The Birds of Wapusk National Park

Robert F. Rockwell, Kenneth F. Abraham, Christopher R. Witte, Paul Matulonis, Michael Usai, Drake Larsen, Fred Cooke, Diana Pollak and Robert L. Jefferies

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DEDICATION

This work is dedicated to the memories of Al Pakulak, Malcolm Ramsay and Don Rusch whose research in the area now known as Wapusk National Park inspires us all.


Birds of Wapusk National Park.
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With its establishment in 1996, Wapusk National Park provided federal protection for 11,475 square kilometres of the Hudson Bay Lowlands. It contains more than 200 km of shoreline and salt marsh grading inland into coastal tundra, fens, bogs and boreal forest. Although perhaps best known for its Polar Bears (*Urus maritimus*) (Wapusk is the Cree word for white bear), the park also is home to an abundance of birds, rich in diversity. As the “supremacy of winged creatures” is deeply rooted in Aboriginal tradition (Manitoba Avian Research Committee 2003), it is only fitting that during these early years of this new national park, every attempt be made to carefully document its avifauna. A detailed inventory will not only reveal the identity of bird species occurring in the park but will also provide the benchmarks necessary to plan effective management and monitoring of its resources. Because birds play such a crucial role in the functioning of ecosystems, their study becomes integral to maintenance of the ecological integrity of the park.

The information presented in this paper draws on 39 years of research carried out in what is now Wapusk National Park. Although much of that research has been directed at a few key species, e.g. Lesser Snow Goose and Canada Goose (all scientific names are in Tables 1 and 3), several other species have also received concentrated attention (e.g. Common Eiders, Semipalmed Sandpipers and Willow Ptarmigan). The work has been carried out by field ecologists and naturalists whose strong commitment led them to seek out and record all the species of birds they encounter. Given the biology of those primary focal species, many of the observations were historically restricted to the near-coastal habitat and adjacent coastal tundra grading into the taiga. More recently, and in direct cooperation with Wapusk National Park, substantial efforts have been made to inventory more inland areas of the park’s peatlands and boreal forest. Although there are still several areas of the park that need to be explored and inventoried, it is important to provide this initial assessment of the Birds of Wapusk National Park, given the potential impacts on the park from both global climate change and the burgeoning population of Lesser Snow Goose, a primary park summer resident.

### WAPUSK NATIONAL PARK HABITAT DIVERSITY

Typical of the Hudson Bay Lowland, Wapusk National Park (Figure 1) is a mosaic of habitats reflecting the isostatic emergence of the land from Hudson Bay, modulated by climatic influences associated with Hudson Bay itself (Mackay 1969; Larsen 1980, 1982). Diversity at several geographic scales reflects local variation in geology, geological history, permafrost, fire and wildlife grazing (Brook 2001). To a certain extent, the temporal course of these processes is reflected spatially as one moves from the coast to more inland portions of the park.

These diverse habitats have been grouped by Parks Canada into four landscape units by integrating data on hydrology, geology and vegetation (Parks Canada 2000). Each unit is comprised of several habitat patches. The landscape units (organized from the coast inland) and their contained habitat patches are:

- **Salt Marshes**, comprised of patches of mudflats, salt marshes and supralittoral marshes with low-lying, account for 4% of the area of the park.
- **Coastal Fens**, comprised of patches of historic beach ridges, sedge fens, Tamarack fens, Spruce stands with sphagnum or lichen and water bodies, account for 13% of the area of the park.
- **Barens**, comprised of patches of lichen-peat plateaus, sedge fens, Spruce stands with sphagnum and water bodies, account for 31% of the area of the park.
- **Spruce Forests**, comprised of patches of tamarack stands with sphagnum or lichen, Tamarack fens, sedge fens, palsa, quaking bogs, drunken forests and water bodies, account for 52% of the area of the park.

This landscape unit based classification will be used as a basic organizational point of reference throughout this paper.

A more detailed accounting of habitat diversity within Wapusk National Park, based to a great extent on vegetation assemblages, can be found in Brook (2000) and Brook and Kenkel (2002). In their work, the park is broken into 16 ground-truthed vegetation-based habitat classification scheme, the park includes:

<table>
<thead>
<tr>
<th>Habitat Type</th>
<th>Description</th>
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<tbody>
<tr>
<td>Marine area</td>
<td>Includes coastal areas adjacent to the park that are rich in bird diversity.</td>
</tr>
<tr>
<td>Tundra</td>
<td>Includes coastal tundra and upland vegetation.</td>
</tr>
<tr>
<td>Forests</td>
<td>Includes upland vegetation.</td>
</tr>
<tr>
<td>Wetlands</td>
<td>Includes freshwater lakes and rivers, marshes, bogs, and supralittoral marshes.</td>
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The same potential is seen in the evaluation of the area occupied by Wapusk National Park in the Manitoba Avian Research Committee’s *The Birds of Manitoba* (2003). There, the park falls into the Taiga Shield and Hudson Plains region for purposes of bird conservation. It is noted that since mid-summer temperature is a good predictor of bird species composition and because these two regions of the park span two climate zones based on mean July temperatures, an enriched avifauna is to be expected. Using their vegetation-based habitat classification scheme, the park includes:

- **Tundra and Forest-tundra** habitat including coastal tundra with elevated beach ridges supporting dry-heaty tundra.
- **Boreal Forest** habitat including both hydric (with bogs and swamps) and mesic (with drier, upland vegetation) habitat and open lichen woodlands.
- **Freshwater lakes** and rivers, marshes, bogs, and supralittoral marshes.

In addition, they record that the area includes freshwater lakes and rivers, marshes, fens, bog, muskeg and swamps.

The Park is positioned between the vast boreal forest to the south and west, and Hudson Bay on the north, encompassing a significant transition across Canada’s two largest biomes. Additionally, the Nelson River (to the south) and Churchill River (to the west) are both known bird migration corridors, as is the Hudson Bay coastline, which forms both the eastern and northern boundary of the park. The Cape Churchill peninsula, projecting as it does into Hudson Bay, and La Pèrouse Bay, provide a natural stopover and staging area for many bird species. These habitats provide large numbers of nesting, migrating and breeding diving ducks. In sum, the diverse mosaic of habitat patches within the park coupled with unique features of its geographic location result in a rich and diverse avian community.
GENERAL METHODS AND SCOPE OF SURVEYS

Not surprisingly, a variety of techniques have been used in the bird checklist compiled during 39 years of research in what is now Wapusk National Park. These have ranged from “casual” bird watching, to systematic searches of specific study areas (e.g. riparian systems), to line transects with constant recording during transit, supplemented by records from regularly spaced “stations” used for systematic searches of specific study areas.

For example, the Spruce Forest and Barrens sections include several burn areas of various ages. The river itself served as a transect and we surveyed it from the western Park boundary to its mouth on Hudson Bay. Additional 500 m transects with listening/observation stations (about every 100 m) were opportunistically set up perpendicular to the river. The dawn chorus was monitored each morning from overnight campsites. There was a total effort of 216 person-hours from 26 June to 4 July 2002.

A complete list of the 198 species of birds encountered and confirmed within Wapusk National Park since 1968 by the Hudson Bay Project team and other contributors is provided in Table 1. The table includes relative abundance, evidence for breeding (using the Ontario Bird Breeding Atlas criteria), an indication of which of the four landscape units in which the species has actually been recorded, and Canadian SARA status where appropriate. Details are summarized in Table 1 footnotes. Breeding evidence codes are described in Table 2.

POTENTIAL SPECIES

A list of accidental and rare bird species that have been reported for the Churchill region but have not been recorded in the park is provided in Table 3. It is based on a list compiled by Manitoba Conservation (Cam Elliott, personal communication) and supported by information in Manitoba Avian Research Committee (2003) and Jehl (2004).

As with any bird checklist, the species in Table 1 are a snapshot in time and those listed in Table 3 are potential future additions (as are others not listed). However, to be useful for management, such additions must be documented as accurately as possible and we encourage visitors to the park to make careful notes on any observations of rare or non-listed species and submit copies to the Superintendent of Wapusk National Park for possible inclusion in revisions of the composite bird list. Such notes should include not only a thorough account of the bird (with sketches or photographs, if possible) but also details on location, habitat, date, time, lighting conditions and the experience of the observer with the reported (and related) species.

SPECIES LIST

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Lesser Snow Goose: Snow Geese found in Wapusk National Park are members of the Lesser (C. c. caurulicennis) subspecies. The C. c. atlantica subspecies (Greater Snow Goose) nests in northeastern Arctic Canada and northwestern Greenland. Lesser Snow Geese come in two generalized colour morphs (white and blue) that were formerly (before 1963) considered the distinct species C. hyperborea and C. caurulicennis, respectively. The first research done on this species at La Pérouse Bay found that the basis for the colour dimorphism is a single autosomal gene locus. However, because the “blue” allele is incompletely dominant to the “white” allele, heterozygous individuals (those with both alleles) display varying levels of white on the belly of lele, heterozygous individuals (those with both alleles). Such a surplus of pairs with like-coloured birds is referred to as an assortative mating pattern and can be the simple result of an individual preferring to select a mate of its own colour. However, research showed that the pattern results from an imprinting-like process wherein a gosling prefers a mate that is the colour of its parents. Given the genetics of the colour dimorphism and the fact that colour mismatched families with birds of both colours can also result from eggs being laid in other pairs’ nests, fostering and general brood mixing, there are always some mixed pairs formed but never the number expected if mating was random (Geramita 1982).

One of the more notable features of the Lesser Snow Goose in Wapusk National Park is the phenomenal growth of their population in recent decades. Geese were first observed nesting at La Pérouse Bay in 1953 (Wellen and Newcomb 1953). The first thorough inventory in 1968 found approximately 2000 nests in a 2 km² area along the west coast of La Pérouse Bay and the northwest border of what is now Wapusk National Park. A complete helicopter-based nesting survey in 1997 identified more than 47,000 nests over at least a 200 km² area that extends east to Cape Churchill, south to at least the White Whale River and inland to tree line. This growth closely mirrors the approximately 6% annual growth of the entire Mid-Continent Population of the species (Abraham and Jefferies 1997). A second colony became established at Thompson Point some 35 km south of Cape Churchill, in approximately 2003. That colony now numbers 5000 to 10,000 pairs. Low-density nesting was documented along the east coast of the park all the way to its southern border in 1997 and 2005. This explosive growth is related to human-caused changes in the species’ wintering habitat and along the migration corridors linking those to Arctic nesting grounds. Details can be found in Jefferies et al. (2003).

Coincident with the growth of both the local nesting population and the entire Mid-Continent Population, much of which migrates through Wapusk National Park, there has been an onset of catastrophic degradation of both salt marsh and adjacent freshwater marsh habitats. A detailed account can be found in Jefferies et al. (2003) and a summary is provided below (Habitat Issues). Not surprisingly, the habitat degradation is impacting other species and some of those effects are summarized in the following species accounts.

An overview of research from 1968 to 1991 on Lesser Snow Geese in Wapusk National Park can be found in Cooke et al. 1995.

Ross’s Goose: In the 1970s and early 1980s, Ross’s Geese were rare in the La Pérouse Bay region and when they were observed, it was nearly always as a male mated to a Lesser Snow Goose female. This fit expectations of mate choice in the two species, wherein each female returned to her natal colony with a mate she selected on the wintering grounds or on migration. There was some overlap in wintering area of the two species and selecting a mate of the “wrong” species resulted from mistakes in the same behavioural system that allowed white and blue Lesser Snow Geese to select the “wrong” colour (Geramita et al. 1982; Cooke et al. 1988). Importantly, the hybrid offspring of these mixed-species pairs are viable and fertile. Over time, we began finding small but increasing numbers of individuals that were intermediate between the two species (Trauger et al. 1971). Again, consistent with our understanding of fidelity to hatching site in the two species, they were females. A small proportion of these had actually been marked as goslings and we could demonstrate that their parents were indeed a mixed-species pair.

In the late 1990s, however, there was a dramatic increase in the abundance of Ross’s Goose in the La Pérouse Bay region and sightings from an observation tower indicated that not only were female Ross’s Geese present but that in most cases they were paired to male Ross’s Geese and were accompanied by broods of apparently full Ross’s Goose goslings. This sudden increase is likely an immigration influx related to the recent rapid increase in the species in mid-continent North America and it is consistent with establishment of similar and even larger nesting colonies elsewhere (Moser 2001). We were not certain where they were actually nesting until 2003, when the source of these families was found to be a relatively discrete colony of nearly 1,000 pairs of Ross’s geese located in freshwater habitat 2 km inland from the east coast of La Pérouse Bay and 8.5 km from the La Pérouse Bay Research Station. The colony is surrounded by nesting Lesser Snow Goose and some mixed-species pairs and is located in an area previously used (and degraded) by Lesser Snow Geese. The colony has persisted as a semi-isolated unit and in both 2004 and 2005 it contained approximately 1,500 to 2,000 pairs of nesting Ross’s Geese. It is likely that the numbers of Ross’s Geese nesting in the region is slightly higher than our estimate from the colony alone because individual pairs have been observed nesting at much lower density over a broader area.

Sibley’s field guide (2000) provides an excellent set of diagnostic figures and descriptions for those interested in discriminating Ross’s and Lesser Snow Geese from each other and their hybrids.

Cackling Goose: Recently, several small subspecies of Canada Goose have been re-classified as a separate species, named the Cackling Goose. While field identification of some populations of Cackling Goose is clear, some populations contain individuals whose field identification remains problematic because their size and standard field marks are intermediate. In the Churchill and Wapusk National Park region, this species is most commonly encountered during spring migration when members of the Tall Grass Prairie Population move through on the way to nesting grounds further north. Alex Drum binned one member of this new species at La Pérouse Bay in 2001.
Canada Goose: The Canada Geese nesting in Wa-
pusk National Park are members of the Branta
canadensis interior subspecies and are managed joint-
ly by Canada and the United States as part of the
Eastern Prairie Population (EPP). Alan J. Fakalak be-
gan studying their biology south of Cape Churchill
in 1965 and that work continued under the leader-
ship of Don Rusch and, more recently, David An-
dersen. That work is summarized briefly by Rusch
and Andersen in Jehl (2004) and more extensively by
Walters (1999). One of the most striking findings of
local relevance is that nesting abundance of this spe-
cies in its traditional Park habitat has decreased sub-
stantially. Because this subspecies is increasing in
the rest of its range (south of Wapusk National Park)
and in the vicinity of Churchill, it is thought that the
local decline is related to degradation of brood rear-
ning habitat initiated by Lesser Snow Geese whose de-
structive foraging has led to severe changes in the
water quality and zooplankton of the ponds (Milka-
ovic et al. 2001). In contrast, large numbers (hun-
dreds) of Northern Shovelers have been seen annu-
ally feeding in and along shallow lakes in the Coast-
al Fens Landscape Unit and in more coastal ponds
associated with less degraded habitat between Cape
Churchill and the Owl River. Curiously, in 2005, 15 to 20 Northern Shovelers were seen at La Pérouse
Bay, more than had been seen in the previous ten
years.

Northern Shoveler: This species feeds on zooplank-
ton in small ponds and was often seen foraging
and nesting in the supratidal marshes adjacent to
coastal portions of Wapusk National Park near the
La Pérouse Bay Research Station. However, begin-
nining in the 1980s, its abundance declined and only
one nest has been found in the area since 1990. It is
possible that the decline in this portion of Wapusk
National Park is related in part to local habitat deg-
ratation initiated by Lesser Snow Geese whose de-
structive foraging has led to severe changes in the
water quality and zooplankton of the ponds (Milka-
ovic et al. 2001). The manikin at Skidmore Lake,
which normally hosts several hundred ducks and
gulls, supported only 35 ducks and an estimated 20
Black Gulls in late June 2005. The gulls have been
reported foraging at Skidmore Lake (Jehl et al.
1999) and in other areas of the park (Koons et al.
2001). In contrast, large numbers (hundreds) of Nor-
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years.

Northern Pintail: Large numbers of this species
(mostly males) aggregate along the coast in mid
summer for molting. Their numbers have in-
creased over the past ten years and are always high-
er in years of extreme drought in the prairie pothole
region. The species nests in more intact vegetation
west and north of the La Pérouse Bay Research Sta-
tion where nesting density averages about one nest
per km². On at least three occasions, a female has
nested and successfully hatched a brood along the
small stream that flows through the research sta-
tion. The species has been decreasing in Manitoba
since 1994 (Downes et al. 2003).

Common Eider: The Common Eiders nesting in
Wapusk National Park are members of the Soma-
tera mollissima sedentaria subspecies. To the best of
our knowledge, they winter in polynyas in northern
Hudson Bay and Foxe Basin (Greg Robertson, per-
sonal communication). While they are found nest-
ing at low density across much of the Salt Marsh
and Coastal Fen Landscape Units of the park, the
highest density is found in two colonies located near
the La Pérouse Bay Research Station. One colony is
located in the lagoons of the Mast River immedi-
ately west of the Station. The other is located in the
lagoons of the upper portions of Wawao Creek ap-
proximately 3 km south of the station. In both cases,
females nest in close proximity to each other on is-
lands in the lagoons and along the shorelines. Each
colony seems to have a reasonably stable population
of between 150 to 250 nests. Together, they are the
largest known nesting aggregation of the species in
Manitoba.

The male Common Eider is a strikingly beautiful bird. Photograph: RF Rockwell.

Dove-like cooing of the males marks the species’
courtship, which continues until all the females
have begun incubating. This may take more than a
month after which the males depart. Many of them
are thought to form feeding flocks off Foxe Island
and Cape Churchill. Like the onset of incubation,
hatching can be protracted for as long as a month.
As soon as ducklings hatch, the females take them
down the streams and into La Pérouse and Hudson
Bays. Sometimes, evidence that females whose
nests fail remain and share brood rearing of the
combined broods (crèches) of successful females.
In spring, the courtship calls of males and females
are an ever-present part of the nocturnal symphony
of the region. These are soon replaced by the softer
calls females make while feeding, incubating and
brood rearing.

One of the more intriguing aspects of the popula-
tion dynamics of this species is its apparent stability
despite periodic catastrophic failures in reproduc-
tive success related to predation. Over the past ten
years, there have been at least three years that had
virtually no duckling production at La Pérouse Bay.
In one case, Arctic Foxes (Alopex lagopus) depredated
nearly all the nests, in a second, a large number of
sub-adult Bald Eagles depredated many nests and in
a third, a single sub-adult Polar Bear ate the eggs
from more than 90% of the nests. In all cases, Her-
gring Gulls and Common Ravens took advantage of
the general disturbances to depredate and scavenge
many of the remaining eggs and nests. Since the dy-
namics of long-lived species such as the Common
Eider are controlled more by adult survival than re-
productive success, the population’s apparent stabili-
ity is not a complete surprise. It is not clear, how-
ever, just how frequent such catastrophes can occur with-
out impacting the population’s dynamics, nor what
effect missing or reduced age classes will have on
long-term dynamics (Koons et al. 2003).

Surf Scoter, White-winged Scoter and Black Scoter:
All three scoter species can be seen in large rafts off
Cape Churchill and Foxe Island from spring break-up
through late summer, apparently feeding on mussel
beds. They are also seen in large flocks on the inte-
rior lakes. Both White-winged and Surf Scoter pairs
were observed at Skidmore Lake in late June 2005
displaying behaviour typical of mates. A lone female
Black Scoter was seen at the same time. On 27 July
2005, a brood of six White-winged Scoter ducklings
accompanied by a hen was observed at Bayside Lake
documenting that the species breeds in Wapusk
National Park. All three species of this poorly un-
derstood group of sea ducks may breed near larger
lakes throughout the Barrens Landscape Unit. The
White-winged Scoter is the least common of the three
in Churchill (Manitoba Avian Research Committee
2003) although our surveys indicate it is at least as
common as the others within the park. The Sea Duck
Joint Venture (2003) indicates that although there is
poor nest survey data on the group, it is likely that all
three species are declining.
Rock Ptarmigan: This sought-after species can only be seen by birders willing to brave the colder temperatures of late fall through early spring. Like all “grouse”, their numbers fluctuate substantially from year to year, perhaps linked in some time-delayed fashion to the numbers of foxes and Gyrfalcons, their main predators in the park. During early spring research on Willow Ptarmigan in the early 1980s, we were often treated to large flocks of these “rock partridges” (as they were called by Samuel Hearne in the 1700s, C. McAtee 1987).

Historical fluctuations in the Churchill region are summarized by Jehl (2004). Near the La Pérouse Bay Research Station, there were more than 100 territorial males during the early 1980s. Territorial jousts by males were common, and the roofs of the station buildings were often the battle ground. Abundance noticeably declined by the early 1990s, when seeing more than five Willow Ptarmigan in a day became a rare event. It is likely that the death of shrubs in this species’ local decline. The species is still prevalent in portions of the park where Willow habitat is intact.

Pacific Loons: These species live on large, deep lakes and streams. Although census data for this species is spotty at best, it is thought that its population size is reasonably stable, at least in Manitoba (Sauer et al. 2005).

Pacific Loons are often found in the Mast River near the La Pérouse Bay Research Station. Photograph: Kristopher Winiarski.

**North America’s traditional, charismatic “sounds of the north” and are major contributors to the park’s nocturnal symphony. The distribution of this pair of species parallels the distribution of the Red-breasted and Common Mergansers, with Pacific Loons being more abundant in the northern portions of the park (and associated with smaller and shallower lakes and streams) and Common Loons being more prevalent in the southern portions of the park, especially on large, deep lakes. Several pairs of Pacific Loons have nested near the La Pérouse Bay Research Station since its installation in 1972. They continue to raise one or two chicks annually and are extremely protective of their young.**

American Bittern: This cryptic species is likely more prevalent than thought throughout the park. We have encountered it in all landscape units. It uses stealth in the wetlands, stream and lake borders near the La Pérouse Bay Research Station to catch and consume both Wood and Boreal Chorus Frogs (Rana sylvatica and Pseudacris maculata, respectively) as well as Three-spine Sticklebacks (G. aculeatus). Although its call is low in volume and frequency range, it provides a penetrating “buzz” to the park’s nocturnal symphony. It is reported to be increasing in Manitoba (Sauer et al. 2005).
Young Sandhill Cranes (called colts) are rarely seen although many are produced annually in Wapusk National Park. Photograph: Drake Larsen.

Yellow Rail: This small secretive marsh bird is seldom seen as it prefers to run or walk rather than fly and is often mistaken for a fleeing mammal. Its distinctive call, imitated by tapping two rocks together in a “click-click, click-click-click” pattern, was once a common sound at the La Pérouse Bay Research Station. Coincident with increased habitat degradation, Yellow Rails have seldom been heard there since the mid-1980s. However, they have recently been heard in several freshwater marshes and sedge fen meadows in the Coastal Fen Landscape Unit away from Lesser Snow Goose-associated degraded habitat. This species requirement for intact habitat makes it a good indicator of habitat integrity. Sora: This visually inconspicuous but noisy bird is found primarily in the Barrens and Spruce Forest Landscape Units. Once heard, the loud descending whinny call “whee-hee-hee-hee-hee-hee-hee” is unmistakable. The Sora is a major contributor to the nocturnal symphony on interior wetlands such as the one adjacent to Skidmore Lake. It is reportedly decreasing in Manitoba since 1979 (Downes et al. 2003).

Sandhill Crane: This species is a common, although secretive nester throughout Wapusk National Park. The adults perform vigorous courtship dances in the spring and coordinated distraction displays while nesting and raising their colts. They are voracious foragers, depleting the nests of many species in the region, including Lesser Snow Geese, Common Eiders and various shorebird species. One pair became particularly adept at finding Semipalmated Sandpiper nests that had been marked three away with small nest stakes. They also have been observed chasing, catching and consuming goslings. One pair was observed on a lichen plateau west of Skidmore Lake from 8 to 11 July 2004, that made us question that assumption. The two birds were seen daily calling to each other, sometimes flying together and moving towards each other when separated. It was usually the case that one individual was more conspicuous. The area was thoroughly searched for a nest but none was found. During that searching, however, both birds were observed performing a broken wing display. While Wapusk National Park is substantially south of the listed breeding range for this species, the pair’s habitat was consistent with nesting habitat for the species. Combining habitat with behaviour, we have indicated this species to be a possible breeder and hope further inventories will clarify this.

Sempipalmated Plovers: Several pairs of Semipalmated Plovers nest in the sand and gravel habitat typical for this species along the western shore of La Pérouse Bay. However, they have also exploited two types of habitat in the region that are atypical for the species. One pair successfully nested near the base of a large willow clump east of the La Pérouse Bay Research Station (Nguyen et al. 2004). Five to ten pairs annually make use of habitat that was once a lush grass-shrub community habitat but is now a barren landscape, degraded by processes initiated by destructive Lesser Snow Goose foraging (Rockwell et al. 2003). In this habitat, the pair typically builds its nest near remnants of dead willows, often bringing dead twigs to surround the nest in a pattern reminiscent of stones in their typical habitat. Although the species is known for protecting its nest and chicks with extreme distraction and broken-wing displays, its foraging behaviour is equally intriguing, especially in extremely degraded habitat. While the species’ standard foraging patterns are seen, several other behaviours have been added that seem attuned to local conditions. These include displacing and inverting fallen stems of dead willows and sections of dried algal mats in search of spiders, standing motionless between small remnants patches of vegetation and then chasing spiders, beetles and true bugs (Hemiptera) moving between patches and harvesting insects that have fallen into traps set by students inventoring the spider and insect population. While reported to be possibly declining in the Churchill region (Jehl and Lin 2001), this species is stable or even increasing in the La Pérouse Bay region of Wapusk National Park.

Lesser Yellowlegs, Solitary Sandpipers, Spotted Sandpiper and Short-billed Dowitchers: These four species of shorebird are commonly seen foraging on inter-tidal mudflats along the coast of Wapusk National Park. The first three are especially common along areas where rocky streams flow into Hudson Bay. What many may not realize is that these shorebirds actually breed in the more interior portions of the park often in association with Spruce stands, Tamarack fens and drunken forests. Lesser Yellowlegs and Solitary Sandpipers often display from the tops of 10-15 metre Spruce trees. Although more commonly seen feeding in salt marshes, Short-billed Dowitchers periodically perch on the tops of willows (Salix spp.) in the supra-tidal marsh. Photograph: Drake Larsen.
Whimbrel: This is one of the largest shorebirds in the region, uniquely identifiable by its long decurved bill. Although Whimbrels consume a variety of foods, students at the La Pérouse Bay Research Station found that they are also egg predators. Depredation of nests of Willow Ptarmigan, Red-necked Phalarope and Savannah Sparrow were confirmed and it is likely the Whimbrels forage on eggs of other species occupying the supratidal marshes. Like the preceding group of shorebirds, Whimbrels often perch on the higher willows. Some Churchill residents refer to this as the “rain bird”, claiming its unmistakable call is an indication of impending storms.

Hudsonian Godwit: This one common, large shorebird was nearly extirpated by market hunters before it was afforded protection by the Migratory Bird Treaty Act of 1918. Its numbers have rebounded and Wapusk National Park is the species’ major Manitoba staging and breeding area. It showed a decline in the La Pérouse Bay region during the 1980s and 1990s but its numbers there have increased and is now not unusual to see flocks of 50 to 100 foraging in the delta of the Mast River near the La Pérouse Bay Research Station.

Semipalmated Sandpiper: This species formed the basis of one of the longest term studies of a Nearctic breeding shorebird. Over a nine year period, Cheri Gratto-Trevor examined basic and breeding biology of this species has also declined in the Churchill region (Jehl and Lin 2001). Although Semipalmated Sandpipers have decreased their nesting in the degraded regions of Wapusk National Park, they can still be found in more intact habitat. Photograph: Sarah Hargreaves.

Although Semipalmated Sandpipers have decreased their nesting in the degraded regions of Wapusk National Park, their abundance in her 3 km² (Gratto et al. 1985) study area declined from 153 in 1983 to only 23 in 1993. Using demographic data and a partially stochastic stage projection model, Hitchcock and Gratto-Trevor (1997) were able to mimic the observed decline remarkably well. That projection suggested the population in the study area would stabilize at approximately 21 nests. We examined that prediction in 1998 and 1999 and found only 11 and six nests, respectively. The most likely explanation is a further reduction in local survival and site fidelity, possibly related to Lesser Snow Goose-induced habitat degradation demonstrated in the study area (Abraham et al. 2005). A similar explanation was offered by Jehl and Lin (2010) for the decline in this species in the Churchill area.

Least Sandpiper: This is one of the most abundant breeding shorebirds in the region. Its numbers declined precipitously in the La Pérouse Bay region during the 1980s and 1990s, coincident with degradation of the inter- and supratidal marshes. Its numbers near the La Pérouse Bay Research Station have recently increased somewhat so that seeing groups of five to ten feeding in the Mast River delta on a single day is as likely as it was in the 1970s. The species has also declined in the Churchill region (Jehl and Lin 2001).

White-rumped Sandpiper: Although this migrant’s stay at La Pérouse Bay is brief, it is spectacular. It is one of the earliest shorebirds to arrive in the spring and its numbers can be staggering, with flocks numbering in the hundreds or even thousands. They congregate and feed primarily on the intertidal marshes but can occasionally be seen in more brackish settings in the delta of the Mast River. It is often seen in the region, uniquely identifiable by its long de

Ruff: There have been several sightings of this species in and near Wapusk National Park. On more than one occasion lone or groups of two to three males have been observed displaying courtship behaviour. One incident involved a male displaying to three females and raised the possibility that there may be a breeding population somewhere in the region (Reynolds 1994, Jehl 2004).

Wilson’s Snipe: This species is often heard winnowing and can be seen in the steep dives primarily used to create the sound. Wilson’s Snipe breed in sedge bogs, fens, willow swamps and the marshy edges of ponds, rivers, and brooks (Mueller 2005). Such habitat abounds in Wapusk National Park and we have located several nests, each containing four eggs. All were found in the more interior sections of the Coastal Fen Landscape Unit.

Red-necked Phalarope: The behaviours associated with this species’ sex-role reversal are summarized by John Reynolds in Jehl (2004). The species is also notable for its foraging behaviour, which involves swimming on the surface of shallow pools in tight circles, stirring the sediment with its feet and plucking displaced aquatic invertebrates with its needle-like beak. Their abundance has declined strikingly from a 1982 high of more than 90 nests in the 2 km² area monitored by Reynolds (1987) to no more than one nest annually in the same area since 1995. Some courting pairs have been observed in the lagoons of the Mast River west of the La Pérouse Bay Research Station. The species has decreased substantially in the Churchill region (Jehl and Lin 2001) and more broadly.

Parasitic Jaeger: One to two pairs of this species forage in the La Pérouse Bay region each year and nests have been found on several occasions. Although the nest is rarely more than a depression in coastal terrain, it is rigorously defended by both the male and female. Once the chicks hatch, both parents try to distract human intruders with broken-wing displays and if pressed, finally resort to aerial assaults. These superb flyers often take shorebirds from the air as a team. They also depredate Lesser Snow Goose eggs, leaving a characteristic hole in the upper surface of the egg through which they extract the embryo. One Parasitic Jaeger was observed depredating eggs in a Herring Gull nest while the Herring Gull was depredating eggs of Lesser Snow Goose.

Dunlin: The Dunlin migrating through and nesting in Wapusk National Park are most likely Calidris alpina hudsonia. Dunlin are the most common migrant through La Pérouse Bay in both spring and late summer with flocks often numbering in the thousands. Large flocks of foraging Dunlin are prevalent in both the inter- and supratidal marshes of the park with nesting pairs found throughout the Salt Marsh and Coastal Fen Landscape Units. Although Dunlin are well known for foraging on a variety of freshwater, marine and terrestrial invertebrates with probing and jabbing, we have also seen huge flocks of Dunlin gleanmg adult mosquitoes from the leaves of Mare’s Tail (Hippuris vulgaris) on windy days when the insects are likely seeking refuge.

Stilt Sandpiper: This is one of the most strikingly beautiful shorebirds in the region. Its numbers declined precipitously in the La Pérouse Bay region during the 1980s and 1990s, coincident with degradation of the inter- and supratidal marshes. Its numbers near the La Pérouse Bay Research Station have recently increased somewhat so that seeing groups of five to ten feeding in the Mast River delta on a single day is as likely as it was in the 1970s. The species has also declined in the Churchill region (Jehl and Lin 2001).

Bonaparte’s Gull: Flocks of 25 to 50 of these black-headed gulls are often seen in the lagoons of the Mast River delta near the La Pérouse Bay Research Station where they feed on aquatic invertebrates. While most observers are accustomed to seeing them in that habitat, they make a more striking appearance at their nests built in Black Spruce trees in the interior portions of Wapusk National Park. They usually nest as colonial groups and any intrusion sets off a cacophony of defensive calls followed by aerial attacks.

The Parasitic Jaeger is an exceptionally successful predator that spends most of its time flying. Photograph: Lauraine C. Newell.
**Herring Gull**: This species is the primary predator on the eggs and goslings of Lesser Snow Geese in the La Pérouse Bay region. They are experts in taking advantage of disturbances. In some cases, the Herring Gulls cruise the colony opportunistically consuming eggs from temporarily unattended nests. In other cases, large groups of gulls converge on an incubating female goose, chase her from the nest with close dives and then consume the eggs. In some cases, eggs are broken and eaten on site while in others they are carried intact and eaten elsewhere. Herring gulls use similar tactics on Common Eiders nesting near the La Pérouse Bay Research Station. They scavenge the remains of prey killed by other avian and mammalian predators.

**Sabine’s Gull and Ross’s Gull**: These two species are sought-after favourites of birders. They are periodically seen in the lagoons of the Mast River delta near the La Pérouse Bay Research Station and more rarely on the lagoons of the upper reaches of Wawao Creek. They are usually in the company of small flocks of Bonaparte’s Gull.

**Arctic Tern**: The arrival of this species from its Antarctic wintering grounds is the sure sign of spring at La Pérouse Bay. Numerous pairs nest on the small barren islands that remain above the tide in the intertidal zone of the bay. Although the “nest” is seldom more than a depression in the substrate, it and the one-three eggs are vigorously defended by both the attendant pair and neighbors. Many who have walked through the “tern area” of La Pérouse Bay have returned with bleeding heads and hands. Other species fare no better, as we once observed a group of nesting terns drive a female Polar Bear and her cub from their island lounging spot that just happened to include two tern nests.

**Snowy Owl**: Snowy Owls are regular spring and fall migrants in the park and are known to nest in years of high lemming abundance. In 2003, for example, more than 20 nests were observed during a helicopter flight from the La Pérouse Bay Research Station to the mouth of the White Whale River 15 km away.

**Northern Hawk Owl and Boreal Owl**: Both these owls are favourites of birders and can be found (usually heard) in the more interior portions of the Wapusk National Park. During years of high lemming abundance they have been seen closer to the coast along with many of the park’s other avian predators. Both species have also been seen in the coastal regions in years when numerous fires are raging further south.

**Great Grey Owl**: With the publication of Robert Nero’s (1980) book, Great Grey Owls became synonymous with Manitoba and the boreal forest. This elusive yet charismatic species nests in Spruce and more commonly, Tamarack bogs, and hunts primarily for small mammals in more open areas. The patchwork nature of the park’s Spruce Forest Landscape Unit is ideal. There have been several observations of this species near the La Pérouse Bay Research Station, one made during a year of extensive forest fires in the south. On that occasion, a lone bird initially perched on a 2-metre tall willow bush near one of our observation towers. As its weight made the branch bend, the bird moved laterally towards the base of the bush. As the thicker portion of the branch also bent, the bird moved again and this continued until the owl was perching less than a third of a metre from the ground – but on a section of branch that no longer bent. It remained there several hours.

**Short-eared Owl**: This species nests and feeds regularly in the near-coastal areas of the park and has been seen in more open interior regions. Abundance and distribution is tightly linked to numbers of voles and lemmings. Several nests have been found over the years in the La Pérouse Bay region with a single pair nesting immediately adjacent to the La Pérouse Bay Research Station in 1984. The pair raised six young, which when fledged, were often seen on the roofs of the station buildings. Both parents would fly by carrying food and encourage the young to chase them.

**Short-eared Owl**: This Short-eared Owl is approximately 3 weeks old and has a voracious appetite. Photograph: RF Rockwell.

**Great Grey Owl**: The Red-necked Phalarope forages on small aquatic invertebrates often found in the grasses along pond edges. Photograph: Lauraine C. Newell.

**Great Grey Owl**: The Red Phalarope spins in tight circles while kicking its feet under water and then grabs aquatic invertebrates that come to the surface. Photograph: Lauraine C. Newell.
Communal Nightingale: Wapusk National Park is near the northern limit for this species in Manitoba and does not provide the forested rock outcrops often preferred by Common Nightingales for nesting. However, the birds are known to use burned areas for nesting and those do exist within the park. Our only records for this species are from burn areas along the Owl River. The species forages at dawn and dusk on large flying insects feeding in abundance in the park. An analysis of the breeding bird survey indicates the species is declining in Manitoba (Sauer et al. 2005).

American Three-toed Woodpecker: This species occurs primarily in Spruce forests where it forages on bark beetles that are often frequent after forest fires. Our only records of this species are from burn areas of the Spruce Forest Landscape Unit along the Owl River. While the species is not overly abundant anywhere, our low encounter rate also likely reflects its association with burns and the patchy nature of habitat in the park. We recorded our highest encounter rate of this species near the northern limit for this species in Manitoba (Downes et al. 2003). Common Ravens are opportunistic foragers and successful scavengers, often eating the remains of Bald Eagle and Herring Gull predations at nests of both Lesser Snow Geese and Common Eiders. They have also been observed taking eggs from unattended nests of both these species and are often seen following Polar Bears and Caribou (Rangifer tarandus) as the mammals move through colonies, displacing incubating females. Common Ravens are adept at pursuing, killing and consuming gosling Lesser Snow Geese shortly after they have hatched.

Horned Lark: Horned Larks specialize in nesting in open, sparsely vegetated country and have been recorded as the first species to colonize the bare ground made available by surface mine reclamation and brush removal projects (Jehl 2004). As such, it is not surprising that they, along with Semi-collared Plovers, have been recorded during the station’s operation for nearly 40 years. In the spring, when many potential singing perches are still snow covered, they all use the real forest found in Spruce and Tamarack patches throughout the interior of Wapusk National Park. Its density rivals that of Gray-cheeked Thrushes and Rusty Blackbirds with which it co-occurs.

Northern Mockingbird: Although often associated with southern portions of the United States, this species has been extending its range north since the 1950s. Although non-migratory through much of its range, the more northern members do migrate as none-over-winter in central Manitoba, and in spring, individuals over-shoot the nesting range relatively frequently. Mockingbirds are famous for their mimetic ability and one bird that occurred regularly at the La Pérouse Bay Research Station had a repertoire that included mimicking Lincoln’s, White Crowned, American Tree Sparrows but, amusingly, also included Herring Gulls and Common Ravens in its repertoire.

Eastern Yellow Wagtail: A single individual was seen on 2 May 1988 by Jack Hughes and Mike Carter at the La Pérouse Bay Research Station. The pipit-like bird was seen on a snow bank flipping its tail in a fashion typical of the wagtails. Its yellow throat and underparts contrasted with both its dark back and wings and black legs. The species has not been observed again.

Bohemian Waxwing: This gregarious species feeds in flocks of ten to twenty-five individuals in drier patches of Spruce and Tamarack and on palsas throughout the park. Northern Mockingbirds are absent from degraded habitat associated with destructive foraging by Lesser Snow Geese in the La Pérouse Bay region. This is one of the most successful grassland sparrow species in North America being relatively distributed (geographically large), occupying an array of habitats ranging from fallow prairie to shopping centre parking lots. It is ubiquitous in grass and sedge/vegetation throughout the park. Nonetheless, the population near the La Pérouse Bay Research Station has undergone a 77% decline over the past 25 years, coincident with a 63% reduction in the species’ preferred grassland-shrub habitat, while nesting density in the nearby Churchill area has not changed over that same time period and has actually increased substantially in Manito- baa. (Rockwell et al. 2003). There is no question that this hardy species has been negatively impacted by the destructive foraging of Lesser Snow Geese in the La Pérouse Bay region.

Purple Martin: A single male was seen flying and feeding with a flock of nine tree swallows on 6 June 2003. It is worth noting that 2003 was the earliest season on record and many seldom-seen birds were observed in the spring in La Pérouse Bay region. The factors leading to this are not fully understood but may be due to its dependency on sugar fruits for most of the year and insects during the summer (Witmer 2002).

Blackpoll Warbler: This is the other exceptionally common warbler in Wapusk National Park. It makes more use of transitional habitat between open tundra and boreal forest than the Yellow Warbler. Its soft, gentle call and somewhat drab plumage make it more difficult to find and may result in underesti- mation of its abundance. It has become less common near the La Pérouse Bay Research Station where the birds are observed. Chicken and duck predation pro- cesses initiated by Lesser Snow Goose foraging.

American Tree Sparrow, Lincoln’s Sparrow, Swamp Sparrow and White-crowned Sparrow: Along with the Savannah Sparrow, these four are the most common and prevalent sparrow species near the La Pérouse Bay Research Station. All have nested and fledged young within the confines of the Sta- tion. Their singing has awakened and entertained researchers during the station’s operation for nearly 40 years. In the spring, when many potential sing- ing perches are still snow covered, they all use the Station’s radio masts and weather vane in amazing displays of intra-specific aggression but inter-specif- ic tolerance.
Habitat Issues

There are at least four processes that will continue to influence the diversity and structure of the avifaunal community in Wapusk National Park. First is the destructive foraging of Lesser Snow Goose and Canada Goose. Second is the inorganic upland that annually exposes additional coastal sediment and gravels, and elevates more inland habitat relative to sea level. Third are the processes that are especially pronounced in the Barrens and Spruce Forest Landscape Units. Lastly, there is global climate change which will continue to drive changes in the regional avifauna during the following subsections. In the spring, it is worth noting that this is the only North American passerine species that breeds exclusively in Canada.

Lapland Longspur: This species has declined substantially in the La Pérouse Bay region, likely as a result of habitat degradation related to destructive foraging by Lesser Snow Goose. Similar reductions closer to Churchill are also likely related to habitat degradation but in that case it is related to drainage and road construction (Jehl 2004). Inland and south of the degraded habitat associated with La Pérouse Bay, the species is still prevalent within Wapusk National Park, especially in moister mires and sedge meadows. Closer to treeline, where hummocks become taller and more frequent, where clumps of Spruce and Tamarack punctuate the meadows, and where the habitat is somewhat drier, the Lapland Longspur is increasingly replaced by Smith’s Longspur.

Smith’s Longspur: This species is another favourite of birders, in part because it has never been as common as the “other” longspur found in the region, and partly because it has a restricted winter range in the mid continent region so has better opportunities to see it. Like the Lapland Longspur, this species has also declined in the Churchill region. There are no known data on its status in Wapusk National Park. The species is not as frequent as the Lapland Longspur but does replace it in more interior regions (above). The Smith’s Longspur is highly vocal during breeding and displays rich and somewhat legalistic courtship behaviour as summarized by Briskie (1993).

Rusty Blackbird: Although this species has declined throughout much of its North American range and has become scarce in Churchill (Jehl 2004), it remains one of the most abundant nesting passerines in Black Spruce and Tamarack stands throughout the interior portions of Wapusk National Park. Surveys on 19 June 2003, north of Klohn Lake (see Figure 1 sites “1”) produced density estimates for calling males of one to two individuals per hectare. More recently, however, the nesting density has declined substantially, consistent with continent-wide declines in the abundance of this species.

Common Redpoll and Hoary Redpoll: These two species are both present in Wapusk National Park as are many individuals that appear intermediate for many of the “distinguishing” species’ characters. The taxonomic status of this complex of between one and six species is not yet fully resolved (e.g. Sutin et al 1995). However, the two for Redpoll species found in the park are energetic and acrobatic small finches that are always pleasant to observe.

Feathers in preparation for fall migration. Nitrogen fixing plants in the mid continent region are impacted by the “grazing-defecation” relationship with its healthy “grazing-defecation feedback” relationship with its primary consumers. At these low densities, spring grubbing led only to devestation of small, well-dispersed patches, and did not alter the overall structure of the marshes. These small patches can recover within a growing season or at least between growing seasons, as long as the intensity of grubbing among years remains low. From the late 1970s onward, however, there were nearly exponential increases in local breeders and, more importantly, staging birds (those which continue to migrate further north to breed) of the burgeoning Mid-Continent Population of Lesser Snow Geese. These increases led to extensive and repeated spring grubbing at a rate that far out-paced plant regrowth. With these high densities of geese, an unsustainable “grubbing-devestation-soil deterioration” feedback loop overwhelmed the healthy “grazing-defecation” feedback relationship and the habitat became severely degraded. A detailed account of degradation in the La Pérouse Bay region can be found in Jeffers et al. (2003, 2004). In the following, we briefly summarize these papers in terms of several processes and outcomes that are particularly relevant to the park’s avifauna.

Habitat Issues

There are at least four processes that will continue to influence the diversity and structure of the avifaunal community in Wapusk National Park. First is the destructive foraging of Lesser Snow Goose and Canada Goose. Second is the inorganic upland that annually exposes additional coastal sediment and gravels, and elevates more inland habitat relative to sea level. Third are the processes that are especially pronounced in the Barrens and Spruce Forest Landscape Units. Lastly, there is global climate change which will continue to drive changes in the regional avifauna during the following subsections. In the spring, it is worth noting that this is the only North American passerine species that breeds exclusively in Canada.
mately 20 m of new tidal flats per year. As these flats grow, this leads to an estimated exposure of approximately 1 cm per year in much of the Hudson Bay region and in the coastal sections of Wapusk National Park. This is due to isostatic uplift, or rebound, which allows for additional grubbing and shoot pulling. The process continues at an ever-increasing rate with small barren patches again coalescing into large tracts of exposed sediment.

The areas of once-lush graminoid and shrub assemblages near the La Pérouse Bay Research Station and another area near Thompson Point are particularly good examples of degradation of supratidal marsh. The area east of the high willow fringe near the east coast of La Pérouse Bay and the area adjacent to the headwater lagoons of Wawao Creek near tree line are good examples of degradation in more inland habitat. In the latter area, both Black Spruce and Tamarack have died at least in part from hypersalinization of the soil resulting from the removal of grasses and sedges in what was formerly a freshwater area.

Degradation of the intertidal graminoid lawns has reduced forage for both Lesser Snow Geese and other herbivores, such as Canada Geese and American Wigeon. Additionally, it has likely impacted shorebirds and other species foraging on the intertidal marshes (Vacek 1999). The loss of supratidal marsh habitat has reduced availability of both foraging and nesting habitat for a variety of species including those dependent on the now degraded ponds that dot the region (Milakovic et al. 2003). The fact that degradation of supratidal marsh has reduced nesting density of the otherwise resilient Savannah Sparrow (Rockwell et al. 2003) does not bode well for more sensitive passerine species dependent on near-coastal assemblages of graminoid and shrub vegetation. By contrast, however, some species like the Semipalmated Plover and Horned Lark seem to be able to exploit these degraded areas that resemble their preferred more-open habitat. The loss of graminoids in more inland wetlands (bogs and fens) certainly limits nesting and likely foraging by many species that nest there. As the degradation extends into stands of Black Spruce and Tamarack, yet another type of nesting and foraging habitat will become compromised.

**Isostatic Uplift**

Isostatic uplift (or rebound) is the gradual rise in the land that was depressed by the mass of the ice sheets that once covered the region during the Wisconsin Glaciation (maximum extent 20,000 years ago). On average, the land is rising relative to the sea about 1 cm per year in much of the Hudson Bay region and in the coastal sections of Wapusk National Park, this leads to an estimated exposure of approximately 20 m of new tidal flats per year. As these flats become populated with aquatic invertebrates (e.g., polychaete worms) they will provide new foraging opportunities for the more than 25 species of shorebirds that have been seen foraging in the intertidal zones of the park. As long as there are not large numbers of geese, graminoid swards may develop on these emergent lands such as those historically seen along the coast (e.g., Chou et al. 1992) and provide food to both herbivores and a variety of shorebird and passerine species that glean insects from the vegetation. However, it is important to note that global climate change may lead to a rise in sea level (see below) which may offset any rise in land level due to isostatic uplift, so that there may be no net change in land level relative to sea level in the immediate coastal zone.

Isostatic uplift is occurring at the regional level and is leading to the interior regions rising above the local fresh water tables. As a result, the land drains and becomes drier. This process is exacerbated by the impact of onshore winds that become warmer and more desiccating as they move inland (Rouse and Bello 1985). The drying-out of inland habitats encourages the development of shrub vegetation and possibly heathland. As the inland habitats become more shrub and heath-like, sedge meadow nesters such as Least Sandpipers and Nelson’s Sharp-tailed Sparrows may be replaced by American Golden Plovers and American Tree Sparrows.

**FIRE**

The Park’s ecosystems developed in the presence of periodic fires especially in the Barrens and Spruce Forest Landscape Units. There is not much known about the dynamics of fire or post-fire recovery in this region; however, in the forest tundra zone in both Europe and other parts of North America, fire has resulted in the tree-line moving south because of lack of propagules, a poor seed bank and episodic seed production of remaining trees. As such, rather than recovery to pre-fire status, there may be an increase in open sedge and grass communities that may ultimately change to lichen pasture after 50 years or so. Whether the same processes are operating on the Cape Churchill peninsula is unclear. The short-term impact of fires on the avifauna of these landscape units is obvious and both short- and long-term loss of required habitat will likely lead to dispersal to adjacent, more appropriate habitat with some potential increase in local competition. Long-term effects will depend on the pattern of succession. Additional data are needed at both time scales. There are some species that “benefit” from fires in

- **Photograph:** RF Rockwell

- **Expanse of dead willows near tree line result from spring grubbing. These areas were once used by numerous species of passerines. Photograph: Lauraine C. Newell.**

- **Photograph:** RF Rockwell

- **Photograph:** Lauraine C. Newell

- **Photograph:** RF Rockwell

- **Photograph:** Lauraine C. Newell
the sense that they exploit recently burned habitat. Of the birds that occur in Wapusk National Park, this list includes American Three-toed Woodpeckers and Common Nighthawks. It is also possible that Northern Hawk Owls, Boreal Owls, American Kestrels, Common Goldeneye and Hoolock Mergansers make use of burned areas for nesting cavities. Clearly, additional inventories and monitoring are needed to clarify these observations.

GLOBAL CLIMATE CHANGE

The current models of global climate change predict that several features of the environment will be altered in the near-term ways that may impact the habitat of Wapusk National Park either directly or indirectly by the processes discussed above. These changes are:

- increases in temperature, decreases in precipitation and a rise in the sea level. The predicted changes in temperature and precipitation will extend the current prairie drought north, particularly in summer. These changes will also exacerbate drying of the interior portions of the park, increasing the frequency of fires and perhaps extending them into the Coastal Fen Landscape Unit. These desiccating effects will enhance the salinization of surface-exposed sediment associated with habitat degradation and will retard the establishment of new swards of grasses on any emergent coast. As mentioned above, increased sea levels (melting ice caps and the thermal expansion of sea water) could actually offset coastal emergence resulting from isostatic uplift.

More directly, increasing summer drought linked to prairie drought will affect rates of evapotranspiration from vegetation and soil. It is likely to lead to a decrease in soil moisture content, a drying of the rooting zone, an increase in the number of dry events, an increase in the number of dry days and a decrease in the number of wet days. The plants in the Churchill region, approximately 12-18 freeze-thaw cycles occur in the soil at freeze-up and melt. Climate change is predicted to extend the snow-free season, which will result in the freeze-thaw cycles occurring earlier in the season. If plant growth at the onset of spring is driven by photoperiod rather than by temperature, it may result in an increased mismatch between the date of seed release and plant activity. As a result, the nutrients may be lost in melt-water from the system. This will affect the forage quality of plants that are grazed by vertebrate herbivores, including geese, during spring and summer. Hence, the loss of soil nutrients may lead to so-called bottom-up effects that impinge on all trophic levels, especially as nitrogen and phosphorus are limited in these systems.

EVIDENCE FOR RECENT AVIFAUNAL CHANGE

Had we suspected that the nesting colony of Lesser Snow Goose at La Pérouse Bay (and the Mid-Continental Population) would grow at the rate it did and that such growth would initiate the habitat degradation it has, we would have designed a quantitative monitoring program to assess impacts on the avifauna in the region. The same program could have been used to see if the other processes discussed above might lead to changes, although the time course of their potential effects is much longer. In the absence of such foresight, we have used our long-term bird data to try to detect any avifaunal changes that might be coincident with the habitat degradation in La Pérouse Bay region. Because these data were collected for several reasons and under varying conditions, we have been cautious and conservative in our evaluation. In the following section, we outline our approach, present the basic findings and conclude that it is changed avifauna for both declines of several species and a general impact on the avifauna. A challenge when using this type of data to detect trends, is the need to minimize potential biases related to directional changes or even random variation in effort, coverage or skill of the observers over time. The new habitats that occurred in several ways. We selected species whose identification is relatively clear and simple, species that are fairly frequent and species whose habitat at the Churchill region was available in the area (Table 4). Annual data were restricted to a time period when there were a number of researchers in the field each day. Given the nature of research at La Pérouse Bay, this period includes a large portion of the Lesser Snow Goose incubation period. However, since there are annual differences in the timing of that period and since Lesser Snow Goose often begin incubation before many other birds arrive, analyses were further limited to observations made between 1 June and 30 June. During this period, both resident and transient birds are present in the marsh and adjacent habitat. Finally, as the nesting Lesser Snow Goose colony increased in numbers, it also grew geographically. Although research initially expanded to match this growth, we eventually centered most of our efforts on a fixed portion of the region. After reviewing logs detailing Snow Goose study areas, botany and shorebird study areas and various surveys, we concluded that geographic coverage was reasonably consistent during the June observation period for the years 1980 to 1996. Fortunately, these years span the time course of habitat degradation initiated by Lesser Snow Goose rather well (Jefferys and Rockwell 2002; Abraham et al. 2005). It is important to note that the geographic area thus defined is the immediate vicinity of La Pérouse Bay, and not Wapusk National Park in general, so that trends discussed are not assumed to apply over the whole park.

We recorded the total number of each species observed each day for four factors such as multiple counts of individuals by several observers and other general enumeration difficulties (e.g., Bibby et al. 1999). The proportion of days on which a species was observed during the June period can be used as a surrogate for its relative abundance during that observation period and we can evaluate whether that proportion has changed over the 17 years. This approach assumes the detection and identification abilities of the observers for the species have not changed systematically. Although the relationship between “abundance” and “being observed” will differ between species owing to species-specific difference in ease of detection or identification (e.g. Tundra Swans are easier to observe than Red-necked Phalaropes), this poses no problem for our purposes. We can assume that the proportion of days on which a species does not itself change over time.

The proportion of days on which a species was observed has clearly declined for some species (Figure 2 – Stilt Sandpipers) over the 17 years. For others the pattern is less obvious (Figure 2 – Common and Hoary Redpoll). The extent of linear change in this surrogate measure of abundance over the 17 years was estimated using regression analyses and results for the 34 selected species are presented in Table 4. Negative values indicate a decline in relative abundance over time and the larger the negative slope, the greater the decline (e.g. the decline for Stilt Sandpipers is greater than that for Redpolls). When interpreting these slopes, one must be mindful of annual variation in the data and consider whether the magnitude of the estimate is greater than expected by chance. One approach is to consider the “p” values that are associated with the regression test statistic “F” (Table 4). Historically, values of p ≤ 0.05 were considered ‘statistically significant’. However, one problem with such an approach is that since there is a 5% chance of being wrong on any given value, considering 34 of them at once leads to a roughly 83% chance that one or more of your assessments will be incorrect. To guard against this particular problem, we used the more conservative Bonferroni criterion discussed in Table 4 and found that four species; American Wigeon, Northern Shoveler, Stilt Sandpipers and Short-billed Dowitchers have declined more than expected by simple chance variation.
Interpreting these statistical results biologically requires that we keep several factors in mind. Increasingly, statistical significance is viewed more as providing evidence in support of one of a set of hypotheses, rather than the more traditional linkage of ‘statistically significant’ to ‘biologically meaningful’ (Taper and Lele 2004). In this case, conservatively assessed declines in four species paired with a general decline across 34 species supports the hypothesis that the abundance of at least some bird species declined in the La Pérouse Bay region over a time period that coincides with severe habitat degradation. This support is reinforced by understanding that our surrogate measure of abundance likely underestimates real declines for some species. There is no doubt that some species-specific minimum abundance must be reached before the species is not likely to be observed on a given day. As such, the absence of a ‘significant’ decline for a given species in the proportion of days it was observed does not necessarily mean its abundance has not decreased.

The Hudsonian Godwit provides a good example. In the 1970s and 1980s, flocks of 50 to 100 were often seen foraging in the Mast River near the La Pérouse Bay Research Station. By the 1990s, these feeding flocks rarely contained more than five to ten individuals. This lower abundance was still sufficient for the species to continue to be observed on most days, as evidenced by its small and non-significant rate of decline (Table 4). The same scenario likely explains why Semipalmated Sandpipers, Red-necked Phalaropes and Savannah Sparrows continued to be observed regularly despite substantial decreases in their nesting density (see accounts in Highlighted Species). Such underestimation of decline is even more likely for species that are highly ‘detectable’ in that they will continue to be recorded as ‘present’ even at very low abundance. The penetrating call of the Long-tailed Duck and the striking flight and vigorous foraging behaviour of Red-breasted Mergansers are examples of this, and their high detection ability likely contributed to their small decline highlighted in Table 4, despite direct evidence of declines in nesting.

Although the declines occurred over a time period that coincided with severe habitat degradation, this does not necessarily prove that the degradation itself led to the declines. For example, species decline could be geographically more widespread and unrelated to local changes. However, the evidence for a local effect related to habitat loss is strong in more than one case. It is strongest for Savannah Sparrows whose nesting density decline is restricted just to local habitats degraded by Lesser Snow Geese (Rockwell et al. 2003). Similarly, local rarity of species such as Northern Shoveler, Long-tailed Duck and Willow Ptarmigan contrasts with higher abundance in other parts of Wapusk National Park and again supports local effects. Finally, several species of shorebirds that have declined in the La Pérouse Bay region have also declined closer to Churchill, and those declines have also been related to goose-induced habitat degradation (Jehl and Lin 2001; Jehl 2004).

ACKNOWLEDGEMENTS

This work provides the first detailed account of the avifauna of Wapusk National Park. It is clear that the habitat diversity and location of the park combine to support a diverse avifaunal community including at least 198 species. This list includes one of the most well-studied species of migratory waterfowl (Lesser Snow Goose), a duck whose feathers and down are known globally for their warmth (Common Eider), an owl that is legendary in Manitoba (Great Grey Owl), two species whose voices define the north (Pacific Loon and Long-tailed Duck), the only passerine that nests exclusively in Canada (Harris’s Sparrow) and several of the most sought-after prizes of North American bird watching (Ross’s Gull, Hudsonian Godwit, Boreal and Northern Hawk Owl, Willow and Rock Ptarmigan and Smith’s Longspur).

Because birds play a pivotal role in the functioning of ecosystems, this list provides a benchmark for monitoring not just the avifauna, but also the ecological integrity of Wapusk National Park. Monitoring goes hand in hand with formulating and executing management plans to maintain ecological integrity, particularly in light of processes that will change the ecological structure of the park. A continuing and evolving monitoring program should include inventories of the less-studied regions of the park, both to increase understanding of the distribution and habitat associations of the avifaunal community and to identify any additional species. A second, crucial objective of such a program is to design and execute studies to quantify the abundance of the various species already identified, and then regularly estimate those abundances. Because the detection methods (or detection corrections) to be used vary across species (Bibby et al. 2000), the species list provided in this paper will aid in the development of a quantitative assessment plan. While there is a temptation to focus on rarities and sensitive species (in the spirit of a miner’s canary), we suggest a combination of species that bracket the park’s habitat types and represent both sensitive and robust species. For example, the demonstration that Lesser Snow Geese have impacted Savannah Sparrows is far more informative and alarming than any impact they may have had on more sensitive species.

The traditional Aboriginal view of the “supremacy of winged creatures” is amply illustrated by the extensive list of species in Wapusk National Park and their use of this diverse landscape. We hope this work spurs further appreciation of that point.
LITERATURE CITED


Parks Canada. 2000. Background information to the Wapusk ecological integrity statement. Western Canada Service Centre, Winnipeg, Manitoba.


Figure 1. Wapusk National Park. Number codes correspond to targeted survey areas cited in the text. (1. Coastal Fen Landscape Unit Sites; 2. Fletcher Lake Barrens Landscape Unit; 3. Owl River; 4. Rupert Creek; 5. Skidmore Lake; 6. Helicopter Waterfowl Surveys. See text for additional detail.) Original figure provided by Parks Canada.
Figure 2. The proportion of days on which Stilt Sandpipers and Redpolls (both Common and Hoary) were observed at La Perouse Bay over 17 years. Solid lines are linear regressions.

<table>
<thead>
<tr>
<th>SPECIES</th>
<th>COMMON NAMES</th>
<th>ABUNDANCE</th>
<th>BREEDING EVIDENCE</th>
<th>LANDSCAPE UNITS</th>
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A see details under Black-bellied Plover and Ruff in Highlighted Species section.

Species Superscripts - Numeric superscripts reflect the species status designation according to the Canadian Government Species at Risk Act schedules (given in parenthesis). http://www.sararegistry.gc.ca/species/default_e.cfm.

1 threatened (schedule 1)
2 special concern (schedule 1)
3 special concern (schedule 3)
4 special concern (COSEWIC)

Landscape Units are those units (defined in Parks Canada (2000) and discussed in the text) where a species has been observed.

sm: Salt Marshes
cf: Coastal Fens
ba: Barrens
sf: Spruce Forest


Abundance provides a qualitative assessment of the likelihood a species will be encountered in the park. For species seen only as migrants (those whose Breeding Status is a blank) the assessment is for the normal spring and/or fall periods when the species is staging in the park. For Rock Ptarmigan, it refers to the late fall, winter and early spring periods when they are resident in the park.

accidental: not likely to be seen (recorded 1-2 times in 36 years).
rare: not seen every year
regular: seen every year but not every day
common: seen on most days each year

Breeding Evidence: Status and Code are based on the system used by the Ontario Breeding Bird Atlas (Table 2).

http://www.birdsontario.org/download/atlas_feb03.pdf;
Table 2. Coding System for Determining Breeding Status of Birds Observed in Wapusk National Park.

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<th>Code</th>
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<td>X</td>
<td>Species observed in breeding season - no further evidence and no migrants</td>
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<tr>
<td>H</td>
<td>Species observed in its breeding season in suitable nesting habitat</td>
</tr>
<tr>
<td>S</td>
<td>Singing male present, or breeding calls heard, in its breeding season in suitable habitat</td>
</tr>
<tr>
<td>P</td>
<td>Pair observed in their breeding season in suitable habitat</td>
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<tr>
<td>T</td>
<td>Permanent territory registered through territorial song on at least 2 days in same place a week apart</td>
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<td>D</td>
<td>Courtship or display between a male and a female or 2 males including courtship, feeding or copulation</td>
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<tr>
<td>V</td>
<td>Visiting probable nest site</td>
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<tr>
<td>A</td>
<td>Agitated behavior or anxiety calls of an adult</td>
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<tr>
<td>B</td>
<td>Brood patch on adult female or classical protuberance on adult male</td>
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<tr>
<td>N</td>
<td>Nest-building or excavation of nest hole</td>
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<tr>
<td>DD</td>
<td>Distraction display or feigning injury</td>
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<tr>
<td>NU</td>
<td>Used nest or egg shell found (occupied or laid within period of study)</td>
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<td>FY</td>
<td>Recently fledged young or downy young, including young incapable of sustained flight</td>
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<td>AE</td>
<td>Adults leaving or entering nest site in circumstances indicating occupied nest</td>
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<td>FS</td>
<td>Adult carrying fecal sack</td>
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<tr>
<td>CF</td>
<td>Adult carrying food for young</td>
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<td>Nest containing eggs</td>
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<tr>
<td>NY</td>
<td>Nest with young seen or heard</td>
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Probable Breeding

Possible Breeding

Confirmed Breeding

Table 3. Accidental and Rare Birds of the Churchill Region Not Yet Recorded in Wapusk National Park.

<table>
<thead>
<tr>
<th>Species</th>
<th>Common Names</th>
<th>Abundance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aix sponsa</td>
<td>Wood Duck</td>
<td>accidental</td>
</tr>
<tr>
<td>Oxyura jamaicensis</td>
<td>Ruddy Duck</td>
<td>accidental</td>
</tr>
<tr>
<td>Bonasa umbellus</td>
<td>Ruffed Grouse</td>
<td>accidental</td>
</tr>
<tr>
<td>Gavia adamsi</td>
<td>Yellow-billed Loon</td>
<td>rare</td>
</tr>
<tr>
<td>Podilymbus podiceps</td>
<td>Pied-billed Grebe</td>
<td>rare</td>
</tr>
<tr>
<td>Accipiter striatus</td>
<td>Sharp-shinned Hawk</td>
<td>rare</td>
</tr>
<tr>
<td>Accipiter cooperii</td>
<td>Cooper's Hawk</td>
<td>accidental</td>
</tr>
<tr>
<td>Rallus limicola</td>
<td>Virginia Rail</td>
<td>accidental</td>
</tr>
<tr>
<td>Grus americana</td>
<td>Whooping Crane</td>
<td>rare</td>
</tr>
<tr>
<td>Numenius borealis</td>
<td>Eskimo Curlew</td>
<td>endangered</td>
</tr>
<tr>
<td>Larus atricilla</td>
<td>Laughing Gull</td>
<td>accidental</td>
</tr>
<tr>
<td>Larus ridibundus</td>
<td>Black-headed Gull</td>
<td>accidental</td>
</tr>
<tr>
<td>Larus canus</td>
<td>Mew Gull</td>
<td>rare</td>
</tr>
<tr>
<td>Larus fuscus</td>
<td>Lesser Black-backed Gull</td>
<td>accidental</td>
</tr>
<tr>
<td>Rissa tridactylia</td>
<td>Black-legged Kitiwake</td>
<td>accidental</td>
</tr>
<tr>
<td>Columba livia</td>
<td>Rock Pigeon</td>
<td>rare</td>
</tr>
<tr>
<td>Asio otus</td>
<td>Long-eared Owl</td>
<td>rare</td>
</tr>
<tr>
<td>Archilochus colubris</td>
<td>Ruby-throated Hummingbird</td>
<td>accidental</td>
</tr>
<tr>
<td>Melanerpes lewis</td>
<td>Lewis's Woodpecker</td>
<td>accidental</td>
</tr>
<tr>
<td>Melanerpes erythrophalus</td>
<td>Red-headed Woodpecker</td>
<td>accidental</td>
</tr>
<tr>
<td>Picoides arcticus</td>
<td>Black-backed Woodpecker</td>
<td>regular</td>
</tr>
<tr>
<td>Empidonax traillii</td>
<td>Willow Flycatcher</td>
<td>accidental</td>
</tr>
<tr>
<td>Tyrannus forficatus</td>
<td>Scissor-tailed Flycatcher</td>
<td>accidental</td>
</tr>
<tr>
<td>Lanius ludovicianus</td>
<td>Loggerhead Shrike</td>
<td>accidental</td>
</tr>
<tr>
<td>Vireo solitarius</td>
<td>Blue-headed Vireo</td>
<td>accidental</td>
</tr>
<tr>
<td>Vireo philadelphia</td>
<td>Philadelphia Vireo</td>
<td>accidental</td>
</tr>
<tr>
<td>Cyanocitta cristata</td>
<td>Blue Jay</td>
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<tr>
<td>Pica hudsonia</td>
<td>Black-billed Magpie</td>
<td>regular</td>
</tr>
<tr>
<td>Poecile atricapillus</td>
<td>Black-capped Chickadee</td>
<td>rare</td>
</tr>
<tr>
<td>Sitta canadensis</td>
<td>Red-breasted Nuthatch</td>
<td>rare</td>
</tr>
<tr>
<td>Salpinctes obsoletus</td>
<td>Rock Wren</td>
<td>accidental</td>
</tr>
<tr>
<td>Troglodytes aedon</td>
<td>House Wren</td>
<td>accidental</td>
</tr>
<tr>
<td>Oenanthe oenanthe</td>
<td>Northern Wheatear</td>
<td>rare</td>
</tr>
<tr>
<td>Anthus pratensis</td>
<td>Sprague's Pipit</td>
<td>accidental</td>
</tr>
<tr>
<td>Bombycilla edororum</td>
<td>Cedar Waxwing</td>
<td>rare</td>
</tr>
<tr>
<td>Setophaga ruticilla</td>
<td>American Redstart</td>
<td>accidental</td>
</tr>
<tr>
<td>Wilsonia citrina</td>
<td>Hooded Warbler</td>
<td>accidental</td>
</tr>
</tbody>
</table>
### Nomenclature and Order

### Abundance
Provides a qualitative assessment of the likelihood a species may be encountered in the park. Based on abundance estimates for the Churchill region from Manitoba Avian Research Committee (2003) and Jehl (2004).
- **accidental:** not likely to be seen (recorded 1-2 times in 36 years).
- **rare:** not seen every year
- **regular:** seen every year but not every day

### Species Superscripts
- Numeric superscripts reflect the species status designation according to the Canadian Government Species at Risk Act schedules (given in parenthesis). [http://www.sararegistry.gc.ca/species/default_e.cfm].
1 endangered (schedule 1)
2 threatened (schedule 1)
3 special concern (schedule 1)
4 special concern (schedule 3)
5 special concern (COSEWIC)

## Table 4: Change in the proportion of days 34 species were seen at La Pêrouse Bay from 1980 to 1996.

<table>
<thead>
<tr>
<th>Species</th>
<th>Slope Estimate</th>
<th>Standard Error</th>
<th>F</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tundra Swan</td>
<td>0.0002</td>
<td>0.0083</td>
<td>0.00</td>
<td>0.9845</td>
</tr>
<tr>
<td>American Wigeon</td>
<td>-0.0391</td>
<td>0.0076</td>
<td>26.48</td>
<td>0.0001</td>
</tr>
<tr>
<td><strong>American Black Duck</strong></td>
<td>-0.0051</td>
<td>0.0101</td>
<td>0.25</td>
<td>0.629</td>
</tr>
<tr>
<td>Mallard</td>
<td>-0.0031</td>
<td>0.0097</td>
<td>0.01</td>
<td>0.7536</td>
</tr>
<tr>
<td>Northern Shoveler</td>
<td>-0.0510</td>
<td>0.0083</td>
<td>37.79</td>
<td>0.0001</td>
</tr>
<tr>
<td>Northern Pintail</td>
<td>0.0017</td>
<td>0.0060</td>
<td>0.08</td>
<td>0.7995</td>
</tr>
<tr>
<td>Green-winged Teal</td>
<td>-0.0113</td>
<td>0.0071</td>
<td>2.54</td>
<td>0.1319</td>
</tr>
<tr>
<td>Long-tailed Duck</td>
<td>-0.0102</td>
<td>0.0078</td>
<td>1.72</td>
<td>0.2099</td>
</tr>
<tr>
<td>Red-breasted merganser</td>
<td>-0.0101</td>
<td>0.0081</td>
<td>1.54</td>
<td>0.2335</td>
</tr>
<tr>
<td>Northern Harrier</td>
<td>-0.0024</td>
<td>0.0077</td>
<td>0.10</td>
<td>0.7612</td>
</tr>
<tr>
<td>Sandhill Crane</td>
<td>0.0020</td>
<td>0.0075</td>
<td>0.07</td>
<td>0.7885</td>
</tr>
<tr>
<td>Semipalmated Plower</td>
<td>-0.0022</td>
<td>0.0060</td>
<td>0.14</td>
<td>0.7176</td>
</tr>
<tr>
<td>Whimbrel</td>
<td>-0.0291</td>
<td>0.0085</td>
<td>11.80</td>
<td>0.0037</td>
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<tr>
<td>Hudsonian Godwit</td>
<td>-0.0060</td>
<td>0.0060</td>
<td>1.03</td>
<td>0.3289</td>
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<tr>
<td>Ruddy Turnstone</td>
<td>-0.0193</td>
<td>0.0079</td>
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<td>0.0271</td>
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<tr>
<td>Semipalmated Sandpiper</td>
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<td>0.0057</td>
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<td>0.2982</td>
</tr>
<tr>
<td>Least Sandpiper</td>
<td>0.0017</td>
<td>0.0060</td>
<td>0.08</td>
<td>0.7995</td>
</tr>
<tr>
<td>Dunlin</td>
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<td>0.0060</td>
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<td>0.0321</td>
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<tr>
<td>Stilt Sandpiper</td>
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<td>0.0087</td>
<td>23.43</td>
<td>0.0002</td>
</tr>
<tr>
<td>Short-billed Dowitcher</td>
<td>-0.0262</td>
<td>0.0064</td>
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<td>0.0010</td>
</tr>
<tr>
<td>Red-necked Phalarope</td>
<td>-0.0136</td>
<td>0.0069</td>
<td>3.86</td>
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<tr>
<td>Parasitic Jaeger</td>
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<td>0.0091</td>
<td>9.46</td>
<td>0.0077</td>
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<tr>
<td>Bonaparte’s Gull</td>
<td>-0.0382</td>
<td>0.0118</td>
<td>10.58</td>
<td>0.0054</td>
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<tr>
<td>Arctic Tern</td>
<td>0.0050</td>
<td>0.0068</td>
<td>0.53</td>
<td>0.4770</td>
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<tr>
<td>Short-eared Owl</td>
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<td>9.03</td>
<td>0.0089</td>
</tr>
<tr>
<td>Common Raven</td>
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<td>0.0052</td>
<td>0.92</td>
<td>0.3523</td>
</tr>
<tr>
<td>Horned Lark</td>
<td>-0.0102</td>
<td>0.0067</td>
<td>2.32</td>
<td>0.1485</td>
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<tr>
<td>Yellow Warbler</td>
<td>-0.0020</td>
<td>0.0073</td>
<td>0.07</td>
<td>0.7910</td>
</tr>
<tr>
<td>American Tree Sparrow</td>
<td>0.0066</td>
<td>0.0077</td>
<td>0.73</td>
<td>0.4057</td>
</tr>
<tr>
<td>Savannah Sparrow</td>
<td>0.0099</td>
<td>0.0074</td>
<td>1.77</td>
<td>0.2032</td>
</tr>
<tr>
<td>White-crowned Sparrow</td>
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<td>0.0101</td>
<td>0.10</td>
<td>0.7558</td>
</tr>
<tr>
<td>Lapland Longspur</td>
<td>-0.0297</td>
<td>0.0101</td>
<td>8.69</td>
<td>0.0100</td>
</tr>
<tr>
<td>Snow Bunting</td>
<td>-0.0153</td>
<td>0.0101</td>
<td>2.33</td>
<td>0.1474</td>
</tr>
<tr>
<td>Common and Hoary Redpoll</td>
<td>-0.0109</td>
<td>0.0119</td>
<td>0.83</td>
<td>0.3755</td>
</tr>
</tbody>
</table>

To maintain an overall $\alpha$-error rate $\leq 0.05$, each regression was evaluated using a Bonferroni correction requiring $p \leq 0.0015$ for rejection of the null hypothesis that there had been no change over time in the proportion of days a given species was seen. Those species that meet this criterion are indicated in bold.