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An Arctic-Breeding Bird Survey on the Northwestern Ungava Peninsula, Quebec, Canada

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ABSTRACT. Knowledge of breeding bird distribution and abundance in the Canadian Arctic remains rudimentary for many species, particularly for shorebirds and songbirds. To help fill this gap, randomly selected plots were surveyed on the northwestern coast of the Ungava Peninsula, Quebec, Canada, during 2002. Thirty-eight species were recorded at 34 sites, where small songbirds were much more frequent than shorebirds. Breeding waterbirds were more abundant at low elevations near the coast, and songbirds tended to be more abundant at higher elevations. A high occurrence of nesting hawks and owls was probably the result of a high lemming population. Information from the survey extended the known breeding ranges of green-winged teal, spotted sandpiper, pectoral sandpiper, dunlin, American golden-plover, Wilson's snipe, and short-eared owl. Further work on the Ungava Peninsula would likely document additional Arctic-breeding bird species. A more thorough knowledge of Arctic-breeding bird distribution will be needed to determine how species might be affected by global climate change.

Key words: Arctic birds, breeding, Canada, Quebec, shorebirds, survey

RÉSUMÉ. La connaissance de la répartition et de l'abondance des oiseaux nicheurs dans l'Arctique canadien demeure rudimentaire pour bien des espèces, surtout pour les oiseaux de grève et les oiseaux chanteurs. Dans le but de combler ce vide, des parcelles choisies au hasard ont été étudiées sur la côte nord-ouest de la péninsule de l'Ungava, dans la province de Québec, au Canada, en 2002. Trentre-huit espèces ont été consignées dans 34 sites, où les oiseaux chanteurs se retrouvaient beaucoup plus souvent que les oiseaux de grève. Les oiseaux aquatiques nicheurs étaient beaucoup plus abondants en basse altitude près de la côte, tandis que les oiseaux chanteurs avaient tendance à être plus abondants en haute altitude. Une grande quantité de faucons et de hiboux nicheurs découle probablement d'une forte population en lemmings. Les renseignements recueillis à partir de l'étude ont permis d'étendre les échelles de reproduction des sarcelles à ailes vertes, des chevaliers branlequeues, des bécasseaux variables, des bécasseaux à poitrine cendrée, des pluviers dorés, des bécassines ordinaires et des hiboux des marais. D'autres recherches dans la péninsule de l'Ungava permettraient vraisemblablement d'obtenir des renseignements sur d'autres espèces d'oiseaux nicheurs de l'Arctique. La connaissance plus poussée de la répartition des oiseaux nicheurs de l'Arctique s'impose si nous voulons déterminer comment les espèces seront touchées par le changement climatique à l'échelle mondiale.

Mots clés : oiseaux de l'Arctique, reproduction, Canada, Québec, oiseaux de grève, étude

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INTRODUCTION

For most places in the Canadian Arctic, knowledge of breeding bird distribution and abundance remains rudimentary for many species. The Arctic region of Quebec's Ungava Peninsula, where few studies of breeding birds have been conducted, is no exception. Although numerous expeditions were made along the Ungava Peninsula coast between 1885 and 1947 (summarized in Manning, 1949), bird observations were often limited in duration and geographic coverage. Harper (1958) compiled bird observations from the forested central and southern regions of the Ungava Peninsula but did not address its Arctic region. Adjacent to Quebec, Todd (1963) generated a thorough account of the birds of nearby Labrador, including its Arctic region. Churchill, Manitoba, across Hudson Bay, has a long history of ornithological study (e.g., Taverner and Sutton, 1934; Jehl and Smith, 1970; Gratto-Trevor and Vacek, 2001), and to the north, on Baffin Island, the Canadian Wildlife Service continues the legacy of bird studies begun by earlier naturalists (e.g., Soper, 1946a, b, c; Sutton and Parmelee, 1956). The more recently published breeding bird atlas of Quebec (Gauthier and Aubry, 1996) focused primarily on the southern portions of the province but included brief information on Arctic birds. In recent years, biologists from the Canadian Wildlife Service and other agencies (e.g., Caccamise et al., 2000) have studied Canada geese (*Branta canadensis*) at several sites near the community of Povungnituk and have compiled ancillary data on other species.

As part of an Arctic-wide pilot effort to generate unbiased estimates of population sizes and trends of breeding

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shorebirds (see Skagen et al., 2003) that will be reported elsewhere, surveys were conducted on the northwestern Ungava Peninsula, Quebec, in June 2002. The area in northern Quebec was chosen because 1) an established camp provided access, 2) the Canadian Wildlife Service was able to provide financial support, 3) little was known about breeding shorebirds in the region, and 4) readily available satellite imagery enabled generation of a vegetation-based sampling frame. Although the primary goal was to determine the density of breeding shorebirds, the project collected information on all bird species observed. Here I report on the occurrence and abundance of all breeding species encountered during these surveys on the northwestern Ungava Peninsula.

METHODS

The study area is located along the eastern shore of Hudson Bay (60˚00′ N, 77˚10′ W), which lies on the Canadian Shield's Larch Plateau within the Arctic Ecoclimate Province (Fig. 1). The vegetation is typically Arctic, consisting mainly of grasses, sedges, herbaceous plants, mosses, lichens, and dwarf shrubs. Low shrubs, mainly willows (*Salix* spp.), occurred throughout the area. Although the area is considered low Arctic, the rocky substrate has prevented the development of extensive wetlands and a thick peat layer. The northernmost edge of the study area lies in the transition zone between low and mid-Arctic regions.

Forty survey sites were randomly selected within a 200 × 100 km area centered on the community of Povungnituk. Sampling intensity was greatest near the coast because we expected higher densities of breeding shorebirds and possibly greater variability among sites there. At each site, four 10 ha plots located about 2.0–3.5 km apart were systematically selected around the site center. Shapes of plots were mainly square but occasionally varied because of large lakes; plots were selected so that less than 50% of each plot contained open water. From satellite imagery data, maps of broad vegetation types were produced for each plot, which aided navigation on the plots. UTM coordinates (NAD83) were provided for all plot corners, and observers used them to find plot borders. All selection algorithms and preparation of plot vegetation maps were completed by Dr. Jonathan Bart, U.S. Geological Survey. Subsequent to field surveys, I used 1:250 000 topographic maps to measure the maximum elevation and nearest distance to the coast of each site.

Survey timing was set to correspond with shorebird and landbird territory establishment, courtship, nest-building, and early incubation. When the survey crew arrived at the Tuksukatuk Polemond River camp on 31 May 2002, however, more than 90% of the land area was still covered by snow, and melt proceeded slowly. Daily minimum temperatures at the camp did not exceed 0˚C until 15 June, and daily maximum temperatures seldom exceeded 10˚C between 1 and 17 June. Wind speed at 0800 averaged 12.5 km/hr and ranged from 2 to 26 km/hr. Beginning on 9 June, a helicopter was used to access survey plots. Snow cover on initial survey days was often 40% or more of the plot. Most snow, however, lingered on the slopes of hills, particularly on the banks of steep-sloping lakes.

Because of a weather-dependent change in staffing, one of the selected plots, randomly chosen, was not surveyed at each site. In a few cases, errors were made in noting plot corners and substitute plots were surveyed; coordinates of plot substitutions were recorded. Cost constraints also eliminated the ability to survey seven sites in the extreme northern and southern portions of the study area. A total of 100 plots (including three at camp) at 34 sites were surveyed between 9 and 17 June 2002.

At each site, observers were dropped off outside plot corners. Each surveyor then systematically searched the entire plot and recorded all individuals of every species encountered. Observers used behavioral cues to determine which individuals were likely breeding on the plot. During the approximately one-hour survey period, observers plotted all bird encounters on field maps. Immediately after completing the survey, they estimated the total number of birds and the number of pairs or territorial males on the plot. On each plot, observers also estimated the proportional coverage of the broad vegetation types delineated using satellite imagery. A detailed description of survey methods is provided by Bart and Earnst (2002).

In addition to recording numbers of all birds encountered on plots, observers noted large birds (gulls, raptors, waterfowl) seen outside the 10 ha plots during surveys. I also surveyed for large birds from the helicopter when moving among plots at a site. I combined this information with plot results to determine frequency of occurrence of individual species and calculated species richness (by species group, e.g., waterbirds, shorebirds, landbirds) at each site. I used a two-stage random sample estimator (Snedecor and Cochran, 1980) to compare coarse (based on 10 ha-sized plots), apparent (did not account for detectability) plot density among shorebird and small songbird species. All scientific nomenclature and common names follow the American Ornithologists' Union current checklist (2005); English, French, and scientific names of breeding birds are provided in Table 1.

RESULTS

Thirty-eight bird species, all of which were suspected of breeding, were recorded at 34 sites in the study area, and three species (Canada goose, American pipit, and Lapland longspur) were recorded at every site (Table 1). The Ungava lemming (*Dicrostonyx hudsonius*) was abundant everywhere throughout the study area, which probably led to the high occurrence of breeding rough-legged hawks and owls at survey sites (Table 1). Long-tailed duck and northern pintail pairs occurred at more than 50% of the

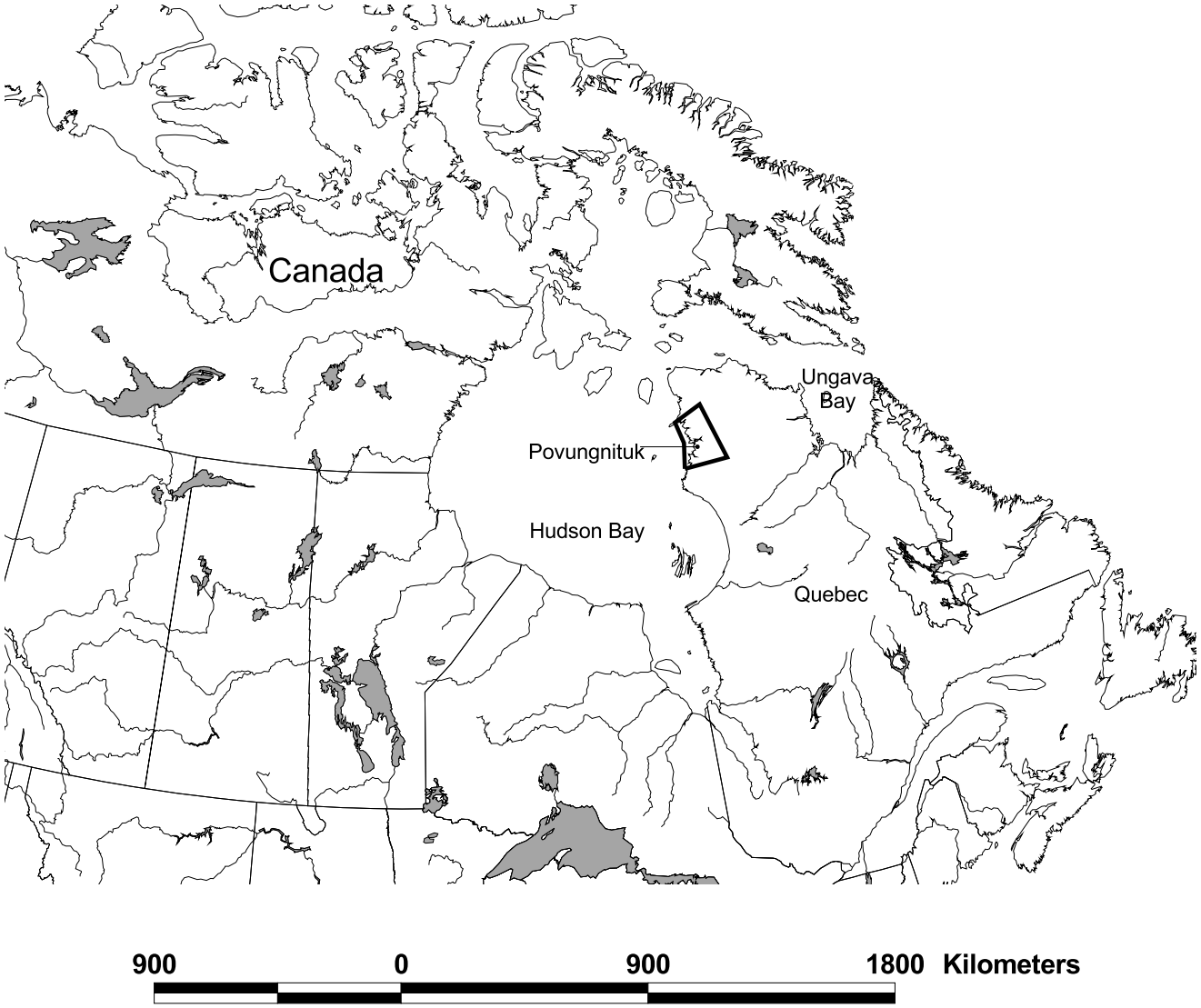

FIG. 1. Study area on the northwestern Ungava Peninsula, Quebec, Canada, for the Arctic-breeding bird survey in 2002.

sites. Only one shorebird, the semipalmated sandpiper, occurred at more than 50% of the sites, whereas five of nine songbirds occurred at more than 75% of the sites (Table 1). Confirmatory breeding evidence for herring gulls and redpolls (hoary and common considered together) was often difficult to assess, so adults observed at sites are included in the analysis. Several other species observed off the sites or at camp may breed in the study area: harlequin duck, common eider, common merganser, glaucous gull, and arctic tern (Table 1). An additional four waterfowl, three gull, and five shorebird species were present only as migrants (Table 1).

Shorebirds were absent from the camp upon arrival of the survey crew, but were evident by 3 June, whereas songbirds and waterfowl were already present at camp when we arrived. Many male shorebirds displaying around camp on 3 June, or shortly after, remained in the vicinity throughout the period. A major passage of shorebirds, particularly of white-rumped sandpipers, occurred on 11–12 June. Lapland longspurs were observed building nests on 3 June, and the first full-clutch nest of a horned lark was found on 11 June. Chronology of shorebird breeding by 18 June included nest-building by semipalmated sandpipers and dunlins, copulations among the American golden-plovers and semipalmated plovers, courtship or territory establishment among the least sandpipers and Wilson's snipes, and pairs of red-necked phalaropes.

I used count data from plot surveys to determine coarse, apparent density of small songbirds and shorebirds. Small songbirds constituted 94% of all observations made on plots and, in general, were much more abundant than shorebirds (Table 2). The most abundant shorebird, the semipalmated sandpiper, was a magnitude lower in abundance than the most abundant songbird (Lapland longspur).

I found a strong relationship between the distance from the coast and elevation of surveyed sites ($F = 158.1$; df = 1,32; $p < 0.001$; $R^2 = 0.83$). I therefore used the regression tree procedure in S-Plus (Venables and Ripley, 2002) to

TABLE 1. Occurrence of breeding bird species (percent of sites at which each species was seen) and occurrence of other breeding (B) and migrant (M) species observed on the northwestern Ungava Peninsula (Quebec, Canada) in 2002.

English Common Name	French Common Name	Scientific Name	Percent of Sites Where Observed
Snow goose	Oie des neiges	*Chen caerulescens*	M
Canada goose	bernache du Canada	*Branta canadensis*	100
Tundra swan	cygne siffleur	*Cygnus columbianus*	18
American black duck	canard noir	*Anas rubripes*	9
Mallard	canard colvert	*A. platyrhynchos*	M
Northern shoveler	canard souchet	*A. clypeata*	M
Northern pintail	canard pilet	*A. acuta*	53
Green-winged teal	sarcelle d'hiver	*A. crecca*	12
Greater scaup	fuligule milouinan	*Aythya marila*	9
King eider	eider à tête grise	*Somateria spectabilis*	6
Common eider	eider à duvet	*S. mollissima*	B?
Harlequin duck	arlequin plongeur	*Histrionicus histrionicus*	B?
White-winged scoter	macreuse brune	*Melanitta fusca*	3
Black scoter	macreuse noire	*M. nigra*	18
Long-tailed duck	harelde kakawi	*Clangula hyemalis*	62
Common goldeneye	garrot à oeil d'or	*Bucephala clangula*	M
Common merganser	grand harle	*Mergus merganser*	B?
Red-breasted merganser	harle huppé	*M. serrator*	3
Willow ptarmigan	lagopède des saules	*Lagopus lagopus*	3
Rock ptarmigan	lagopède alpin	*L. mutus*	29
Red-throated loon	plongeon catmarin	*Gavia stellata*	12
Common loon	plongeon huard	*G. immer*	9
Rough-legged hawk	buse pattue	*Buteo Lagopus*	71
Peregrine falcon	faucon pèlerin	*Falco peregrinus*	6
Sandhill crane	grue du Canada	*Grus canadensis*	3
Black-bellied plover	pluvier argenté	*Pluvialis squatarola*	M
American golden-plover	pluvier bronzé	*Pluvialis dominica*	6
Semipalmated plover	pluvier semipalmé	*Charadrius semipalmatus*	38
Ruddy turnstone	tournepierre à collier	*Arenaria interpres*	M
Semipalmated sandpiper	bécasseau semipalmé	*Calidris pusilla*	59
Least sandpiper	bécasseau minuscule	*C. minutilla*	9
White-rumped sandpiper	bécasseau à croupion blanc	*C. fuscicollis*	M
Baird's sandpiper	bécasseau de Baird	*C. bairdii*	M
Dunlin	bécasseau variable	*C. alpina*	29
Wilson's snipe	bécassine de Wilson	*Gallinago delicata*	35
Red-necked phalarope	phalarope à bec étroit	*Phalaropus lobatus*	3
Red phalarope	phalarope à bec large	*P. fulicarius*	M
Parasitic jaeger	labbe parasite	*Stercorarius parasiticus*	M
Long-tailed jaeger	labbe à longue queue	*Stercorarius longicaudus*	15
Herring gull	goéland argenté	*Larus argentatus*	85
Iceland gull	goéland arctique	*L. glaucoides*	M
Glaucous gull	goéland bourgmestre	*L. hyperboreus*	B?
Great black-backed gull	goéland marin	*L. marinus*	M
Arctic tern	sterna arctique	*Sterna paradisea*	B?
Snowy owl	harfang des neiges	*Nyctea scandiaca*	18
Short-eared owl	hibou des marais	*Asio flammeus*	29
Common raven	grand corbeau	*Corvus corax*	26
Horned lark	alouette hausse-col	*Eremophila alpestris*	82
American pipit	pipit d'Amérique	*Anthus rubescens*	100
American tree sparrow	bruant hudsonien	*Spizella arborea*	88
Savannah sparrow	bruant des prés	*Passerculus sandwichensis*	85
White-crowned sparrow	bruant à couronne blanche	*Zontrichia leucophrys*	53
Lapland longspur	bruant lapon	*Calcarius lapponicus*	100
Snow bunting	bruant des neiges	*Plectrophenax nivalis*	26
Common/hoary redpoll	sizerin flammé/blanchâtre	*Carduelis flammea/hornemanni*	32

partition bird count data into two elevation groups: sites located less than 50 m asl and those at or over 50 m asl. Elevation had a significant, negative effect on the species richness at sites both for shorebirds alone and for all waterbirds (including shorebirds), and it had a weak, positive effect on songbird richness (Table 3). For common shorebirds, increasing elevation had a strong, negative effect on the occurrence of semipalmated sandpipers and dunlins (Fig. 2). Semipalmated plovers and Wilson's snipes were more equitably distributed among sites in the two elevation groups. Wilson's snipes tended to occur more frequently at sites south of Povungnituk (45.5%, n = 22) than at those north of the community (16.7%, n = 12; Fisher's Exact Test, $p = 0.140$).

DISCUSSION

Despite low temperatures and persistent snow in early June, many shorebirds around camp had settled on territories

TABLE 2. Coarse, apparent density (mean number of birds/km^2 ± 1 SE) of shorebirds and small songbirds breeding on the northwestern Ungava Peninsula (Quebec, Canada) in 2002. The two-stage sample includes 100 plots surveyed at 34 sites.

	Birds/km^2 (mean ± SE)
Shorebirds:	
American golden-plover	0.1 ± 0.1
Semipalmated plover	0.6 ± 0.3
Semipalmated sandpiper	2.2 ± 0.7
Least sandpiper	0.3 ± 0.2
Dunlin	0.3 ± 0.2
Wilson's snipe	0.6 ± 0.3
Songbirds:	
Horned lark	4.9 ± 0.9
American pipit	11.1 ± 1.5
American tree sparrow	7.6 ± 1.5
Savannah sparrow	6.4 ± 1.3
White-crowned sparrow	2.7 ± 0.7
Lapland longspur	30.7 ± 2.9
Snow bunting	0.7 ± 0.3
Common/hoary redpoll	0.4 ± 0.3

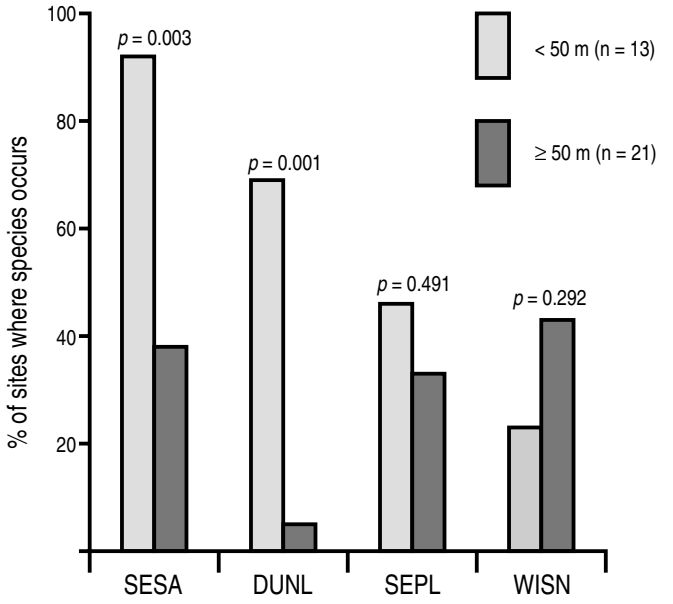

FIG. 2. The effect of elevation (less than 50 m and 50 m and above) on occurrence of common breeding shorebirds at sites (n = 34) on the northwestern Ungava Peninsula (Quebec, Canada) in 2002. (SESA = semipalmated sandpiper, DUNL = dunlin, SEPL = semipalmated plover, WISN = Wilson's snipe). *P*-values refer to Fisher's Exact test results for proportions in each elevation group within a species.

by the time helicopter surveys were initiated on 9 June. Survey results should be representative of the Arctic-breeding bird assemblage inhabiting the study area; however, because the season was late, occurrence of some species that depend on open-water habitats (such as king eider, red-necked phalarope, and Arctic tern) could be underestimated. Detection ratios will be used to determine densities of shorebirds across the Arctic and will be reported elsewhere. On the basis of preliminary estimates of detection rates (80%–90%; J. Bart, U.S. Geological Survey, unpubl. data), I am confident that incorporation of detection ratios will not substantially change the patterns of abundance reported here. The openness and low vertical variation of Arctic vegetation among sites likely minimizes the effect of site on detectability, and the same set of observers surveyed all sites. On a single test of longspur detectability, observers found 90%–100% of suspected breeding males.

In many Arctic regions, wetland occurrence and extent, and hence waterbird abundance, are related to the distance from the coast and elevation (e.g., Morrison, 1997). In this study, breeding density of shorebirds was three to four times lower than has been found in most low and mid-Arctic sites surveyed elsewhere (Johnston et al., 2000: Table 4). The high elevations and rocky substrates encountered on the Ungava Peninsula are likely the cause of low densities of breeding shorebirds and other wetland-dependent species. At higher elevations, sites were better drained, and wetlands were less abundant and extensive. Because elevational variation was relatively low (0–140 m), snowmelt did not seem to vary among inland and coastal sites. Where wet areas did occur, grasses appeared to contribute as much to the vegetation cover as sedges. Shorebird species that nest primarily in the Arctic tended to have a stronger preference for low-elevation, coastal wetlands than did those species that have primarily boreal breeding distributions. Because of the mainland connection, the avifauna of the Ungava Peninsula's Arctic ecoclimatic province is an interesting mix of northward-extending boreal species (e.g., common loon, Wilson's snipe, and white-crowned sparrow) and southern-reaching Arctic species (e.g., king eider, dunlin, and snowy owl).

During the shorebird passage event on 11–12 June, numerous male white-rumped sandpipers were observed performing many of the courtship behaviors (single wing displays, buzzy aerial glides, the "sharp-tailed grouse"

TABLE 3. Species richness at sites (n = 34) where maximum elevation was either less than 50 m or 50 m and above on the northwestern Ungava Peninsula (Quebec, Canada) in 2002.

	Elevation < 50 m		Elevation ≥ 50 m				
	Mean no. of spp.	SE	Mean no. of spp.	SE	t-value	df[1]	*p*-value
All waterbirds	12.3	1.1	8.8	0.7	2.83	20	0.0103
Shorebirds only	3.9	0.3	2.1	0.3	4.12	25	0.0004
Songbirds	5.2	0.3	5.9	0.2	-1.78	24	0.0877

[1] Calculated using Satterthwaite's approximation (Snedecor and Cochran, 1980:97).

display) described by Parmelee (1992). Parmelee did not mention that males performed these behaviors away from the breeding grounds but did note that females were immediately receptive on arrival and perhaps arrived paired. Such en-route displays may hasten nest initiation on the mid- or high-Arctic nesting grounds. Breeding of the white-rumped sandpiper has not been confirmed anywhere on the Ungava Peninsula (Manning, 1949; Godfrey, 1986; Parmelee, 1992); however, white-rumped sandpipers were the second most abundant shorebird breeding on the Great Plain of the Koukdjuak, southwestern Baffin Island (pers. obs. 2003).

Two breeding shorebird species were recorded in the study area outside of the current survey window—a spotted sandpiper nested in 1990 (J. Hughes, pers. comm. 2002), and a pectoral sandpiper brood was discovered in July 2002 (R. Cotter, pers. comm. 2002). Spotted sandpipers nest throughout the forested portions of the Ungava Peninsula (Manning, 1949; Harper, 1958), but breeding had not previously been confirmed for the pectoral sandpiper (Manning, 1949; Godfrey, 1986; Holmes and Pitelka, 1998). The frequency of dunlin observations, coupled with previous observations in the area (J. Hughes, pers. comm. 2002), indicates that the dunlin is a much more abundant breeder on the Ungava Peninsula than previously suggested. Manning (1949) found no records of dunlin from the peninsula, and recently published breeding ranges for the species do not include the Ungava Peninsula (Godfrey, 1986; Warnock and Gill, 1996). Confirmed breeding of the American golden-plover represents the first breeding record for the Ungava Peninsula (Godfrey, 1986; Johnson and Connors, 1996), and plovers may be uncommon breeders along the Ungava's coastal river terraces. Manning (1949) reported American golden-plovers only in the fall. Few red-necked phalaropes were observed, but the species is likely more abundant in the study area (J. Hughes, pers. comm. 2002). Although not confirmed as breeding in the study area (J. Hughes, pers. comm. 2002), the red phalarope was the most abundant breeding shorebird on the Great Plain of the Koukdjuak, southwestern Baffin Island (pers. obs. 2003). Observations of Wilson's snipe extend its previously reported breeding range northward beyond the tree line (Manning, 1949; Godfrey, 1986; Mueller, 1999).

Rough-legged hawks and snowy owls would assuredly be less abundant in years with low lemming populations; their cyclic breeding patterns on the Ungava Peninsula were noted by Manning (1949) and are known from other parts of the Arctic (e.g., Underhill et al., 1993). This study corroborated the reports by Turner (1885) and Manning (1949) that the rough-legged hawk was one of the abundant birds of prey on the peninsula. Although Manning (1949) cited many observations of snowy owls, particularly during fall migration, breeding was noted only at Kuujjuaq by Turner (1885). In this study, snowy owls were observed at six sites, five of which were north of Povungnituk. The high lemming year in 2002 may also have allowed a northward expansion of breeding short-eared owls, which previously had not been reported nesting north of the tree line on the Ungava Peninsula (Manning, 1949; Holt and Leasure, 1993). Although gyrfalcons were previously reported widely from the Ungava Peninsula, primarily during winter and migration periods (Manning, 1949), none were found breeding in the study area. Nesting on the Ungava Peninsula was reported from Wakeham Bay (Manning, 1949).

Some of the most abundant, open-country landbirds observed in this study (the Lapland longspur, American pipit, savannah sparrow, and horned lark) were previously reported to be widespread and common breeders across the peninsula north of the tree line (Manning, 1949). The uncommonly recorded snow bunting was suggested by Manning (1949) to be a far more abundant breeder on the islands of Hudson Bay and Hudson Strait. Manning (1949) did not report American tree sparrows or white-crowned sparrows breeding as far north as this study, but more recent authors include all of the Ungava Peninsula in their breeding range maps (Naugler, 1993; Chilton et al., 1995; Gauthier and Aubry, 1996). Many landbirds are limited by the extent of shrub cover, and increases in Arctic shrubbiness caused by global warning may increase the northern breeding range limits of species such as the American tree sparrow and the white-crowned sparrow.

Red-throated loons were previously reported as much more widely distributed and abundant than recorded in this study (Manning, 1949). Late ice melt may have delayed nesting of loons in the study area in 2002. Although Manning (1949) reported that tundra swans were absent as breeders on the mainland Ungava Peninsula, most recent distribution maps for this species include the eastern shore of Hudson Bay, which includes our study area (Limpert and Earnst, 1994). The high density of nesting Canada geese in the study area has been known since the early 1900s (Low, 1902). The pairs of green-winged teal recorded in this study expand the known breeding range northward from Kuujjuaq, where they were reported by Turner (1885) and on the more recently derived distribution map by Johnson (1995). Manning (1949) reported the long-tailed duck, the most abundant duck in this study, as numerous throughout most of the Ungava Peninsula.

Additional systematic surveys of the Ungava Peninsula's Arctic region will likely increase the number of Arctic species known to breed in the region and will certainly increase our knowledge about the distribution and abundance of breeding birds. The number of range expansions documented in this study attests to the limited knowledge we have about Arctic regions. A better knowledge will be needed to determine which species may be most vulnerable to the vegetation shifts anticipated to result from global climate change.

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REFERENCES

AMERICAN ORNITHOLOGISTS' UNION. 2005. Check-list of North American birds. http://www.aou.org/checklist/index.php3. Accessed May 2005.

BART, J.R., and EARNST, S. 2002. Double sampling to estimate density and population trends in birds. Auk 119:36–45.

CACCAMISE, D.F., REED, L.M., CASTELLI, P.M., WAINRIGHT, S., and NICHOLS, T.C. 2000. Distinguishing migratory and resident Canada geese using stable isotope analysis. Journal of Wildlife Management 64:1084–1091.

CHILTON, G., BAKER, M.C., BARRENTINE, C.D., and CUNNINGHAM, M.A. 1995. White-crowned sparrow *Zonotrichia leucophrys*. In: Poole, A., and Gill, F., eds. The birds of North America, No. 183. Philadelphia: The Academy of Natural Sciences and the American Ornithologists' Union.

GAUTHIER, J., and AUBRY, Y., eds. 1996. The breeding birds of Quebec: Atlas of breeding birds of southern Quebec. Montreal: Association québécoise des groupes d'ornithologues, Province of Quebec Society for the Protection of Birds, and Canadian Wildlife Service, Environment Canada, Quebec Region.

GODFREY, W.E. 1986. The birds of Canada. Rev. ed. Ottawa: National Museums of Canada.

GRATTO-TREVOR, C.L., and VACEK, C.M. 2001. Longevity record and annual adult survival of semipalmated sandpipers. The Wilson Bulletin 113:348–350.

HARPER, F. 1958. Birds of the Ungava Peninsula. University of Kansas Museum of Natural History Miscellaneous Publication No. 17.

HOLMES, R.T., and PITELKA, F.A. 1998. Pectoral sandpiper *Calidris melanotos*. In: Poole, A., and Gill, F., eds. The birds of North America, No. 348. Philadelphia: The Academy of Natural Sciences and the American Ornithologists' Union.

HOLT, D.W., and LEASURE, S.M. 1993. Short-eared owl *Asio flammeus*. In: Poole, A., and Gill, F., eds. The birds of North America, No. 62. Philadelphia: The Academy of Natural Sciences and the American Ornithologists' Union.

JEHL, J.R., Jr., and SMITH, B.A. 1970. Birds of the Churchill region, Manitoba. Winnipeg: Manitoba Museum of Man and Nature.

JOHNSON, K. 1995. Green-winged teal *Anas crecca*. In: Poole, A., and Gill, F., eds. The birds of North America, No. 193. Philadelphia: The Academy of Natural Sciences and the American Ornithologists' Union.

JOHNSON, O.W., and CONNORS, P.G. 1996. American golden-plover *Pluvialis dominica* and Pacific golden-plover *Pluvialis fulva*. In: Poole, A., and Gill, F., eds. The birds of North America, No. 201–202. Philadelphia: The Academy of Natural Sciences and the American Ornithologists' Union.

JOHNSTON, V.H., GRATTO-TREVOR, C.L., and PEPPER, S.T. 2000. Assessment of bird populations in the Rasmussen Lowlands, Nunavut. Occasional Paper Number 101. Ottawa: Canadian Wildlife Service.

LIMPERT, R.J., and EARNST, S.L. 1994. Tundra swan *Cygnus columbianus*. In: Poole, A., and Gill, F., eds. The birds of North America, No. 89. Philadelphia: The Academy of Natural Sciences and the American Ornithologists' Union.

LOW, A.P. 1902. Report of an exploration of the east coast of Hudson Bay from Cape Wolstenholme to the south end of James Bay. Geological Survey of Canada Annual Report 13:1D–84D.

MANNING, T.H. 1949. The birds of north-western Ungava. In: Manning, E.W. A summer on Hudson Bay. London: Hodder and Stoughton, Ltd. 153–224.

MORRISON, R.I.G. 1997. The use of remote sensing to evaluate shorebird habitats and populations on Prince Charles Island, Foxe Basin, Canada. Arctic 50(1):55–75.

MUELLER, H. 1999. Common snipe *Gallinago gallinago*. In: Poole, A., and Gill, F., eds. The birds of North America, No. 417. Philadelphia: The Academy of Natural Sciences and the American Ornithologists' Union.

NAUGLER, C.T. 1993. American tree sparrow *Spizella arborea*. In: Poole, A., and Gill, F., eds. The birds of North America, No. 37. Philadelphia: The Academy of Natural Sciences and the American Ornithologists' Union.

PARMELEE, D.F. 1992. White-rumped sandpiper *Calidris fuscicollis*. In: Poole, A., Settenheim, P., and Gill, F., eds. The birds of North America. No. 29. Philadelphia: The Academy of Natural Sciences and the American Ornithologists' Union.

SKAGEN, S.K., BART, J., ANDRES, B., BROWN, S., DONALDSON, G., HARRINGTON, B., JOHNSTON, V., JONES, S.L., and MORRISON, R.I.G. 2003. Monitoring the shorebirds of North America: Towards a unified approach. Wader Study Group Bulletin 100:102–104.

SNEDECOR, G.W., and COCHRAN, W.G. 1980. Statistical methods. 7th ed. Ames: Iowa State University Press.

SOPER, J.D. 1946a. Ornithological results of the Baffin Island expeditions of 1928–1929 and 1930–1931, together with more recent records (Part 1). Auk 63:1–24.

———. 1946b. Ornithological results of the Baffin Island expeditions of 1928–1929 and 1930–1931, together with more recent records (Part 2). Auk 63:223–239.

———. 1946c. Ornithological results of the Baffin Island expeditions of 1928–1929 and 1930–1931, together with more recent records (Part 3). Auk 63:418–427.

SUTTON, G.M., and PARMELEE, D.F. 1956. On certain Charadriiform birds of Baffin Island. Wilson Bulletin 68: 210–223.

TAVERNER, P.A., and SUTTON, G.M. 1934. The birds of Churchill, Manitoba. Annals of the Carnegie Museum 23:1–83.

TODD, W.E.C. 1963. Birds of the Labrador Peninsula and adjacent areas: A distributional list. Toronto: University of Toronto Press.

TURNER, L.M. 1885. List of birds of Labrador, including Ungava, East Main, Moose and Gulf districts of the Hudson Bay Company together with the Island of Anticosti. Proceedings of the U.S. National Museum 3:233–254.

UNDERHILL, L.G., PRYS-JONES, R.P., SYROECHKOVSKI, E.E., Jr., GROEN, N.M., KARPOV, V., LAPPO, H.G., VAN ROOMEN, M.W.J., RYBKIN, A., SCHEKKERMAN, H., SPIEKMAN, H., and SUMMERS, R.W. 1993. Breeding of waders (Charadrii) and brent geese *Branta bernicla bernicla* at Pronchishcheva Lake, northeastern Taimyr, Russia, in a peak and a decreasing lemming year. Ibis 135:277–292.

VENABLES, W.N., and RIPLEY, B.D. 2002. Modern applied statistics with S-Plus. 4th ed. New York: Springer-Verlag.

WARNOCK, N.D., and GILL, R.E. 1996. Dunlin *Calidris alpina*. In: Poole, A., and Gill, F., eds. The birds of North America, No. 203. Philadelphia: The Academy of Natural Sciences and the American Ornithologists' Union.