The Birds of Wapusk National Park

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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.

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INTRODUCTION

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 (*Ursus 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 Geese and Canada Geese (all scientific names are in Tables 1 and 3), several other species have also received concentrated attention (*e.g.* Common Eiders, Semipalmated 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 to 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 Geese, a primary Park summer resident.

In the first section of this paper, there is a brief overview of the diverse habitats of Wapusk National Park. The extent and pattern of habitat diversity along with the geographic location of the park contribute substantially to the richness of its avifaunal communities. Next, is an overview of the research methods and geographic scope of our inventories. Species accounts are presented in two forms. The first is a tabular, comprehensive checklist of all species encountered in the park. It indicates abundance, evidence for breeding, landscape units in which species have been observed and status for those species listed under the Canadian Government Species at Risk Act (SARA). The second is a more extensive account of a selected subset of the species for which there is additional data specific to Wapusk National Park or which may be of special interest to the park or its users. It is not the intent to provide detailed accounts of the species encountered in Wapusk National Park because *The Birds of Manitoba* (Manitoba Avian Research Committee 2003) and *Birdlife of the Churchill Region* (Jehl 2004) do an admirable job of that. Instead, additional information that comes from both long and shorter term research projects, less structured data collection, field notes and personal experiences and anecdotes is presented. The species included are an eclectic assemblage reflecting in part the research interests of past and present scientists and their students. Others are species for which our observations may inspire future research. We also included species encountered in habitats not often visited and species we did not expect to encounter at all. (Field notes are included for the latter.) Finally, there are some species whose very existence defines the nature of Wapusk National Park and whose presence and behaviour thrilled us and others. Following the species accounts, we consider the relationship of the avifauna to processes leading to recent, continuing and future changes in the park's habitats. We conclude with comments on the implications of the high bird diversity for the park and suggestions on future monitoring and research goals.

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, 1989). 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 mud flats, salt marshes and supratidal marshes with willows, 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.

Barrens, comprised of patches of lichen peat plateaus, sedge fens, Spruce stands with lichen or sphagnum and water bodies, account for 31% of the area of the park.

Spruce Forests, comprised of patches of Spruce stands with lichen or sphagnum, Tamarack fens, sedge fens, palsas, 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 (2001) and Brook and Kenkel (2002). In their work, the park is broken into 16 ground-truthed vegetation classes that are mapped onto the park using LANDSAT satellite imagery. They highlight the extreme mosaic pattern reported in the coarser analysis of landscape unit patches. The dispersed distribution of these vegetation classes across the park's landscape and the transitions between them (ecotones) suggest that Wapusk National Park has the potential to hold a rich and diverse bird community.

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:

Marine and Shoreline zone habitat including salt marshes and supratidal marshes.

Tundra and Forest-tundra zone habitat including coastal tundra with elevated beach ridges supporting dry-heath tundra. They comment, "The Churchill area is well-known by naturalists as one of the few accessible areas for viewing low arctic tundra plants and animals. The richness of the local fauna and flora exceeds most other arctic sites. …".

Boreal Forest zone habitat including both hydric (with bogs and swamps) and mesic (with drier, upland vegetation) habitat and open lichen woodlands.

In addition, they record that the area includes freshwater lakes and rivers, marshes, fens, bogs, 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 Pérouse Bay, provide a natural stopover and staging area for many species migrating to nesting areas further north. The spit systems and shoals associated with Cape Churchill and Watson's Point, on the western edge of La Pérouse Bay, harbor extensive mussel beds that support large numbers of migrating, moulting and brood-rearing 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 to amass 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 (sometimes using grid systems), to line transects with constant recording during transit, supplemented by records from regularly spaced "stations" used for 5 minutes of both visual and auditory counts (Bibby *et al.* 2000). Some of the techniques were specific to work in particular regions of the park and are further detailed below. The numbers of observers have varied greatly over the years and there is no doubt some duplication of records has occurred within years. These combine to make quantification difficult beyond the relative "abundance" categories explained in a footnote of Table 1 and the analyses of "Highlighted Species" or of a set of species for a block of years that had reasonably equal observational effort (see "Habitat Issues"). In each year, several biologists with extensive birding experience maintained a daily bird list and served as *ad hoc* arbiters of acceptability of records. Over the years, this group has included: Ken Abraham, Fred Cooke, George Finney, Cheri Gratto-Trevor, Peter Kotanen, Drake Larsen, Kathy Martin, Pierre Mineau, John Reynolds, Greg Robertson, Robert Rockwell, Ken Ross, Tony Williams and Chris Witte, among others.

It is also not surprising that much of the survey has centered on the near-coastal areas of La Pérouse Bay and the Cape Churchill peninsula, as they have been the areas most used by the focal species of the historic work of the Hudson Bay Project and its collaborators. For that reason, there is likely some bias towards birds that primarily use habitats of the Salt Marsh and Coastal Fen Landscape Units. At the same time, however, many birds that primarily use habitats in other portions of the park are seen and recorded in the near-coastal areas for varying portions of the year. For example, many species that nest in more interior portions of the park are found along the coast during early spring while the interior, more forested areas are still snow bound (e.g. Harris's Sparrows and American Robins). Other interior nesting species (e.g. Short-billed Dowitchers and Bonaparte's Gulls) forage in coastal habitats throughout the summer. Finally, a variety of more interior species (e.g. Great Grey Owls and Northern Hawk Owls) make coastal appearances especially during extensive fires in the Barrens and Spruce Forest Landscape Unit.

In addition to the coastal, supratidal and freshwater marsh-nesting habitats of Lesser Snow Geese (Cooke *et al.* 1995), other study areas have been established at La Pérouse Bay and intensively searched for both a particular target species and all other avian inhabitants. These included areas for Common Eiders, Willow Ptarmigan, Semipalmated Sandpipers, Red-Necked Phalaropes and Savannah Sparrows (specific location details can be found in Schmutz *et al.* 1983, Martin 1984, Gratto *et al.* 1985, Reynolds 1987 and Weatherhead 1979, respectively). Detailed 50 m^2 grid searches for all avian inhabitants were undertaken in the freshwater fens between La Pérouse Bay and Cape Churchill (Figure 1) in 1999-2001. Moser and Rusch (1988a,b) describe study plots established in the vicinity of Nester 1, (the research camp of long-term studies of nesting Canada Geese conducted by Mississippi Flyway co-operators), south of Cape Churchill, where all other avian inhabitants were inventoried as well. The entire coastal strip from Cape Churchill to the Broad River has been walked and inventoried at least twice (Robert Rockwell and Matt Collins, 1991 and 1992). Intensive observations of ducks have been made at the mouth of the Broad River on at least five occasions since 1985 (most recently in 2004).

In cooperation with Wapusk National Park, the Hudson Bay Project has undertaken several additional surveys from 1999 to 2007 that targeted landscape units and habitat patches that have not been as thoroughly inventoried as the Salt Marshes and Coastal Fens and their primary habitat patches. These are indicated by number on Figure 1 and include:

1. Coastal Fen Landscape Unit sites - These include many tamarack fens, quaking bogs, "drunken" forests and Black Spruce stands that were examined with line transects that included listening/observation stations, spaced about every 200 m and monitored for 5 minutes each. There was a total effort of 156 person-hours on 19 June and 28 June 2001.

2. Fletcher Lake Barrens Landscape Unit – This includes Black Spruce stands that, along with the near-shore portion of the lake were examined with the use of line transects and listening/observation stations about every 200 meters along the southeast shoreline. There was a total effort of 16 person-hours on 2 July 2001.

3. Owl River – The river traverses the park and passes through all four landscape units. 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.

4. Rupert Creek site – This site is in the Southern Spruce Forest Landscape Unit (~5 km inland from Hudson Bay) and includes habitat patches typical of that unit as well as an extensive sedge fen meadow. The area was inventoried with two 5 km line transects perpendicular to the creek that included listening/observation points every 200 m and a 6 km "transect" following the banks of the creek. Activity on the creek, which was used as a flight corridor especially by ducks and loons, as well as the dawn chorus were monitored from the camp. There was a total effort of 72 person-hours on 25 to 26 June 2003.

5. Skidmore Lake – This site is in the Barrens Landscape Unit and was examined with line transects and listening/observation stations. Several transects perpendicular to the Lake were explored and the dawn chorus was monitored from a camp on the western shore. The entire shoreline was observed from a canoe, which also allowed us to examine all the islands in the lake. We explored the lake and stream that are the primary inflow as well as the stream that is the primary outflow of the lake. There was a total effort of 248 person-hours on 8 to 11 July 2004, and 21 to 25 June 2005.

6. Helicopter Waterfowl Surveys – On 19 June 2001, Klohn, Hannah, Mary and Napper Lakes were examined for ducks and their broods from a helicopter for approximately one hour using three observers. On 28 July 2004, the same approach was used to produce an inventory for the southwest portion of the park along the approximate flight line indicated in Figure 1. The southern portion of that 2-hour survey included waterways (e.g. Silcox and Brezino Creeks) and the lakes between them, some of which are associated with a large recent forest fire in that portion of the park.

SPECIES LIST

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 indicates 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.

HIGHLIGHTED SPECIES

The male Lesser Snow Goose provides much of the brood defense for the goslings his mate has incubated for 24 days. Photograph: RF Rockwell.

Lesser Snow Goose: Snow Geese found in Wapusk National Park are members of the Lesser (*Chen caerulescens caerulescens*) subspecies. The *C. c. atlantica* subspecies (Greater Snow Geese) 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. caerulescens*, 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 an otherwise dark-backed bird (Rattray and Cooke 1984). These heterozygote individuals, while classified as "blue", can produce some white goslings when mated with another heterozygote or to a white bird.

Approximately 70% of the Lesser Snow Geese at La Pérouse Bay are white (w) and 30% are blue (b). If mating were random with respect to colour, then one would expect 49% of the pairs to be w × w, 9% to be b × b and 42% to be mixed pairs. However, we found over 35 years that only 15% of the nesting pairs are mixed (w × b) with the rest being either w × w (65%) or b × b (20%). 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 pair's nests, fostering and general brood mixing, there are always some mixed pairs formed but never the number expected if mating was random (Geramita *et al.* 1982).

One of the more notable features of the Lesser Snow Geese 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 (Wellein and Newcomb 1953). The first thorough inventory in 1968 found approximately 2000 nests in a 2 km^2 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 km^2 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 5,000 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 Geese 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 Geese have been re-classified as a separate species, named the Cackling Goose. While field identification of some populations of Cackling Geese 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 Dzubin banded one member of this new species at La Pérouse Bay in 2001.

Canada Goose: The Canada Geese nesting in Wapusk National Park are members of the *Branta canadensis interior* subspecies and are managed jointly by Canada and the United States as part of the Eastern Prairie Population (EPP). Alan J. Pakulak began studying their biology south of Cape Churchill in 1965 and that work continued under the leadership of Don Rusch and, more recently, David Andersen. 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 species in its traditional Park habitat has decreased substantially. 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 rearing habitat initiated by Lesser Snow Geese or perhaps direct competition with them for limited food resources (Nack and Andersen 2004). Recent surveys by members of the Hudson Bay Project have found Canada Goose broods making extensive use of forage throughout the interior regions of the park. In addition to the "interior" subspecies, "giant" Canada Geese of the *B. c. maxima* subspecies make extensive use of coastal regions of the park during their moult in mid to late summer (Jehl 2004).

Tundra Swan: Wapusk National Park is the primary Manitoba nesting area for this species and the number of nesting pairs has been increasing in recent years. Nests have been observed in all four landscape units, always in association with lakes, ponds and streams. Many of the nests are large collections of various types of vegetation gathered from the immediate vicinity of the nest. In the early spring, large numbers of Tundra Swans are seen along the coast, often participating in raucous displays of courtship.

Northern Shoveler: This species feeds on zooplankton 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, beginning 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 degradation initiated by Lesser Snow Geese whose destructive foraging has led to severe changes in the water quality and zooplankton of the ponds (Milakovic *et al.* 2001). In contrast, large numbers (hundreds) of Northern Shovelers have been seen annually feeding in and along shallow lakes in the Coastal 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 Pintail: Large numbers of this species (mostly males) aggregate along the coast in mid to late summer for moulting. Their numbers have increased over the past ten years and are always higher 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 Station where nesting density averages about one nest per km^2. On at least three occasions, a female has nested and successfully hatched a brood along the small stream that flows through the research station. The species has been decreasing in Manitoba since 1994 (Downes *et al.* 2003).

This hen Northern Pintail raised her brood of 4 ducklings on the small stream that runs through the La Pérouse Bay Research Station.

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

Common Eider: The Common Eiders nesting in Wapusk National Park are members of the *Somateria mollissima sedentaria* subspecies. To the best of our knowledge, they winter in polynyas in northern Hudson Bay and Foxe Basin (Greg Robertson, personal communication). While they are found nesting 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 immediately west of the Station. The other is located in the lagoons of the upper portions of Wawao Creek approximately 3 km south of the station. In both cases, females nest in close proximity to each other on islands 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.

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. There is some 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 population dynamics of this species is its apparent stability despite periodic catastrophic failures in reproductive 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, Herring Gulls and Common Ravens took advantage of the general disturbances to depredate and scavenge many of the remaining eggs and nests. Since the dynamics of long-lived species such as the Common Eider are controlled more by adult survival than reproductive success, the population's apparent stability is not a complete surprise. It is not clear, however, just how frequent such catastrophes can occur without impacting the population's dynamics, nor what effect missing or reduced age classes will have on longer-term dynamics (Koons *et al.* 2005).

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 interior 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 located at Skidmore Lake, documenting that the species breeds in Wapusk National Park. All three species of this poorly understood 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.

Long-tailed Duck: The call of the male of this species is a piercing nocturnal signature of Wapusk National Park. Its call is the basis for the nearly 30 regional imitative (sonic) common names given to this species (McAtee 1957). In the late 1960s and early 1970s, this species was common in the vicinity of the La Pérouse Bay Research Station. Since the 1980s, the abundance has declined in that area to the point that no more than one to two pairs have been seen there annually since 2000. By contrast, flocks of several hundred have been seen on the larger lakes in the Coastal Fens-Barrens Landscape Units. Like many sea ducks, population estimates for this species are imprecise. However, the Sea Duck Joint Venture (2003) reports a 5% decline for Long-tailed Ducks in North America.

One pair of Long-tailed Ducks nested on the south shoreline of the Mast River adjacent to the La Pérouse Bay Research Camp in June 2003, and vigorously defended a section of the river against intrusions by both Common Eiders and Red-breasted Mergansers. Both the male and female were observed diving in the river's shallow water, dislodging 5 to 10 cm rocks and capturing crane fly larvae (Tipulidae). While they ultimately selected a nest site in their defended territory, no eggs were observed and the pair abandoned the site after about ten days.

Common Goldeneye: Large rafts of this species are found offshore at Cape Churchill and Foxe Island in late July along with the three scoter species. Flocks numbering in the hundreds are also present on the large lakes and on the larger streams in southern portions of the park from mid-June. While most of these are thought to be moulting or perhaps non- or failed breeding birds, it is quite likely that small numbers of this hole-nesting species may breed in the southern sections of the Spruce Forest Landscape Unit. Commonly called "whistle ducks" or "whistlers" (reflecting the noise made by their rapidly beating wings), their nocturnal flights add a soft backdrop to the nighttime music of the park. Their numbers have been decreasing in Manitoba since 1994 (Downes *et al.* 2003).

Hooded Merganser: This species is found on lakes and streams in the central and southern portions of the park. In late June 2003, four drakes were observed chasing and courting a lone female along Rupert Creek. This hole-nesting species may breed in the Spruce Forest Landscape Unit. The species is listed as declining in the breeding bird survey in Manitoba (Sauer *et al.* 2005)

Common Merganser: This species becomes relatively more abundant in the southern portion of the park where it tends to replace the Red-breasted Merganser, especially on the larger, deeper 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).

Red-breasted Merganser: This merganser is more abundant in the northern portion of the park, especially on smaller lakes and shallow streams near the coast. It feeds extensively on threespine sticklebacks (*Gasterosteus aculeatus*) and crane fly larvae (Tipulidae). In 1982, seven nests were located in the 2 km^2 Northern Phalarope study area described in Reynolds (1987). Since 1993, only two nesting attempts have been recorded in that same area and neither of those was successful. It is possible that the local decline in numbers is related to a decline in the quality of supratidal lakes linked to Lesser Snow Goose-initiated habitat degradation (Milakovic *et al.* 2001) although there is some indication that this species is declining more broadly (Sea Duck Joint Venture 2003).

Willow Ptarmigan: This is one of the most entertaining species in Wapusk National Park. From the male's showy breeding plumage, to its courtship struts and territorial flights, to its raucous calls, the species commands attention. More than six years of work on the mating behavior, parental investment and reproductive success of this species by Kathy Martin can be found summarized in Hannon *et al.* (1998). Like many species of grouse-like birds, the abundance of this species fluctuates and perhaps even cycles and differs at various geographic scales.

This male Willow Ptarmigan keeps a watchful eye on the photographer while defending his territory near the La Pérouse Bay Research Station. Photograph: RF Rockwell.

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 the area, ultimately linked to the overall Lesser Snow Goose induced habitat degradation (Rockwell *et al.* 2003; Abraham *et al.* 2005), has played a major role in the species' local decline. The species is still prevalent in portions of the park where willow habitat is intact.

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.f.* McAtee 1957).

Pacific Loon and ***Common Loon:*** These species provide the 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 Threespine Sticklebacks (*G. aculeatus*). Although its call is low in volume and frequency range, it provides a penetrating "bass" to the park's nocturnal symphony. It is reported to be increasing in Manitoba (Sauer *et al.* 2005).

Rock Ptarmigan are only found in Wapusk National Park during the late fall, winter and early spring. They forage on the buds of willow bushes (Salix spp) that protrude through the snow. Photograph : Lauraine C. Newell.

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

Bald Eagle: In the coastal portions of Wapusk National Park, adults are usually outnumbered by sub-adults. In some years, those sub-adults have taken advantage of the Common Eider colony near the La Pérouse Bay Research Station, attacking groups of females that nest close to each other on small islands in the Mast River. While such attacks sometimes reward the eagles with a hen eider, the disturbance exposes the nests of many ducks and eagles (along with Herring Gulls and Ravens) then consume the unattended eggs. Adult eagles periodically cruise above the Lesser Snow Goose colony at La Pérouse Bay and as large numbers of geese rise from their nests in a near-funnel form, the eagles seem to target and capture lone geese. During aerial surveys on 28 July 2004, we counted more than 50 adults and sub-adults in the southwestern portion of park near the burn areas. At least one likely nest was seen on that flight.

Gyrfalcon: This favourite of birders is more common in early spring and fall. It has been observed successfully hunting Willow Ptarmigan in the La Pérouse Bay and Cape Churchill region. One banded male Willow Ptarmigan avoided capture almost daily by running under an overturned sled at the La Pérouse Bay Research Station in early May of 1984.

Peregrine Falcon: Both lone and pairs of Peregrine Falcons are seen regularly in the La Pérouse Bay region. They commonly feed on passerines, shorebirds and ducks in the coastal region. One pair was observed near the La Pérouse Bay Research Station for several days in early June 2001 performing courtship flights that included exchanges of food and sticks. The female of that pair was observed taking a small mammal from a Parasitic Jaeger that had taken it from a Northern Harrier.

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*" 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, depredating 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 m away with small nest stakes. They also have been observed chasing, catching and consuming gosling Lesser Snow Geese. One rather famous local Sandhill Crane nicknamed "Fred" was a star in the National Geographic documentary "The Incredible Flight of the Snow Goose". The prehistoric-sounding call of the species can be heard for many kilometres.

Young Sandhill Cranes (called colts) are rarely seen although many are produced annually in Wapusk National Park. Photograph: Drake Larsen.

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.

Black-bellied Plover: This species is commonly seen during its spring migration to its more northern nesting range and again in mid to late summer on its return. Periodically, one or two are seen during the breeding season and we had always assumed they were non- or perhaps failed breeders. However, a 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.

Semipalmated Plover: 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 next to 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 remnant 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 inventorying 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 Sandpiper, Spotted Sandpiper and ***Short-billed Dowitcher:*** These four species of shorebird are commonly seen feeding 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.

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 once 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 it 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 the species, survival, mate and site fidelity and even hormone fluxes in this historically common bird. That extensive work is summarized by her briefly in Jehl (2004) and more extensively in Gratto-Trevor (1992). One important aspect of her work and the dynamics of this species is that nest abundance in her 3 km^2 (Gratto *et al.* 1985) study area declined from 133 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 (2001) for the decline in this species in the Churchill area.

Least Sandpiper: This is one of the most abundant nesting shorebirds in the park. This likely reflects its broad nesting requirements that include almost every type of moist or wet substrate in both salt and freshwater habitat. One pair nested at the La Pérouse Bay Research Station for several years during the mid-1980s providing us with incomparable viewing opportunities of courtship, incubation and brood rearing.

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 flying in mixed flocks where its "white rump" flashes its obvious identity.

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.

Dunlin: The Dunlin migrating through and nesting in Wapusk National Park are most likely *Calidris alpine 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 gleaning adult mosquitoes from the leaves of Mare's Tail (*Hippuris tetraphylla*) 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).

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 1984, 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 km^2 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 barely more than a depression in coastal terrain, it is vigorously 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 Geese.

The Parasitic Jaeger is an exceptionally successful predator that spends most of its time flying. Photograph: Lauraine C. Newell.

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.

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 reclusive 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.

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

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

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.

Common Nighthawk: 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 Nighthawks for nesting. However, the birds are known to use burn 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 flying insects that are 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 Spruce stands in much of Wapusk National Park.

Northern Flicker: The yellow-shafted form of this species occurs throughout Wapusk National Park. Northern Flickers are ground-feeders that specialize in eating ants. Aside from finding favoured prey in natural habitats, flickers are adept at finding and consuming ants in spring and early summer on buildings and boardwalks at the La Pérouse Bay Research Station.

Northern Shrike: This predatory passerine feeds on large flying insects, perching bird species (e.g. redpolls and sparrows), small mammals and both Wood and Boreal Chorus Frogs (*R. sylvatica* and *P. maculata*). It hunts from elevated perches (including buildings at the La Pérouse Bay Research Station) and, when food is plentiful, stores prey by impaling them on twigs of dead willows or even the pin stakes used by biologists to mark nests.

Grey Jay: This year-round resident of Black Spruce and Tamarack habitat is well known as a noisy visitor and thief by campers and hunters who often call it the butcher bird for its habit of foraging on game (especially moose) carcasses. This omnivorous species is also famous for using its sticky saliva to attach food to trees behind flakes of bark, in coniferous foliage or in tree forks for use during the winter when food resources are scarce. It is also locally known as the Whiskey Jack, an apparent corruption of the Algonquian *wiskatjan* (McAtee, 1957). Mated pairs are highly defensive of their nesting territory and young, and have scolded and even pecked at us on several occasions when we got too close to fledglings.

Common Raven: The Common Raven has a long history in the north and plays a key role in the traditions and legends of native people. Many of these stem from its curious and almost gregarious behaviour around humans. In most summers, at least one pair of ravens has taken up residence at the La Pérouse Bay Research Station or one of its remote towers. Coincident with the growth of the Lesser Snow Goose colony, their abundance in the La Pérouse Bay region has increased from early reports of four sightings per day (Cooke *et al*. 1975) to as high as 30 per day in the late 1990s and early 2000s. This mirrors an increasing abundance trend for Manitoba since 1999 (Downes *et al*. 2003). Common Ravens are opportunistic foragers and successful scavengers, often eating the remains of Bald Eagle and Herring Gull depredations at nests of both Lesser Snow Geese and Common Eiders. They have also been observed taking eggs from unattended nests of both those 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 Semipalmated Plovers, have begun using the extremely degraded habitat associated with destructive foraging by Lesser Snow Geese. Unfortunately, these early-arriving and nesting pioneers are also the first prey available in spring to ground based predators such as the Short-tailed Weasel (*Mustela erminea*) and therefore the nesting success of Horned Larks in degraded habitat near La Pérouse Bay Research Station is very low.

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 at La Pérouse Bay.

Boreal Chickadee: Small groups of these birds (two-four) are still encountered in the seriously degraded Black Spruce and Tamarack patches near tree line south of the La Pérouse Bay Research Station. Both the size and numbers of flocks increase in more intact habitat and the species becomes reasonably common in denser and closed portions of the boreal forest habitat in the Spruce Forest Landscape Unit.

Sedge Wren: While Wapusk National Park is north of the current primary geographical range of this species, the intact sedge fen meadows of the Coastal Fens Landscape Unit offer perfect habitat for the species. Our single observation of the species was actually within the compound of the La Pérouse Bay Research Station. However, this secretive wren is often overlooked and its abundance underestimated.

American Robin: Although seldom seen along the coast, this species is ever-present in the open boreal 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 imitative ability and one bird that occurred regularly at the La Pérouse Bay Research Station is no exception. It became adept at mimicking Lincoln's, White Crowned, Savannah and 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 its 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 interior portion of Wapusk National Park. The species is described as having eruptive dynamics in that abundance at a given location can vary substantially from year to year while more global abundance measures are more stable. The factors leading to this are not fully understood but may be due to its dependency on sugary fruits for most of the year and insects during the summer (Witmer 2002).

Yellow Warbler: This is one of the most common and ubiquitous warblers in the Salt Marsh, Coastal Fen and Barrens Landscape Units of Wapusk National Park. It arrives early in the spring and brightens nearly every small patch of willow shrub found on the landscape. Its singing enlivens the daytime chorus of the park throughout the summer.

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 underestimation of its abundance. It has become less common near the La Pérouse Bay Research Station where the taller willows it preferred have been killed by processes 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 Station. Their singing has awakened and entertained researchers 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 Station's radio masts and weather vane in amazing displays of intra-specific aggression but inter-specific tolerance.

Savannah Sparrow: This is one of the most successful grassland sparrow species in North America being widely distributed (geographically) and utilizing an array of habitats ranging from fallow prairie to shopping centre parking lots. It is ubiquitous in grass and sedge habitat throughout the park. Nonetheless, the population nesting 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 Manitoba (Rockwell *et al*. 2003). There is little question that this hardy species has been negatively impacted by the destructive foraging of Lesser Snow Geese in the La Pérouse Bay region.

Nelson's Sharp-tailed Sparrow: This secretive sparrow of grassy marshes is known for running rather than flying when disturbed. As a consequence, it is rarely noticed and its abundance is often underestimated. It has been recorded at several inland sites (e.g. Rupert Creek – Figure 1 site "4") well removed from degraded habitat associated with destructive foraging by Lesser Snow Geese. It has recently been separated from the Salt marsh Sharp-tailed Sparrow (*Ammodraamus caudacutus*) that breeds on the Atlantic coast. The bright buffy orange head and flanks of the sharp-tailed sparrows led to them originally being referred to as the "oriole sparrow".

Harris's Sparrow: This remote breeding and secretive species was one of last of the American passerines to have its nest found. That was accomplished in the Churchill area by Semple and Sutton (1932). The species flourishes in Spruce and Tamarack stands within Wapusk National Park and is especially abundant on palsas. Hectare-sized palsas will often have five to ten singing males in mid June. This strikingly marked sparrow is often seen foraging on seeds and invertebrates in open patches of coastal tundra before interior nesting habitat becomes available 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 Geese. 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 fen 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 is has a restricted winter range in the mid continent region so few birders have opportunities to see it. Like the Lapland Longspur, this species has also declined in the Churchill region. There are no temporal data from within 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 liberal courtship behaviours 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 2001, 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.* Seutin *et al.*1995). However, the two (or more) redpoll species found in the park are energetic and acrobatic small finches that are always pleasant to observe.

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 Geese and Canada Geese. Second is isostatic uplift that annually exposes additional coastal sediment and gravels, and elevates more inland habitat relative to mean sea level. Third are fires that are especially pronounced in the Barrens and Spruce Forest Landscape Units. Lastly, there is global climate change that not only will modulate the effects of the first three processes but also will alter the habitat directly and influence the avifaunal communities of Wapusk National Park. These processes and their observed and potential impact on the avifauna will be considered, in turn, in the following subsections. In the final subsection, we examine the evidence that there have been changes in the regional avifauna during the tenure of research in the park.

DESTRUCTIVE FORAGING

In the spring, just after their arrival and before aboveground plant growth begins, geese feed in the intertidal and supratidal coastal marshes by grubbing; a process that involves removal of divots of vegetation and soil, and consumption of the nutrient-rich belowground parts of the plants. After plant growth begins, both nesting and brood-rearing geese consume just the above-ground parts of forage plants (grazing). Defecation by these geese allows for nitrogen input into the thin soils, which are nitrogen-limited for plant growth. This readily available nitrogen is incorporated into the plants and the plants, in turn, provide nitrogen and other nutrients (e.g. phosphorus) for gosling growth and development, as well as the replacement of body stores of adult geese. Both goslings and adults depend on these nutrients to acquire or replace flight feathers in preparation for fall migration. Nitrogen fixation by blue-green algae (cyanobacteria) occurs on the soil surface during the snow-free season. This ultimately becomes available for plant growth and replaces the nitrogen removed from the system in the body mass of the geese.

Under the low densities of Lesser Snow Geese that were characteristic of the 1950s to the early 1970s, salt marsh vegetation in the intertidal coastal zone of Wapusk National Park retained this healthy "grazing-defecation feedback" relationship with its primary consumers. At these low densities, spring grubbing led only to devegetation 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-devegetation-soil deterioration" feedback loop overwhelmed the healthy grazing-defecation driven feedback and the habitat became severely degraded. A detailed account of degradation in the La Pérouse Bay region can be found in Jefferies *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.

Beyond actually removing vegetation from the marshes, grubbing destabilizes the soil leading to erosion along shallow melt streams and the formation of shallow ponds where these depressions occur. After spring melt and runoff, moisture is rapidly lost from the soil as the temperature rises in the summer. Without a vegetation layer, soil salinity increases so that the soils become hypersaline (up to three times the salinity of sea water). Additionally, the physical properties of the soils change in that they become compacted, they lose nitrogen and the soil seed bank is lost. Under such conditions, the likelihood of rapid recovery of the vegetation is very low. Plots of exposed sediment in the supratidal marshes of La Pérouse Bay have remained devoid of vegetation since 1984. This destructive foraging has turned once-lush swards of intertidal and supratidal grasses and sedges (graminoids) into mudflats pockmarked with small 1-2 m^2 remnant patches of low-density vegetation. As degradation proceeds and more components of the local coastal ecosystem are impacted, the geese move to adjacent, less-degraded habitat that eventually undergoes a similar fate. Such a pattern of spreading habitat degradation, initiated by run-away consumption by large numbers of geese eventually leads to the coalescence of exposed patches on a larger spatial scale that can be detected with LANDSAT imagery (Jefferies *et al.* 2006).

The loss of habitat has negatively impacted the reproductive success of the Lesser Snow Geese in the La Pérouse Bay coastal marshes. Gosling survival to fledging declined, as did survival over the first years. Additionally, structural size of survivors declined and those that survived to nest were smaller. One might expect this to slow the population growth under what is usually termed density-dependent regulation. For this to work, however, the geese would have to stay in one place and they do not - they are highly mobile and few recruits return to nest in degraded habitats, even while older, site-faithful birds continue to do so. Nesting by Lesser Snow Geese first expanded along the coast as first time breeders occupied areas at the edges of the original La Pérouse Bay colony. The growing numbers of brood rearing geese responded to declining forage resources in La Pérouse Bay by spreading to the salt marshes all along the coastal section of Wapusk National Park. This in turn, led to young birds nesting in the adjacent inland and more freshwater graminoid and shrub assemblages farther and farther from the original colony location.

These low, predominantly freshwater areas contain both temporary and permanent ponds where high densities of sedges, predominantly *Carex aquatilis*, occur. In early spring immediately after melt, the geese pull up the basal shoots of these plants, eating the nutrient-rich parts and discarding the remainder. Unsustainable rates of consumption of these plants have resulted in the death of sedges, exposure desiccation and death of mosses, and the eventual exposure of peat. As increasing areas of intertidal and supratidal marshes are lost, Lesser Snow Geese increasingly use more of the inland freshwater habitats for staging, nesting and brood rearing. In some of these freshwater areas where the peat layer is thin, the underlying saline sediments have been exposed (the Hudson Bay Lowlands were part of the Tyrrell Sea during the post-glacial period after the last Ice Age). Removal of the graminoids leads to increased loss of moisture and higher salinity that kills the shrubs, just as in intertidal and supratidal areas. As the shrubs die, less snow accumulates in winter and the ground is exposed earlier the following year,

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.* 2001). 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 it 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

Semipalmated Plovers have made increasing use of degraded habitat in the La Pérouse Bay region. Photograph: Lauraine C. Newell.

Expanses of dead willows near tree line result from spring grubbing. These areas were once used by numerous species of passerines. Photograph: RF Rockwell

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 Hooded Mergansers make use of burned areas for nesting cavities. Clearly, additional inventories and monitoring are needed to clarify short-and long-term post-fire changes.

GLOBAL CLIMATE CHANGE

The current models of global climate change predict that several features of the environment will be altered in the near-term in ways that may impact the habitat of Wapusk National Park either directly or indirectly via the processes discussed above. Three of 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 more 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 graminoids on any emergent coastline. 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 peat surface and the lowering of the water table. Plant community changes in response to these changes include a decrease in bryophytes and an increase in ericaceous shrubs and shrubs in general. Oxidation of the peat, an increase in acidity and redox potential also are likely to occur at sites where drying is evident. Aquatic insects that rely on bog pools will decrease in frequency as the pools dry out.

At the same time, increases in temperature can lead to lowering the depth of the permafrost, which can, in turn, have various effects. The thawing of peat may lead to slumping of the organic material and the establishment of thermokarst lakes where water drainage is impeded, as occurs already over large sections of the Hudson Bay Lowlands. At other sites, as the ice core melts, palsas will collapse resulting in drunken forests or quaking bogs. In the above situations, the current avifauna will change to reflect the new habitat. In some of the situations outlined, a more upland and drier habitat avifauna will replace wetland avifauna, while in others the reverse will occur, and species such as Harris's Sparrow will be replaced by species such as Swamp Sparrow.

In late winter, as freeze-thaw cycles occur in the soil with increasing temperatures, nutrients that are released from microbial biomass are taken up by plant roots and used during the flush of spring growth of 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 increasing mismatch between soil nutrient 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 Geese at La Pérouse Bay (and the Mid-Continent 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 list data to try to detect any avifaunal changes that might be coincident with the habitat degradation in the La Pérouse Bay region. Because these data were collected for different 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 there is evidence 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. This was addressed in several ways. We selected species whose identification is relatively clear and simple, species that are fairly frequent and species whose habitat requirements reflect the range of those 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 much of the work 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 Geese 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 efforts 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 Geese rather well (Jefferies 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 but factors such as multiple counts of individuals by several observers and other general enumeration difficulties (e.g., Bibby *et al.* 2000) limit the precision of the numbers as estimates of daily abundance. It is reasonably assumed, however, that the more abundant a species is, the more likely it is to at least be observed as present on a given day. As such, 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 analysis as long as we can assume that the relationship between abundance and detection for a given 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 Sandpiper) 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 $p \leq 0.05$ 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.

Inspection of the slopes in Table 4 leads to a second important point. Of the 34 estimates, 26 are negative and only eight are positive. This seems a bit uneven and we can test to see if this is more extreme than we should expect by chance. If there were no changes in our surrogate abundance measure over time, then all the slopes should be 0 with plus and minus estimates simply reflecting chance variation. Under such a scenario, the probability that any one estimate is negative or positive is the same, and equal to 0.5. The overall probability of obtaining 26 negative and eight positive estimates, given there really were no changes, is only 0.0014 (this is the probability of obtaining our 26 to 8 result or one that is more extreme, 27 to 7, 28 to 6, etc.). The implication is that although only four species reached a statistically significant level of decline, there is evidence for more declines among the set of species than one should expect by chance.

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 detectability 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 habitat 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).

Stilt Sandpipers feed on aquatic invertebrates found in shallow pools and streams in the La Pérouse Bay region. Photograph: Lauraine C. Newell.

Hudsonian Godwits often feed on aquatic invertebrates found under stones in the Mast River. Photograph: Lauraine C. Newell.

CONCLUDING REMARKS

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 Geese), a duck whose feathers and down are known globally for 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 inventorying the less-studied regions of the park, both to increase understanding of the distribution and habitat associations of the avifaunal community and to identify 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.

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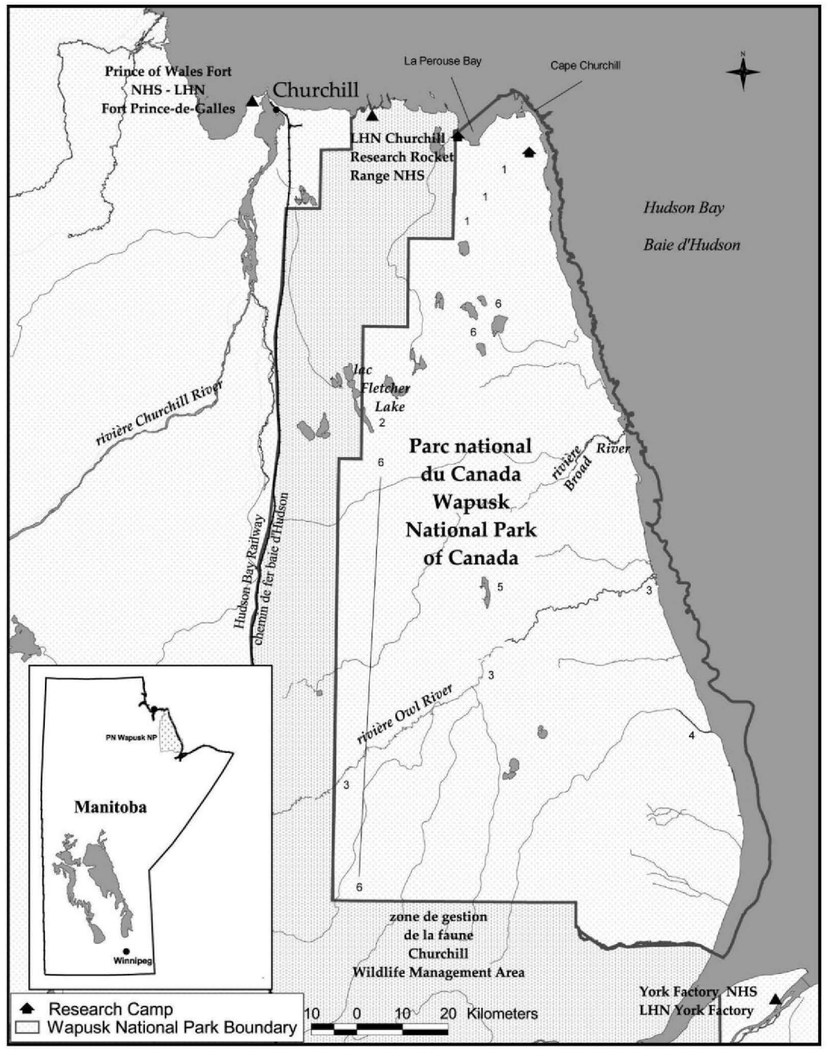

Figure 1. Wapusk National Park. Number codes correspond to targeted survey areas cited in the text. (1. Coastal Fen Landscape Unit Sites; 2. Fletcher Lake Barrens Landscape Unit; 3. Owl River; 4. Rupert Creek; 5. Skidmore Lake; 6. Helicopter Waterfowl Surveys. See text for additional detail.) Original figure provided by Parks Canada.

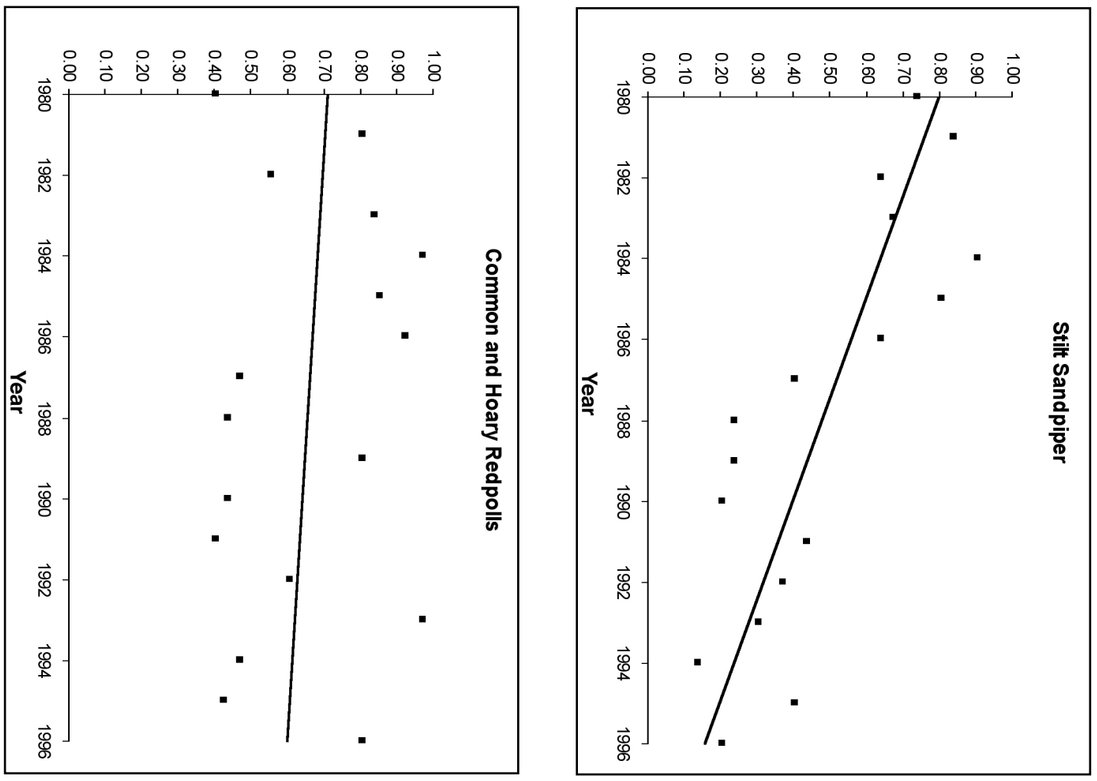

Figure 2. The proportion of days on which Stilt Sandpipers and Redpolls (both Common and Hoary) were observed at La Pérouse Bay over 17 years. Solid lines are linear regressions.

TABLE 1. CHECKLIST OF THE BIRDS OF WAPUSK NATIONAL PARK

SPECIES	COMMON NAMES		ABUNDANCE	BREEDING EVIDENCE		LANDSCAPE UNITS
				STATUS	CODE	
Anser albifrons	Greater White-fronted Goose	Oie rieuse	regular			sm
Chen caerulescens	Snow Goose	Oie de neiges	common	confirmed	NY	sm,cf,ba
Chen rossii	Ross's Goose	Oie de Ross	common	confirmed	NY	sm,cf,ba,
Branta bernicla	Brant	Bernache cravant	regular			sm
Branta hutchinsii	Cackling Goose	Bernache de Hutchins	regular	possible	H	sm
Branta canadensis	Canada Goose	Bernache du Canada	common	confirmed	NY	sm,cf,ba,sf
Cygnus columbianus	Tundra Swan	Cygne tuberculé	common	confirmed	NY	sm,cf,ba,sf
Anas strepera	Gadwall	Canard chipeau	common	probable	P	sm,cf
Anas penelope	Eurasian Wigeon	Canard siffleur	accidental			sm
Anas americana	American Wigeon	Canard d'Amérique	common	probable	D	sm,cf
Anas rubripes	American Black Duck	Canard noir	common	confirmed	NE	sm,cf,ba,sf
Anas platyrhynchos	Mallard	Canard colvert	common	confirmed	NE	sm,cf,ba,sf
Anas discors	Blue-winged Teal	Sarcelle à ailes bleues	regular	probable	D	sm,cf
Anas clypeata	Northern Shoveler	Canard souchet	common	confirmed	NY	sm,cf,ba,sf
Anas acuta	Northern Pintail	Canard pilet	common	confirmed	NY	sm,cf,ba,sf
Anas crecca	Green-winged Teal	Sarcelle d'Hiver	common	confirmed	NY	sm,cf,ba,sf
Aythya valisineria	Canvasback	Fuligule à dos blanc	regular	possible	H	sm,cf,sf
Aythya americana	Redhead	Fuligule à tête rouge	regular	possible	H	sm,cf,sf
Aythya collaris	Ring-neck Duck	Fuligule à collier	regular	possible	H	sf
Aythya marila	Greater Scaup	Fuligule milouinan	common	confirmed	NY	sm,cf,sf
Aythya affinis	Lesser Scaup	Petit Fuligule	regular	probable	P	sm,cf,sf
Somateria spectabilis	King Eider	Eider à tête grise	regular	confirmed	NE	sm,cf
Somateria mollissima	Common Eider	Eider à duvet	common	confirmed	NY	sm,cf,ba,sf
Melanitta perspicillata	Surf Scoter	Macreuse à front blanc	common	probable	P	sm,ba,sf
Melanitta fusca	White-winged Scoter	Macreuse brune	common	confirmed	FY	sm,ba,sf

SPECIES	COMMON NAMES		ABUNDANCE	BREEDING EVIDENCE		LANDSCAPE UNITS
				STATUS	CODE	
Melanitta nigra	Black Scoter	Macreuse noire	regular	possible	H	sm,ba,sf
Clangula hyemalis	Long-tailed Duck	Harelde kakawi	common	confirmed	NY	sm,cf,ba,sf
Bucephala albeola	Bufflehead	Petit Garrot	regular	possible	H	sf
Bucephala clangula	Common Goldeneye	Garrot à oeil d'or	regular	probable	P	sm,cf,ba,sf
Bucephala islandica1	Barrow's Goldeneye	Garrot d'Island	rare			sm
Lophodytes cucullatus	Hooded Merganser	Harle couronné	regular	probable	D	sf
Mergus merganser	Common Merganser	Grande Harle	common	confirmed	NE	sm,cf,ba,sf
Mergus serrator	Red-breasted Merganser	Harle huppé	common	confirmed	NY	sm,cf,ba,sf
Falcipennis canadensis	Spruce Grouse	Tétras du Canada	regular	possible	S	sf
Lagopus lagopus	Willow Ptarmigan	Lagapodes des saules	common	confirmed	NY	sm,cf,ba
Lagopus muta	Rock Ptarmigan	Lagapodes alpin	common			sm
Tympanuchus phasianellus	Sharp-tailed Grouse	Tetras à queue fine	regular	possible	H	sf
Gavia stellata	Red-throated Loon	Plongeon catmarin	rare	possible	H	sm,ba,sf
Gavia pacifica	Pacific Loon	Plongeon du Pacifique	common	confirmed	NY	sm,cf,ba,sf
Gavia immer	Common Loon	Plongeon huard	common	probable	D	sm,cf,ba,sf
Podiceps auritus	Horned Grebe	Grebe esclavon	rare	possible	H	cf
Botaurus lentiginosus	American Bittern	Butor d'Amérique	common	probable	D	sm,cf,ba,sf
Ardea herodias	Great Blue Heron	Grand Héron	accidental			cf
Cathartes aura	Turkey Vulture	Urubu à tête rouge	accidental			sm
Pandion haliaetus	Osprey	Balbuzard pêcheur	rare	confirmed	NU	sm,ba,sf
Haliaeetus leucocephalus	Bald Eagle	Pygargue à tête blanche	common	confirmed	NY	sm,cf,ba,sf
Circus cyaneus	Northern Harrier	Busard Saint-Martin	common	confirmed	NY	sm,cf,ba,sf
Accipiter gentilis2	Northern Goshawk	Autour des palombes	rare			sm,cf
Buteo lineatus	Red-shouldered Hawk	Buse à épaulettes	rare			sm,cf
Buteo jamaicensis	Red-tailed Hawk	Buse à queue rousse	rare			sm,cf
Buteo lagopus	Rough-legged Hawk	Buse pattue	common	confirmed	NE	sm,cf,ba,sf

SPECIES	COMMON NAMES		ABUNDANCE	BREEDING EVIDENCE		LANDSCAPE UNITS
				STATUS	CODE	
Aquila chrysaetos	Golden Eagle	Aigle royal	regular			sm,cf,ba
Falco sparverius	American Kestrel	Crécerelle d'Amérique	regular	possible	H	sm,cf,ba
Falco columbarius	Merlin	Faucon émerillion	regular	possible	H	sm,cf,ba
Falco rusticolus	Gyrfalcon	Faucon gerfaut	regular	possible	H	sm,cf
Falco peregrinus3	Peregrine Falcon	Faucon pelerine	common	probable	D	sm,cf,ba,sf
Coturnicops novemboracensis1	Yellow Rail	Râle jaune	regular	probable	T	sm,cf,ba
Porzana carolina	Sora	Marouette de Caroline	common	confirmed	DD	sm,cf,ba
Fulica americana	American Coot	Foulque d'Amérique	rare	possible	H	sm,cf
Grus canadensis	Sandhill Crane	Grue du Canada	common	confirmed	NY	sm,cf,ba,sf
Pluvialis squatarola	Black-bellied Plover	Pluvier argenté	common	possiblea	DD	sm,cf,ba
Pluvialis dominica	American Golden Plover	Pluvier bronze	common	confirmed	NE	sm,cf,ba
Charadrius semipalmatus	Semipalmated Plover	Pluvier semipalmé	common	confirmed	NY	sm,cf,ba
Charadrius vociferus	Killdeer	Pluvier kildir	regular	confirmed	NE	sm,ba,sf
Tringa melanoleuca	Greater Yellowlegs	Grand Chevalier	common	probable	A	sm,cf,ba,sf
Tringa flavipes	Lesser Yellowlegs	Petit Chevalier	common	confirmed	DD	sm,cf,ba,sf
Tringa solitaria	Solitary Sandpiper	Chevalier solitaire	common	confirmed	NE	sm,cf,ba,sf
Catoptrophorus semipalmatus	Willet	Chevalier semipalmé	rare			sm
Actitis macularius	Spotted Sandpiper	Chevalier grivelé	common	confirmed	NE	sm,cf,sf
Bartramia longicauda	Upland Sandpiper	Maubèche des champs	accidental			Cf
Numenius phaeopus	Whimbrel	Courlis corlieu	common	confirmed	NE	sm,cf,ba,sf
Limosa haemastica	Hudsonian Godwit	Barge hudsonienne	common	confirmed	NE	sm,cf,ba
Arenaria interpres	Ruddy Turnstone	Tournepierre à collier	common			Sm
Calidris canutus	Red Knot	Bécasseau maubèche	common			Sm
Calidris alba	Sanderling	Bécasseau sanderling	common			Sm
Calidris pusilla	Semipalmated Sandpiper	Bécasseau semipalmé	common	confirmed	NY	sm,cf,ba,sf
Calidris mauri	Western Sandpiper	Bécasseau d'Alaska	accidental			sm

SPECIES	COMMON NAMES		ABUNDANCE	BREEDING EVIDENCE		LANDSCAPE UNITS
				STATUS	CODE	
Calidris minutilla	Least Sandpiper	Bécasseau minuscule	common	confirmed	NY	sm,cf,ba,sf
Calidris fuscicollis	White-rumped Sandpiper	Bécasseau à croupion blanc	common			sm
Calidris bairdii	Baird's Sandpiper	Bécasseau de Baird	common			sm
Calidris melanotos	Pectoral Sandpiper	Bécasseau à poitrine cendrée	common	probable	P	sm,cf
Calidris maratima	Purple Sandpiper	Bécasseau violet	regular			sm
Calidris alpine	Dunlin	Bécasseau variable	common	confirmed	NE	sm,cf,ba,sf
Calidris himantopus	Stilt Sandpiper	Bécasseau à échasses	common	confirmed	NE	sm,cf,ba,sf
Tryngites subruficollis	Buff-breasted Sandpiper	Bécasseau rousset	regular			sm,cf
Philomachus pugnax	Ruff	Combattant varié	rare	possiblea	D	cf
Limnodromus griseus	Short-billed Dowitcher	Bécassin roux	common	confirmed	NE	sm,cf,ba,sf
Limnodromus scolopaceus	Long-billed Dowitcher	Bécassin à long bec	regular			sm
Gallinago delicata	Wilson's Snipe	Bécassine de Wilson	common	confirmed	NE	sm,cf,ba,sf
Phalaropus tricolor	Wilson's Phalarope	Phalarope de Wilson	rare			sm
Phalaropus lobatus	Red-necked Phalarope	Phalarope à Bec étroit	common	confirmed	NY	sm,cf,ba,sf
Phalaropus fulicarius	Red Phalarope	Phalarope à Bec large	rare			sm
Stercorarius pomarinus	Pomarine Jaeger	Labbe Pomarin	regular			sm,cf
Stercorarius parasiticus	Parasitic Jaeger	Labbe Parasite	common	confirmed	NY	sm,cf,ba
Stercorarius longicaudus	Long-tailed Jaeger	Labbe à longue queue	regular			sm,cf
Larus pipixcan	Franklin's Gull	Mouette de Franklin	rare			sm
Larus minutus	Little Gull	Mouette Pygmée	rare	possible	H	sm
Larus philadelphia	Bonaparte's Gull	Mouette de Bonaparte	common	confirmed	NE	sm,cf,ba,sf
Larus delawarensis	Ring-billed Gull	Goéland à bec cerclé	rare			sm
Larus argentatus	Herring Gull	Goéland argenté	common	confirmed	NY	sm,cf,ba,sf
Larus thayeri	Thayer's Gull	Goéland de Thayer	rare			sm
Larus glaucoides	Iceland Gull	Goéland arctique	accidental			sm

SPECIES	COMMON NAMES		ABUNDANCE	BREEDING EVIDENCE		LANDSCAPE UNITS
				STATUS	CODE	
Larus hyperboreus	Glaucous Gull	Goéland bourgmestre	regular			sm
Larus marinus	Great Black-backed Gull	Goéland marin	rare			sm
Xema sabini	Sabine's Gull	Mouette de Sabine	rare			sm
Rhodostethia rosea2	Ross's Gull	Mouette Rosée	rare	possible	H	sm
Pagophila eburnea1	Ivory Gull	Mouette blanche	accidental			sm
Sterna caspia	Caspian Tern	Sterne caspienne	rare			sm
Sterna hirundo	Common Tern	Sterne pierregarin	rare			sm
Sterna paradisaea	Arctic Tern	Sterne arctique	common	confirmed	NY	sm,cf,ba
Sterna forsteri	Forster's Tern	Sterne de Forster	rare			sm
Chlidonias niger	Black Tern	Guifette noire	rare	possible	H	sm,cf
Cepphus grylle	Black Guillemot	Guillemot à miroir	rare			sm
Zenaida macroura	Mourning Dove	Tourterelle triste	rare			sm
Bubo virginianus	Great Horned Owl	Grand-duc d'Amérique	rare			ba
Bubo scandiacus	Snowy Owl	Harfang des neiges	common	confirmed	NY	sm,cf,ba
Surnia ulula	Northern Hawk Owl	Chouette épervière	regular	possible	S	sm,sf
Strix varia	Barred Owl	Chouette Rayée	rare			ba,sf
Strix nebulosa	Great Grey Owl	Chouette lapone	regular	possible	S	sm,ba,sf
Asio flammeus3	Short-eared Owl	Hibou des marais	common	confirmed	NY	sm,cf,ba,sf
Aegolius funereus	Boreal Owl	Nyctale de Tengmalm	regular	possible	S	sm,ba,sf
Chordeiles minor	Common Nighthawk	Engoulevent d'Amérique	regular	possible	S	ba,sf
Selasphorus rufus	Rufous Hummingbird	Colibri roux	accidental			sm
Ceryle alcyon	Belted Kingfisher	Martin-pêcheur d'Amérique	regular			ba,sf
Picodes villosus	Hairy Woodpecker	Pic chevelu	regular	possible	H	ba
Picodes dorsalis	American Three-toed Woodpecker	Pic tridactype d'Amérique	regular	possible	H	ba,sf
Colaptes auratus	Northern Flicker	Pic flamboyant	regular	probable	P	sm,cf,ba,sf
Contopus cooperi	Olive-sided Flycatcher	Moucherolle à côtés olive	common	possible	S	ba,sf

SPECIES	COMMON NAMES		ABUNDANCE	BREEDING EVIDENCE		LANDSCAPE UNITS
				STATUS	CODE	
Empidonax flaviventris	Yellow-bellied Flycatcher	Moucherolle à ventre jaune	common	possible	S	ba,sf
Empidonax alnorum	Alder Flycatcher	Moucherolle des aulnes	common	probable	D	ba,sf
Tyrannus verticalis	Western Kingbird	Tyran de l'ouest	regular			ba,sf
Tyrannus tyrannus	Eastern Kingbird	Tyran tritri	accidental			sm
Lanius excubitor	Northern Shrike	Pie-grièche grise	regular	probable	D	sm,cf,ba,sf
Perisoreus canadensis	Grey Jay	Mesangeau du Canada	common	confirmed	FY	cf,ba,sf
Corvus brachyrhynchos	American Crow	Corneille d'Amérique	regular	possible	H	sm,cf
Corvus corax	Common Raven	Grand corbeau	common	confirmed	NE	sm,cf,ba,sf
Eremophila alpestris	Horned Lark	Alouette hausse-col	common	confirmed	NY	sm,cf,ba
Progne subis	Purple Martin	Hirondelle noire	accidental			sm,cf
Tachycineta bicolor	Tree Swallow	Hirondelle bicolore	common	confirmed	NY	sm,ba,sf
Riparia riparia	Bank Swallow	Hirondelle de rivage	common	confirmed	NE	ba,sf
Petrochelidon pyrrhonota	Cliff Swallow	Hirondelle à front blanc	common			ba,sf
Hirundo rustica	Barn Swallow	Hirondelle rustique	regular	possible	H	sm,cf,sf
Poecile hudsonica	Boreal Chickadee	Mesange à tête brune	common	probable	D	ba,sf
Cistothorus platensis	Sedge Wren	Troglodyte à bec court	rare			sm
Regulus satrapa	Golden-crowned Kinglet	Roitelet à couronne dorée	regular	possible	H	ba,sf
Regulus calendula	Ruby-crowned Kinglet	Roitelet à couronne rubis	common	probable	D	cf,ba,sf
Sialia currucoides	Mountain Bluebird	Merlebleu azure	rare			sf
Catharus minimus	Gray-cheeked Thrush	Grive à joues grises	common	confirmed	NE	ba,sf
Catharus ustulatus	Swainson's Thrush	Grive à dos olive	common	possible	S	ba,sf
Catharus guttatus	Hermit Thrush	Grive solitaire	common	possible	S	ba,sf
Turdus migratorius	American Robin	Merle d'Amérique	common	confirmed	NE	sm,cf,ba,sf
Mimus polyglottos	Northern Mockingbird	Moqueur polyglotte	regular	possible	S	sm,cf,ba
Toxostoma rufum	Brown Thrasher	Moqueur roux	rare			ba
Sturnus vulgaris	European Starling	Etourneau sansonnet	rare			sm

SPECIES	COMMON NAMES		ABUNDANCE	BREEDING EVIDENCE		LANDSCAPE UNITS
				STATUS	CODE	
Mortacilla tschutschensis	Eastern Yellow Wagtail	Bergeronnette printaniere	accidental			sm
Anthus rubescens	American Pipit	Pipit d'Amérique	common	confirmed	NE	sm,cf,ba,sf
Bombycilla garrulus	Bohemian Waxwing	Jaseur boreal	common	confirmed	FY	ba,sf
Vermivora peregrina	Tennessee Warbler	Paruline obscure	common	possible	S	cf,ba,sf
Vermivora celata	Orange-crowned Warbler	Paruline verdatre	common	probable	D	sm,cf,ba,sf
Vermivora ruficapilla	Nashville Warbler	Paruline à joues grises	regular	possible	S	cf,sf
Dendroica petechia	Yellow Warbler	Paruline jaune	common	confirmed	NY	sm,cf,ba,sf
Dendroica magnolia	Magnolia Warbler	Parulene à tête cendrée	common	possible	S	ba,sf
Dendroica coronata	Yellow-rumped Warbler	Paruline à croupion jaune	common	possible	S	sm,cf,ba,sf
Dendroica fusca	Blackburnian Warbler	Paruline à gorge orangée	regular	possible	S	sf
Dendroica palmarum	Palm Warbler	Paruline à couronne rousse	common	possible	S	sf
Dendroica striata	Blackpoll Warbler	Paruline Rayée	common	confirmed	NE	cf,ba,sf
Mniotilta varia	Black and White Warbler	Paruline noir et blanc	regular			sf
Seiurus noveboracensis	Northern Waterthrush	Paruline des ruisseaux	common	possible	S	ba,sf
Geothylypis trichas	Common Yellowthroat	Paruline masquee	regular	possible	S	cf
Wisonia pusilla	Wilson's Warbler	Paruline à calotte noire	common	possible	S	sf
Spizella arborea	American Tree Sparrow	Bruant hudsonien	common	confirmed	NY	sm,cf,ba,sf
Spizella passerina	Chipping Sparrow	Bruant familier	common	probable	D	ba,sf
Passerculus sandwichensis	Savannah Sparrow	Bruant des prés	common	confirmed	NY	sm,cf,ba,sf
Ammodramus nelsoni	Nelson's Sharp-tailed Sparrow	Bruant de Nelson	common	possible	H	sf
Passerella iliaca	Fox Sparrow	Bruant fauve	common	confirmed	NE	cf,ba,sf
Melospiza melodia	Song Sparrow	Bruant chanteur	common	cinfirmed	NE	cf,ba
Melospiza lincolnii	Lincoln's Sparrow	Bruant de Lincoln	common	confirmed	NY	sm,cf,ba,sf
Melospiza georgiana	Swamp Sparrow	Bruant de marais	common	confirmed	NE	sm,cf,ba,sf
Zonotrichia albicollis	White-throated Sparrow	Bruant à gorge blanche	common	probable	P	sm,cf,ba,sf
Zonotrichia querula	Harris's Sparrow	Bruant à face noire	common	confirmed	NE	cf,ba,sf

SPECIES	COMMON NAMES		ABUNDANCE	BREEDING EVIDENCE		LANDSCAPE UNITS
				STATUS	CODE	
Zonotrichia leucophrys	White-crowned Sparrow	Bruant à couronne blanche	common	confirmed	NY	sm,cf,ba,sf
Junco hyemalis	Dark-eyed Junco	Junco ardoisé	common	confirmed	FY	sm,cf,ba,sf
Calcarius lapponicus	Lapland Longspur	Bruant lapon	common	confirmed	NY	sm,cf,ba
Calcarius pictus	Smith's Longspur	Bruant de Smith	common	confirmed	NE	cf,ba
Plectrophenax nivalis	Snow Bunting	Bruant des neiges	common			sm,cf
Dolichonyx oryzivorus	Bobolink	Goglu des prés	rare			cf
Agelaius phoeniceus	Red-winged Blackbird	Carouge à épaulettes	common	probable	S	sm
Sturnella neglecta	Western Meadowlark	Sturnelle de l'ouest	rare			cf
Xanthocephalus xanthocephalus	Yellow-headed Blackbird	Carouge à tête jaune	regular			sm,cf
Euphagus carolinus[4]	Rusty Blackbird	Quiscale rouilleux	common	confirmed	NE	sm,cf,ba,sf
Quiscalus quiscula	Common Grackle	Quiscale bronzé	regular			sm,cf
Molothrus ater	Brown-headed Cowbird	Vacher à tête brune	regular			sm,cf
Icterus galbula	Baltimore Oriole	Oriole de Baltimore	rare			cf
Pinicola enucleator	Pine Grosbeak	Durbec des sapins	common	possible	S	ba,sf
Loxia leucoptera	White-winged Crossbill	Bec-croise bifascie	common	possible	S	ba,sf
Carduelis flammea	Common Redpoll	Sizerin flammé	common	confirmed	NY	sm,cf,ba,sf
Carduelis hornemanni	Hoary Redpoll	Sizerin blanchatre	common	confirmed	NY	sm,cf,ba,sf
Passer domesticus	House Sparrow	Moineau domestique	regular			cf

Nomenclature and Order follow the AOU Checklist of North American Birds, 7th Edition with Supplements 42,43,44,45 (2004). http://www.aou.org/aou/birdlist). French common names follow Manitoba Avian Research Committee (2003).

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;

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

TABLE 2. CODING SYSTEM FOR DETERMINING BREEDING STATUS OF BIRDS OBSERVED IN WAPUSK NATIONAL PARK.

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

Based on Ontario Breeding Bird Atlas
http://www.birdsontario.org/download/atlas_feb03.pdf

TABLE 3. ACCIDENTAL AND RARE BIRDS OF THE CHURCHILL REGION NOT YET RECORDED IN WAPUSK NATIONAL PARK.

SPECIES	COMMON NAMES		ABUNDANCE
Aix sponsa	Wood Duck	Canard branchu	accidental
Oxyura jamaicensis	Ruddy Duck	Érismature rousse	accidental
Bonasa umbellus	Ruffed Grouse	Gélinotte huppée	accidental
Gavia adamsii	Yellow-billed Loon	Plongeon à bec blanc	rare
Podilymbus podiceps	Pied-billed Grebe	Grèbe à bec bigarré	rare
Accipiter striatus	Sharp-shinned Hawk	Épervier brun	rare
Accipiter cooperii	Cooper's Hawk	Épervier de Cooper	accidental
Rallus limicola	Virginia Rail	Râle de Virginie	accidental
Grus americana	Whooping Crane	Grue blanche	accidental
Numenius borealis1	Eskimo Curlew	Courlis esquimau	endangered
Larus atricilla	Laughing Gull	Mouette articille	accidental
Larus ridibundus	Black-headed Gull	Mouette rieuse	accidental
Larus canus	Mew Gull	Goéland cendré	rare
Larus fuscus	Lesser Black-backed Gull	Goéland brun	accidental
Rissa tridactyla	Black-legged Kittiwake	Mouette tridactyle	accidental
Columba livia	Rock Pigeon	Pigeon biset	rare
Asio otus	Long-eared Owl	Hibou moyen-duc	rare
Archilochus colubris	Ruby-throated Hummingbird	Colibri à gorge rubris	accidental
Melanerpes lewis	Lewis's Woodpecker	Pic de Lewis	accidental
Melanerpes erythrocephalus4	Red-headed Woodpecker	Pic à tête rouge	accidental
Picoides arcticus	Black-backed Woodpecker	Pic à dos noir	regular
Empidonax traillii	Willow Flycatcher	Moucherolle des saules	accidental
Tyrannus forficatus	Scissor-tailed Flycatcher	Tyranus forficatus	accidental
Lanius ludovicianus	Loggerhead Shrike	Pie-grièche migratice	accidental
Vireo solitarius	Blue-headed Vireo	Viréo à tête bleue	accidental
Vireo philadelphicus	Philadelphia Vireo	Viréo de Philadelphie	accidental
Cyanocitta cristata	Blue Jay	Geai bleu	accidental
Pica hudsonia	Black-billed Magpie	Pie d'Amérique	rare
Poecile atricapillus	Black-capped Chickadee	Mésange à tête noire	rare
Sitta canadensis	Red-breasted Nuthatch	Sittelle à poitrine rousse	rare
Salpinctes obsoletus	Rock Wren	Troglodyte des rochers	rare
Troglodytes aedon	House Wren	Troglodyte familier	accidental
Oenanthe oenanthe	Northern Wheatear	Traquet motteux	rare
Anthus spragueii2	Sprague's Pipit	Pipit de Sprague	accidental
Bombycilla cedrorum	Cedar Waxwing	Jaseur d'Amérique	rare
Setophaga ruticilla	American Redstart	Paruline flamboyante	accidental
Wilsonia citrina	Hooded Warbler	Paruline à capuchin	accidental

SPECIES	COMMON NAMES		ABUNDANCE
Spizella pallida	Clay-colored Sparrow	Bruant des plaines	rare
Calcarius ornatus	Chestnut-collared Longspur	Bruant à ventre noir	accidental
Pheucticus ludovicianus	Rose-breasted Grosbeak	Cardinal à poitrine rose	accidental
Euphagus cyanocephalus	Brewer's Blackbird	Quiscale de Brewer	accidental
Loxia curvirostra	Red Crossbill	Bec-croisé des sapins	accidental

Nomenclature and Order follow the AOU Checklist of North American Birds, 7th Edition with Supplements 42,43,44,45 (2004). http://www.aou.org/aou/birdlist). French common names follow Manitoba Avian Research Committee (2003).

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 PÉROUSE BAY FROM 1980 TO 1996.

SPECIES	SLOPE		F	P
	estimate	standard error		
Tundra Swan	0.0002	0.0083	0.00	0.9845
American Wigeon	-0.0391	0.0076	26.48	0.0001
American Black Duck	-0.0051	0.0101	0.25	0.6219
Mallard	-0.0031	0.0097	0.01	0.7536
Northern Shoveler	-0.0510	0.0083	37.79	0.0001
Northern Pintail	0.0017	0.0060	0.08	0.7795
Green-winged Teal	-0.0113	0.0071	2.54	0.1319
Long-tailed Duck	-0.0102	0.0078	1.72	0.2099
Red-breasted Merganser	-0.0101	0.0081	1.54	0.2335
Northern Harrier	-0.0024	0.0077	0.10	0.7612
Sandhill Crane	0.0020	0.0075	0.07	0.7885
Semipalmated Plover	-0.0022	0.0060	0.14	0.7176
Whimbrel	-0.0291	0.0085	11.80	0.0037
Hudsonian Godwit	-0.0060	0.0060	1.03	0.3258
Ruddy Turnstone	-0.0193	0.0079	5.99	0.0271
Semipalmated Sandpiper	-0.0061	0.0057	1.16	0.2982
Least Sandpiper	0.0017	0.0060	0.08	0.7795
Dunlin	-0.0142	0.0060	5.58	0.0321
Stilt Sandpiper	-0.0419	0.0087	23.43	0.0002
Short-billed Dowitcher	-0.0262	0.0064	16.55	0.0010
Red-necked Phalarope	-0.0136	0.0069	3.86	0.0682
Parasitic Jaeger	-0.0280	0.0091	9.46	0.0077
Bonaparte's Gull	-0.0382	0.0118	10.58	0.0054
Arctic Tern	0.0050	0.0068	0.53	0.4770
Short-eared Owl	-0.0458	0.0152	9.03	0.0089
Common Raven	0.0049	0.0052	0.92	0.3523
Horned Lark	-0.0102	0.0067	2.32	0.1485
Yellow Warbler	-0.0020	0.0073	0.07	0.7910
American Tree Sparrow	0.0066	0.0077	0.73	0.4057
Savannah Sparrow	0.0099	0.0074	1.77	0.2032
White-crowned Sparrow	-0.0032	0.0101	0.10	0.7558
Lapland Longspur	-0.0297	0.0101	8.69	0.0100
Snow Bunting	-0.0153	0.0101	2.33	0.1474
Common and Hoary Redpoll	-0.0109	0.0119	0.83	0.3755

To maintain an overall α-error rate ≤ 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.