTION

Igloolik Island (69°24'N, 81°49'W) is located in the northwest corner of Foxe Basin in the eastern Canadian Arctic (Fig. 1). Avifauna in the island's vicinity has been recorded by early explorers (Lyon, 1824; Parry, 1824; Herring, 1937) and researchers (Bray, 1943; Ellis and Evans, 1960), but their coverage during the non-breeding period was limited or sporadic. A later study by Gaston *et al.* (1986) was limited to aerial surveys of large species. In 1985 and 1986 we had the opportunity to examine more thoroughly the migration and breeding phenologies of Igloolik Island avifauna.

Igloolik Island is a 103 km² area of raised shoreline with intermittent beach ridges, *Dryas*-heath vegetated solifluction slopes and depressions vegetated with grass-sedge wet and dry meadows. Most of the beach ridges lack vegetation or are only sparsely covered with *Dryas*-heath and lichens (Lewis and Belyea, 1983). The numerous small lakes, brackish ponds and tidal flats provide extensive wetland habitats for many shorebird and waterfowl species. The cliffs located on the Coxe Islands (Avvajja), 10 km to the west of the island, provide nesting sites for cliff breeders that forage on Igloolik. In addition, a polynya 10 km off the island's eastern shore permits year-round use, especially by offshore and pelagic species. According to vegetation and climate characteristics defined by Bliss (1977), Igloolik is classified as a "high arctic" site.

The community of Igloolik is situated along the western shore of Turton Bay. During the summer months, an outpost camp is established on the east end of the island; the local residents participate in subsistence hunting and egg collecting over most of the island.

METHODOLOGY

During 1985, field data were collected over the entire island from 1 June to 31 August, representing a cumulative total of approximately 600 hours of observations on foot and by all-terrain vehicle. In 1986, K. Robertson and C. Ogilvie recorded supplemental observations while conducting research on the island's vegetation. Incidental observations from other researchers, (D. Cameron and M. Lewis, Biology Department, York University, pers. comm. 1985; J. MacDonald, Eastern Arctic Scientific Resource Centre, Igloolik, pers. comm. 1986) were also included. Common and scientific bird names and their sequence conform to the American Ornithologists Union Checklist (A.O.U., 1983).

A 10 km² main study site (Fig. 1) was established in 1985 to examine habitat use, breeding density and nesting success of all avian species. The study site included approximately 10% of the island's area and comprised habitat roughly comparable in abundance and composition to the entire island. The study site was classified as wet meadow (65%), *Dryas*-heath

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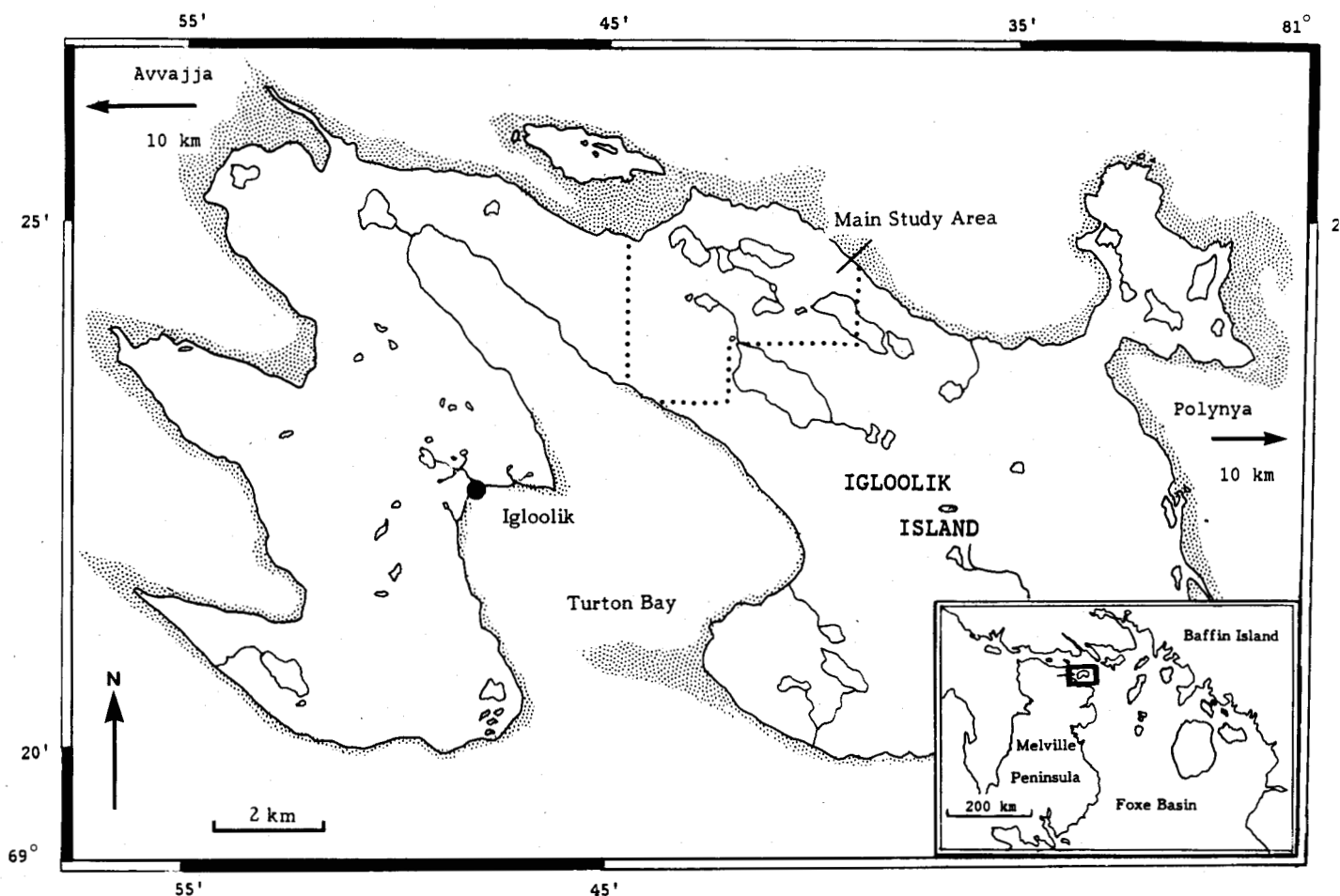


FIG. 1. Location of Igloolik Island, N.W.T., and 10 km² study area.

vegetated slope (25%), dry ridge (4%), rocky shoreline (5%) and disturbed sites (i.e., gravel road beds) (1%). In 1985, the study site was visited almost daily. Transects of 100 m intervals were conducted weekly and the number of individuals and pairs, habitat use and evidence of breeding were recorded for each species. If nests could not be located, then the presence of singing or displaying males was used as an index of breeding density. Data were not collected on breeding density in 1986.

CLIMATE

The climate of Igloolik is classified as "polar tundra" (Koeppel and deLong, 1958), with the warmest month (July) averaging 6.3°C (Eastern Arctic Research Station records, 1978-84). Summer rains contribute half of the average 27.0 cm total annual precipitation. In 1985, temperature and precipitation levels were warmer all season and wetter near the end of the season (Table 1). No inclement weather was recorded during the 1985 nesting period. The spring of 1986 was severe, with a mean daily temperature 7°C lower in June, and each month in 1986 was several degrees colder than corresponding months in 1985. Precipitation levels were normal, but a large proportion of the June total fell as snow. Open water on ponds (bodies of water < 25 m²) was first recorded on 7 June 1985 and 14 June 1986. In both years, larger lakes became ice free 10-12 days after the ice melt on the ponds.

RESULTS

For the collective two-year study, we recorded 40 species, 25 of which were confirmed breeders. In addition, snowy owls (*Nyctea scandiaca*) and parasitic jaegers (*Stercorarius parasiticus*) nested in 1984, when lemmings (*Lemmus sibiricus*, *Dicrostonyx torquatus*) were observed to be abundant. Combining our records with previously published data, a total of 48 bird species have been recorded on Igloolik Island and 30 of these species have been observed nesting (Table 2). A higher number of new or confirmed breeding species were recorded in the present study than in earlier published reports. Of the 8 new breeding species, 5 are shorebirds. Confirmed breeding of purple sandpiper (*Calidris maritima*) is new for the Melville Peninsula region (Godfrey, 1986). Stilt sandpiper (*Calidris himantopus*) and pectoral sandpiper (*Calidris melanotos*) were recorded for the first and second time respectively in the region. Inter-species mating was observed between herring gull and glaucous gull and herring gull and thayer's gull. However, only the herring gull and glaucous gull mating produced young. Red phalarope (*Phalaropus fulicaria*) and lapland longspur (*Calcarius lapponicus*) were the most abundant breeders.

Supplemental information from 1985-86 is provided in the annotated list. Breeding data for the intensive 10 km² study site are presented in Table 3. A total of 21 species bred within the 10 km² study area at a density of 28.5 breeding pairs·km⁻².

ANNOTATED LIST

The following species accounts outline the status of the 40 species recorded in 1985 or 1986 and an additional 8 species were recorded by others during earlier visits. Much of the data refer to the intensive 10 km² study site, but incidental observations from the entire island are included also.

The abundance of a particular species is based on the maximum number of individuals recorded over the entire island in one day. Categories of relative abundance are based upon recorded data from both years as follows: abundant (> 40), common (20-39), uncommon (4-19), occasional (2-3) and rare (1). Species that occur irregularly in varying abundance are noted separately. Breeding status is defined as follows: breeder — copulation, nests or broods recorded; migrant — recorded during migration but no evidence of breeding; transient — juvenile, non-breeding birds or irregular visitors outside of their known geographic distribution.

Species Observed in 1985-86

Red-throated Loon (*Gavia stellata*): Abundant breeder. In summers 1985 and 1986, the appearance of red-throated loons coincided with ice melt on ponds (7 June, 15 June respectively). Following their arrival, this species was observed almost daily on ponds and lakes within the wet meadows. In 1985,

TABLE 1. Comparison of 1985-86 climate data to long-term average during period of migration and nesting

	Igloolik		Hall Beach ¹
	1985	1986	1957-80
May			
Daily mean temp. ²	6.3	-7.8	-9.1
Maximum temp.	-9.5	-4.1	-4.7
Minimum temp.	-3.0	-11.4	-13.5
Total precipitation ³	8.6	21.6	16.6
Rain/snow	0/8.6	0/21.6	4/16.2
June			
Daily mean temp.	4.9	-1.8	0.0
Maximum temp.	8.2	1.3	2.7
Minimum temp.	1.5	-4.9	-2.7
Total precipitation	13.4	12.5	16.7
Rain/snow	12.4/1	2.2/10.3	10.5/6.2
July			
Daily mean temp.	8.2	5.8	5.4
Maximum temp.	12.2	9.4	8.4
Minimum temp.	4.1	2.2	2.3
Total precipitation	29.7	12.5	34.4
Rain/snow	29.7/0	28.8/0	34.1/3
August			
Daily mean temp.	5.0	2.9	4.6
Maximum temp.	8.0	5.7	7.3
Minimum temp.	1.9	0.0	1.8
Total precipitation	74.2	51.6	40.8
Rain/snow	71.3/2.9	49.8/1.8	39.1/1.8
September			
Daily mean temp.	.9	-1.3	-6
Maximum temp.	2.7	.5	1.3
Minimum temp.	-9	-3.0	-2.5
Total precipitation	35.6	23.8	27.4
Rain/snow	21.4/14.2	4.2/19.6	15/12.1

¹Hall Beach (68°47'N, 81°15'W), 110 km south of Igloolik, is the closest climate station providing long-term data.

²Temperature in °C.

³Precipitation in millimetres.

territorial behavior and courtship were first recorded 13 June; the first nest was found 21 June. The last incubated egg was found 27 June 1985 and 23 June 1986. In both years, almost all ponds with an area greater than 20 m² contained a nesting pair. Even elongated ponds of only 10 m² contained a nesting pair and the birds appeared to have no difficulty in taking flight in such a small area. Fledged young were noted from mid- to late August and "rafts" of 5-20 adults were observed on larger lakes and at sea after 25 August 1985.

Pacific Loon (*Gavia pacifica*): Uncommon breeder. In both years Pacific loons arrived later (16 June 1985, 27 June 1986) than red-throated loons. The later disappearance of ice on the larger lakes where Pacific loons typically nested may influence the arrival of this species to the breeding grounds. In 1985, three paired adults were noted from 16 to 21 June and the first of three nests was discovered on 22 June. Of six eggs found in three nests, only one offspring was recorded. This bird was recorded on 19 August swimming with the parents and all three were present up to 27 August.

Snow Goose (*Chen caerulescens*): Abundant spring migrant, uncommon breeder. Large numbers of snow geese were recorded from 2 June to 21 July 1985 and 5 June to 18 July 1986, but only three pairs nest on the island. Throughout 1985, a total of 453 geese were sighted, including both the greater (*C. c. atlanticus*) and lesser (*C. c. caerulescens*) snow geese and 10 blue-phase individuals (all believed to be lesser subspecies). Subspecific designation was based upon the relative size of the birds. All breeding geese reported on Igloolik Island (1984-86) appear to be of the greater subspecies, *C. c. atlantica*. Nesting of snow geese on the island is not colonial and nests were found on a variety of habitats from wetland islets to dry upland tundra. The first nest was recorded on 18 June 1985. In 1986, one adult and three goslings were recorded until 20 August on a freshwater lake.

Brant (*Branta bernicla*): Rare breeder. Two birds were first observed on 12 June 1985 feeding on tidal areas vegetated by *Carex ursina* and *Puccinella phrygenodes*. Daily sightings of flocks with 10-20 birds (and up to 60 on 20 June, 16 August 1985) were recorded. However, breeding was limited; one nest found on 18 June 1985 produced six offspring.

Canada Goose (*Branta canadensis hutchinsii*): Uncommon spring migrant. Two birds were observed in flight with 36 snow geese on 5 June 1985. Single birds were recorded on 13 June 1985 and 3 July 1986; 10 were sighted with 4 snow geese on 8 July 1986. Based upon the small size of the individuals (all Canada geese were similar in size to the lesser snow geese that accompanied them), it appeared that all individuals were of the *hutchinsii* subspecies. There was no evidence of breeding.

Common Eider (*Somateria mollissima*): Occasional transient. Small numbers of this species were observed during June 1985 at the polynya. No evidence of breeding for this species was found on Igloolik Island. Bray (1943) reported a breeding colony at Tern's Island, 30 km to the northwest of Igloolik, which may account for the birds noted at the polynya.

King Eider (*Somateria spectabilis*): Abundant spring migrant, uncommon breeder. King eiders constituted the greatest number of birds observed during the early snow-melt period. From 2 to 8 June 1985, 60-550 migrating birds were sighted daily. Considerably fewer (298) were noted in early June 1986, possibly because of the later spring breakup in that year. In both 1985 and 1986, the egg dates ranged from 15 to 28 June. Nest sites were located in several habitats ranging from dry gravel uplands to wet grass-sedge meadows. Males tended to leave

TABLE 2. Species recorded for Igloolik Island, N.W.T., from this study and published sources

Species	Lyon and Parry, 1824	Horring, 1937	Bray, 1943	Ellis and Evans, 1960	This study, 1985-86
Red-throated Loon	+		B	B	B
Pacific Loon	+		B		B
Northern Fulmar			+		(+:1984) ¹
Tundra Swan	+		+		
Snow Goose	B		+	+	B
Brant	+	+	+	B	B
Canada Goose					+
Common Eider	+	+		B	+
King Eider	+	+	B	B	B
Oldsquaw	+	+	B	B	B
Golden Eagle					+
Peregrine Falcon			+	+	+
Gyrfalcon		+	+	+	
Rock Ptarmigan	+		+		B
Sandhill Crane	+		+		+
Black-bellied Plover			B	B	B
Lesser Golden-Plover	+				B
Semipalmated Plover	+		+		B
Hudsonian Godwit				B	
Ruddy Turnstone			+	B	B
Red Knot					+
Semipalmated Sandpiper					B
White-rumped Sandpiper	B		+	B	B
Baird's Sandpiper				+	B
Pectoral Sandpiper					+
Purple Sandpiper			+	+	B
Dunlin				+	+
Stilt Sandpiper					+
Red Phalarope	B	+	+	B	B
Pomarine Jaeger			B	B	+
Parasitic Jaeger				B	+
Long-tailed Jaeger			+	B	B (B:1984)
Skua sp.					(+:1984)
Herring Gull	+	+	B	B	B
Thayer's Gull		+	B	?	B
Glaucous Gull	+		+	?	B
Black-legged Kittiwake			+		
Sabine's Gull	+	+	B	B	B
Ivory Gull				+	
Arctic Tern	+	+	B	B	B
Dovekie	+		+		+
Thick-billed Murre	+		+		
Black Guillemot			+	+	+
Horned Lark				+	B
Snowy Owl	+		+		+
Common Raven	+	+	+		+
Lapland Longspur	B		B	+	B
Snow Bunting	B	+	B	+	B
Species total	24	12	33	29	40 (+2/1984)
Breeding species total	5	0	12	16	25 (+2/1984)

+ = recorded; ? = observer uncertainty; B = breeding confirmed.

¹Bracketed data refers to incidental records from 1984 that affect species or breeding totals.

females after egg laying and congregated in rafts of all-male groups at sea. The last male was recorded on 12 August 1985; females were recorded until late August.

Oldsquaw (*Clangula hyemalis*): Common breeder, abundant fall migrant. The first pair was recorded on 6 June 1985 and on 5 June 1986. Most ponds had at least one pair; larger ponds supported two to three pairs. A total of 10 nests were discovered between 22 July and 12 August 1985. From mid-to late August, oldsquaw congregated into large "rafts" consisting of several thousand females and juveniles off the eastern shore of the island.

Golden Eagle (*Aquila chrysaetos*): Rare transient. A single adult bird stayed on the island from 14 to 21 May 1986. None

of the oldest Inuit had seen one on the island, although many knew of its Inuktitut name (*nakturalik*) (J. MacDonald, pers. comm. 1986). This sighting is extremely rare for the arctic islands (Godfrey, 1986).

Peregrine Falcon (*Falco peregrinus tundrius*): Rare transient. Single birds were sighted on 18 June, 16 August 1985. Peregrines have bred on the cliffs of Avvajja, 10 km west of Igloolik (Bray, 1943) and the sightings on Igloolik are likely due to the occasional foraging visits of birds from this area.

Rock Ptarmigan (*Lagopus mutus*): Rare breeder, winter transient. One individual was sighted in winter plumage on 1 June 1985. A single nest found on 10 July 1986 produced 8 offspring. Rock ptarmigan were previously believed (by local

Inuit) to winter on Igloolik and nest only on the adjacent Melville Peninsula.

Sandhill Crane (*Grus canadensis*): Rare transient. A single bird was sighted on 21 June 1985 in a meadow on the island's east end. Another bird was recorded in June 1937 (Bray, 1943).

Black-bellied Plover (*Pluvialis squatarola*): Uncommon breeder. This species was uncommon from 7 June to 26 August 1985 and occasionally sighted from 26 June to 11 July 1986. Of an estimated five breeding pairs, only two nests could be found on 25 June 1985.

Lesser Golden-Plover (*Pluvialis dominica*): Uncommon breeder. This species was first sighted on 2 June 1985 and on 18 June 1986. Afterwards, in both years, 2-10 birds were sighted daily until September. Moulting plumage was first observed on 21 July and full winter plumage was recorded for 3 birds on 19 August 1985.

Semipalmated Plover (*Charadrius semipalmatus*): Rare breeder. A single pair was sighted on 12 June 1985 and one adult with two juveniles was sighted on 18 August. A single bird was sighted on 30 August 1985. This species was not seen in 1986.

Ruddy Turnstone (*Arenaria interpres*): Common spring migrant, uncommon breeder. Paired birds were seen daily after 3 June 1985 and after 5 June 1986. No nests were located in 1985 although breeding pairs were observed, and a single nest was found 20 July 1986. Turnstones were last sighted on 16 August 1985, 22 July 1986.

Red Knot (*Calidris canutus*): Rare transient. A single bird was present for one day on 9 June 1985.

Semipalmated Sandpiper (*Calidris pusilla*): Uncommon breeder. This species was periodically sighted from 8 June to 30 August 1985 and 26 June to 15 August 1986. Flight and flashing-wing displays characteristic of breeding/pairing activities were first noted on 13 June. Territorial flights continued to 24 June 1985. Although no nests were found in 1985, two broods were seen on 22 July, constituting the second and third breeding records of this species on the Melville Peninsula.

White-Rumped Sandpiper (*Calidris fuscicollis*): Abundant breeder. Large numbers (10-20) were sighted daily from 4 June to 26 August 1985 and 24 June to 30 August 1986. An estimated 35 pairs nested on the study site in 1985. Although no nests were found in 1986, many birds exhibited territorial flight displays. In both years, large flocks of several hundred birds were observed in late August.

Baird's Sandpiper (*Calidris bairdii*): Occasional breeder. This species was first observed on 2 June 1985 and on 26 June 1986. Pairs were then periodically observed throughout the entire summer but no nests were found in either year. Bray (1943) and Montgomerie *et al.* (1983) report Baird's sandpipers as common breeders on the nearby Melville Peninsula.

Pectoral Sandpiper (*Calidris melanotos*): Rare transient. Different single birds were sighted on 17 and 18 June 1985. Montgomerie *et al.* (1983) established the first breeding record for this species in the Foxe Basin region at Sarcpa Lake, N.W.T., in 1982.

Purple Sandpiper (*Calidris maritima*): Uncommon breeder. This species was first sighted on 2 June 1985 and then recorded daily until 26 August. Two nests were found on 24 June and 27 July 1985, and one nest found on 4 July 1986 produced four offspring. Breeding status for this species in the Melville Peninsula region was previously unknown (Godfrey, 1986).

Dunlin (*Calidris alpina*): Occasional fall migrant. Three birds were sighted on each of 5, 16 and 26 August 1985. A single bird was recorded on 27 June 1986.

Stilt Sandpiper (*Calidris himantopus*): Rare transient. A single bird was sighted on 24 June 1985 with three ruddy turnstones. The known breeding range for this species is hundreds of kilometres west of Igloolik along the District of Mackenzie coast (Godfrey, 1986).

Red Phalarope (*Phalaropus fulicaria*): Abundant breeder. Red phalaropes are one of the most common species utilizing the wet meadow areas during the breeding season. First sightings occurred on flocks of 10-30 on 6 June 1985 and 23 June 1986. Seventeen nests were found between 14 and 23 June 1985; 3 nests were found between 10 and 24 July 1986. In 1985, 3 of 17 nests were incubated by females, contrary to the general rule of paternal brooding in phalaropes (Kistchinski, 1975). Flocks of 10-20 birds (sometimes up to 70) were observed in late August in both years.

Pomarine Jaeger (*Stercorarius pomarinus*): Occasional transient. In both years one to two pomarine jaegers were periodically sighted from 3 June to 12 August. No evidence of breeding was recorded.

Parasitic Jaeger (*Stercorarius parasiticus*): Rare breeder, occasional transient. Observations of 1-19 individuals were recorded from 21 June to 25 August 1985. In 1986, 2 birds were observed on 25 and 27 June. In 1984, a single nest was discovered in *Dryas*-willow heath.

Long-tailed Jaeger (*Stercorarius longicaudus*): Occasional breeder. This species was regularly observed as individuals or in small groups of two to three and was the most common of the three jaeger species. First observations occurred on 3 June

TABLE 3. Estimated numbers of paired birds, nests and mean nesting density in the 10 km² study area, 1985; species are categorized by geographic affinity

Breeding species ¹	Estimated total pairs	# nests found (broods) ²
HIGH ARCTIC		
Snow Goose	1	1
Brant	1	1
King Eider	5	3 (1)
Black-bellied Plover	5	2
Ruddy Turnstone	8	0
White-rumped Sandpiper	35	12
Purple Sandpiper	4	2
Red Phalarope	50	17
Thayer's Gull x Herring Gull	1	1
Glaucous Gull x Herring Gull	1	1
Sabine's Gull	13	10 (2)
Snow Bunting	25	12
LOW ARCTIC		
Semipalmated Sandpiper	15	0 (2)
Herring Gull	29	29
Horned Lark	1	0 (1)
PAN-ARCTIC		
Red-throated Loon	20	15 (2)
Arctic Loon	3	3
Oldsquaw	10	9
Lesser-Golden Plover	3	1
Arctic Tern	13	13
Lapland Longspur	42	12
Total nesting pairs	285	144 (8)
Mean density (km ⁻²)	28.5	

¹High, Low, Pan-Arctic affinities are based on center of breeding abundance in Godfrey (1986).

²Broods indicate only those found in addition to known active nests.

1985 and 29 June 1986. No breeding was apparent in 1985 but a single nest was discovered on 13 July 1986. One of two eggs hatched 28 July. D. Cameron reports this species as a common breeder from 1977 to 1984. (pers. comm. 1985). Fifty birds were observed on 21 July 1985, a number not uncommon during migration (Pitelka *et al.*, 1955). The last individuals were recorded on 21 August 1985 and 26 August 1986.

Herring Gull (*Larus argentatus*): Common breeder, abundant transient. This species' presence is often associated with human activity on Igloolik Island; 60-100 birds were recorded daily in the community garbage dump from 1 June to 7 September in both years. Lower numbers frequent the Inuit outpost camp on the island's east end. In 1985, 29 nests were located on colonial islets in the large lakes of the study site. The egg-laying period lasted from 20 June to 27 July and the juvenile gulls were first recorded 17 August 1985. A large breeding colony also exists on nearby Avvajja (Bray, 1943).

Thayer's Gull (*Larus thayeri*): Rare breeder, uncommon transient. Up to five birds were periodically recorded from 1 June to 7 September 1985 and 1986 at the community garbage dump. An unsuccessful Thayer's-herring gull nest was found on 24 June 1985. The single egg was an uneven bluish colour, paler than observed herring gull eggs. It was found in the water, apparently dislodged from the islet nest three days after being laid. This hybridization is particularly interesting in light of Godfrey's (1986) classification in which the Thayer's gull, a species very similar in appearance to herring gulls (and once considered as the same species), has been established as a subspecies of the Iceland gull (*Larus glaucooides*). Godfrey's classification is based on widespread interbreeding among phenotypes of the two taxa instead of the sympatric assortive mating that was earlier believed to be the case (Godfrey, 1966). Gaston and Decker (1985) reported interbreeding of the Kumlén's race of the Iceland gull and Thayer's gulls on Southampton Island in the southern Foxe Basin. The A.O.U. classifies Thayer's gulls as a separate species but is reviewing the possibility of a *L. glaucooides* subspecies status (A.O.U., 1983).

Glaucous Gull (*Larus hyperboreus*): Rare breeder, abundant fall migrant. From 1 June to 7 September in 1985 and 1986 daily sightings of two to three birds in the garbage dump were recorded. Coastal pre-migratory congregations were common in late summer/early fall in both years (e.g., 23 July 1985, 800-1000 birds; 26 August 1985, 1300-1500 birds). The second recorded North American hybridization involving a glaucous-herring gull pair produced two chicks on 28 June 1985. The first evidence of hybridization was reported in 1982 at Sarcpa Lake, 90 km southwest of Igloolik Island (Montgomerie *et al.*, 1983).

Sabine's Gull (*Xema sabini*): Locally common breeder. The arrival of this species coincided with ice melt in larger ponds. Breeding and feeding activities were concentrated in the extensive wet meadows found throughout the island's northeast section. Ten nests were found between 24 June and 26 July 1985 on the study site.

Arctic Tern (*Sterna paradisaea*): Locally uncommon breeder, abundant fall migrant. Arctic terns were first recorded on 10 June 1985 and 8 June 1986. This species was abundant in coastal areas following sea-ice breakup. Thirteen nests were found in 1985. In late August 1985, several thousand terns amassed on rocky beaches and inland ponds on the island's east side.

Dovekie (*Alle alle*): Abundant transient. Several hundred individuals were seen throughout June 1985 feeding in the

polynya approximately 10 km east of the island. Large numbers of dovekies are known to gather in the northwest Baffin Island area before migrating to Greenland (Renaud *et al.*, 1982), but the only known breeding in Canada occurs on eastern Baffin Island (Finley and Evans, 1984).

Black Guillemot (*Cepphus grylle*): Uncommon transient. Several individuals were sighted among the rafts of dovekies at the polynya. Bray (1943) reports that they are winter residents and breed on islands near Avvajja.

Snowy Owl (*Nyctea scandiaca*): Rare transient, periodic breeder. A single individual was sighted on 11 June 1985. Three sightings of single owls and one sighting of two owls occurred in July 1986. No evidence of breeding was present in 1985 or 1986 but five nests were located in 1984 and three in 1987. Lemmings, an important prey item for snowy owls (Watson, 1957; Parker, 1974), were frequently observed in 1984 and 1987 but rarely observed in 1985 and 1986.

Horned Lark (*Eremophila alpestris*): Rare breeder. In 1985, two to three birds were sighted on 4, 6, 20 and 23 June by roadside and gravel ridge areas. One adult and two juveniles were observed feeding in the community of Igloolik on 18 August 1985, indicating probable breeding on the island.

Common Raven (*Corvus corax*): Uncommon transient. In both years, 20-23 ravens were sighted daily at the garbage dump area but were rarely observed elsewhere. Four juveniles were seen on each of 18 and 19 August 1985 but were likely raised on the Avvajja cliffs because of the absence of appropriate nest sites on Igloolik Island.

Lapland Longspur (*Calcarius lapponicus*): Abundant breeder. Up to 45 individuals were recorded daily throughout the summer in both years. During inclement weather in early June 1986, 9 individuals were observed huddled with 16 snow buntings under a house eave. Twelve nests were found in 1985 (21-24 June), and a single nest was located on 3 July 1986.

Snow Bunting (*Plectrophenax nivalis*): Common breeder. In both years, 10-12 birds were sighted daily in rocky areas of beach ridges as well as in the community from 1 June to 7 September. Twelve nests were found under rocks in the upland ridges of the study site. Seven nests were discovered in the community either under large rocks or in rock piles supporting hydro poles.

Species Not Observed in 1985-86

Northern Fulmar (*Fulmaris glacialis*): Rare transient. A single adult bird was sighted along the southeast shore of Igloolik on 29 July 1984 (D. Cameron, pers. comm. 1985). The closest known nesting colonies are along the northwest coast of Baffin Island (Brown *et al.*, 1975). Bray (1943) reported fulmars north of the island over open water.

Tundra Swan (*Cygnus columbianus*): Rare transient. None has been sighted in recent memory by local Inuit but one was shot on the island in the 1930s (Bray, 1943) and two were recorded in 1824 (Parry, 1824).

Gyr Falcon (*Falco rusticolis*): Rare transient. A single adult was recorded in Igloolik in 1955 (Ellis and Evans, 1960). The cliffs of Avvajja offer potential nesting habitat, which may account for the presence of this species in the vicinity of Igloolik Island. One bird was collected on Avvajja in 1936 (Bray, 1943).

Hudsonian Godwit (*Limosa haemastica*): Rare breeder. Ellis and Evans (1960) reported a breeding pair on the island in 1956. This record is considerably farther north of Southampton Island (550 km south of Igloolik), the most northerly point of confirmed or suspected breeding (Godfrey, 1986).

Skua (*Catharacta* sp.): Rare transient. A single bird was sighted at close range by D. Cameron along the southeast shore on 29 July 1984.

Black-legged Kittiwake (*Rissa tridactyla*): Rare transient. According to Bray (1943), kittiwakes were occasionally seen in late fall in the sea north of the island. These birds may have originated from breeding colonies on the northwest coast of Baffin Island, approximately 500 km north.

Ivory Gull (*Pagophila eburnea*): Offshore migrant? Six were reported by Ellis and Evans (1960) through October 1955.

Thick-billed Murre (*Uria lomvia*): Uncommon transient. Local Inuit are not aware of a nesting colony, but Parry (1824) states that boatswains (murre), dovebies and terns were all common on 29 June 1823. Bray (1943) also reported seeing murre with black guillemots offshore.

DISCUSSION

This is the first study to compile a complete record of avifaunal migration patterns, breeding and nesting success, and densities for Igloolik Island. Parry (1824) and Lyon (1824) kept vague and non-specific records. Data from Denmark's Fifth Thule Expedition in 1924 were deciphered by Horring (1937) and many common species were absent because, as Horring believed, the "observers retained such species to memory believing they themselves were going to publish their data." Bray (1943) visited the Igloolik Island area in winter 1936 and August 1937, after the peak breeding period (mid-July), and possibly missed numerous species. Ellis and Evans (1960) spent most of their time in Foxe Basin rather than on Igloolik Island itself and, as a result, their species list also appears to be incomplete. Because of these limitations, it is not possible to directly compare changes in species occurrence or abundance between this study and those previously conducted in the vicinity of Igloolik Island. However, there is no evidence to suggest that large-scale or general changes in the species composition of Igloolik have occurred; all species recorded as breeding by previous studies were also found breeding in 1985-86. Additional breeding species found in 1985-86 are likely the product of more intensive observation rather than range expansion by new species.

The classification of "low" and "high" arctic sites is widely used but poorly defined. Much of the work has been based on vegetative and climatic divisions (e.g., Bliss, 1977) rather than faunal. The increasing quantity of faunal data from various arctic sites may now permit a classification based upon avifaunal centers of breeding distribution. Renaud *et al.* (1981) con-

sidered "low arctic" to be sites whose species' breeding center of abundance was on the tundra of the arctic mainland and "high arctic" on the central and eastern arctic archipelago (Renaud, pers. comm. 1991). A number of species (e.g., red-throated loon, lesser-golden plover) breed throughout both regions and cannot be separated into high and low arctic species. Montgomerie *et al.* (1983) used scaling ordination of 76 species over 26 sites to determine that Sarcpa Lake possessed species more typical of sites classified as high arctic by Bliss (1977). In this study, we based our division of high arctic sites where less than 25% of the breeding species recorded on the site are of low arctic affinity. Affinity is based on distribution maps in Godfrey (1986) and Ouellet (1990).

Other qualifications were necessary to compare study sites. Sites of colonial nesting birds such as the snow goose colony (165 pairs·km⁻²) at Bowman Bay (Soper, 1940) are atypical of much of the arctic area and as such were not included in the calculated average. Similarly, the breeding densities in western arctic sites (e.g., 126 pairs·km⁻² in Deadhorse, Hohenberger *et al.* [1980]; 207 pairs·km⁻² in the Mackenzie delta, Owen [1974]) are not comparable to eastern sites because of increased habitat diversity and low arctic vegetative affinity.

The density of breeding birds in the eastern Arctic appears roughly comparable throughout the region. A collection of breeding densities from other non-colonial eastern high arctic avifaunal studies indicates an average density (all species combined) of 20.5 total breeding pairs·km⁻² (Table 4). On Igloolik we recorded a higher breeding density of 28.5 pairs·km⁻², more typical of densities on Bylot Island and Sarcpa Lake, sites situated between the Arctic Archipelago and the "low arctic."

The variability in breeding bird densities in the eastern Arctic (e.g., 33 pairs·km⁻² at Bylot Island, 1050 km farther north than the 20 pairs·km⁻² at Frobisher Bay) appears to be related to habitat quantity and quality and to differences in methodology and observer effort. A review of the effort spent in the field in each study suggested similar amounts of observer effort, while definite differences in habitats exist for most of the sites. The Sarcpa Lake study site (Montgomerie *et al.*, 1983) is an exception with a well-vegetated "oasis" habitat within an upland, rocky plateau. The area's high breeding bird density (37.0 pairs·km⁻²) is largely due to the greater number of passerines than found at other study locations in addition to extensive field work by numerous students.

A number of authors (Ouellet, 1990; Freedman and Svoboda, 1982) have noted a general trend of decreasing species diversity with increasing latitude. At more local levels, much of our knowledge is based on very sporadic site descriptions that

TABLE 4. Comparison of avifaunal breeding density¹ in selected eastern and central high arctic sites

Locality	Lat.(°N)	Habitat	# species breeding	Breeding density	Source
Frobisher Bay	63	Sedge meadow, heath	—	20	McLaren, 1965
Foxe Peninsula	64	Coastal, scant vegetation	14	10	MacPherson and McLaren, 1959
Sarcpa Lake	68	Rock upland plateau, lake	22	37	Montgomerie <i>et al.</i> , 1983
Igloolik Island	69	Sedge meadow, <i>Dryas</i> slope	26	28.5	This study
Bylot Island	73	Mosses, sedge	—	33	Van Tyne and Drury, 1959
Truelove Lowland	74	Lowland oasis	19	10.3	Pattie, 1977
Polar Bear Pass	75	Lowland oasis	8(30) ²	12	Mayfield, 1983
Alexandra Fiord	79	Lowland oasis	10	13.3	Freedman and Svoboda, 1982
Average breeding density				20.5	

¹Total number of breeding pairs·km⁻².

²Eight species nested on sample site but 30 have nested in vicinity.

usually present the most biologically interesting area in the region rather than the most representative area. The result is a somewhat misleading presentation of actual bird densities in the Arctic. Almost all of the distribution data comes from highly productive multi-habitat sites along coastal estuaries, tidal flats and lowland oases (e.g., Pattie, 1977; Montgomerie *et al.*, 1983; Mayfield, 1983). Such sites are usually near research base camps or Inuit towns, resulting in a number of additional human-associated species, such as gulls, raven and some passerines, being added to the overall density. The garbage dump at Igloolik attracts 60-100 herring gulls daily from at least 10 km away, while also supporting the nesting colony on the study site. A small, disproportionate number of studies detail the more monotypic and inhospitable interior, where densities are likely much lower. Mayfield (1983) reports a breeding density on Bathurst Island of only 4 pairs·km⁻² on the dry upland site, compared to the 12 pairs·km⁻² in the wetland.

The severe spring and summer of 1986 may have adversely affected nesting, and it is unfortunate that we were unable to determine breeding density in 1986. Species abundance was similar to 1985 but nesting success could have been lower due to the unusual snowfall and late arrival of above-freezing temperatures at the early nesting stage. Local Inuit reported that birds were starving in 1986 (J. MacDonald, pers. comm. 1985).

From accounts of local community members and our field observations we believe that the main spring migration occurs from 1 to 15 June. Only small numbers of birds are typically recorded over land before June (J. MacDonald, pers. comm. 1985). In the fall, large numbers of migrants appeared after 21 August 1985 and 23 August 1986 until the time we departed on 31 August. We were not present for the end of the fall migration, but bird numbers typically decrease rapidly after mid-September (J. MacDonald, pers. comm. 1985). However, it should be noted that intensive observation was not conducted in early spring or late fall and some activity may be missed. Renaud *et al.* (1981), for example, recorded large shorebird numbers through September at Pond Inlet, a site 500 km north of Igloolik.

Our observations indicate that spring migration patterns are influenced by the timing of the appearance of open water on land. The polynya likely allows certain species to arrive early and await inland openings: for example, snow buntings and king eiders have been reported at the ice edge as early as 11 April (Ellis and Evans, 1960), one month before snow begins to melt on land. On Igloolik Island, a greater species richness was present in spring, whereas fall migration was typified by larger numbers of fewer species. The eastern beaches and shore are in close proximity to the migratory flyway through Foxe Basin (Gaston *et al.*, 1986) and for this reason may act as a fall staging area for the large numbers of oldsquaw, Arctic tern, and gull and jaeger species observed there.

On Igloolik Island, egg predation on avifauna was attributed to Arctic fox (*Alopex lagopus*) and local residents. No evidence of avian predation on eggs was recorded. The practice of egg collecting for human consumption was not restricted to any particular species but, because of the ease of finding loon and colonial sites (gull spp. and Arctic tern), these species experienced heavy predation by humans. Egg collecting is facilitated by the use of all-terrain vehicles along the edges of small ponds and lakes and coincides with peak egg laying in early June. For some species, notably loons and Arctic terns, a second egg collecting occurred after re-nesting in early July. In all cases, every egg was removed. On the 10 km study site,

eggs were depredated in 73% (11/15) of red-throated loon nests, 33% (1/3) of snow goose nests, 66% (2/3) of king eider nests, 40% (8/20) of oldsquaw nests, 48% (14/29) of herring gull nests and 93% (13/14) of Arctic tern nests. The impact of this high level of egg predation on long-term productivity of the island's avifauna could not be determined without a longer term study of population demographics. It is likely that this high percentage of nest failure cannot be withstood for more than several generations unless immigration of individuals from elsewhere supplements the local breeding population. Since arctic avifauna studies are mainly annotated lists, we also have no comparison with the effects of this form of egg predation in other high arctic avifaunal communities located near human communities.

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