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Bird Conservation Strategy for Bird Conservation Region 3 Prairie and Northern Region: Arctic Plains and Mountains

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Preface

Environment Canada led the development of all-bird conservation strategies in each of Canada's Bird Conservation Regions (BCRs) by drafting new strategies and integrating new and existing strategies into an all-bird framework. These integrated all-bird conservation strategies will serve as a basis for implementing bird conservation across Canada, and will also guide Canadian support for conservation work in other countries important to Canada's migrant birds. Input to the strategies from Environment Canada's conservation partners is as essential as their collaboration in implementing their recommendations.

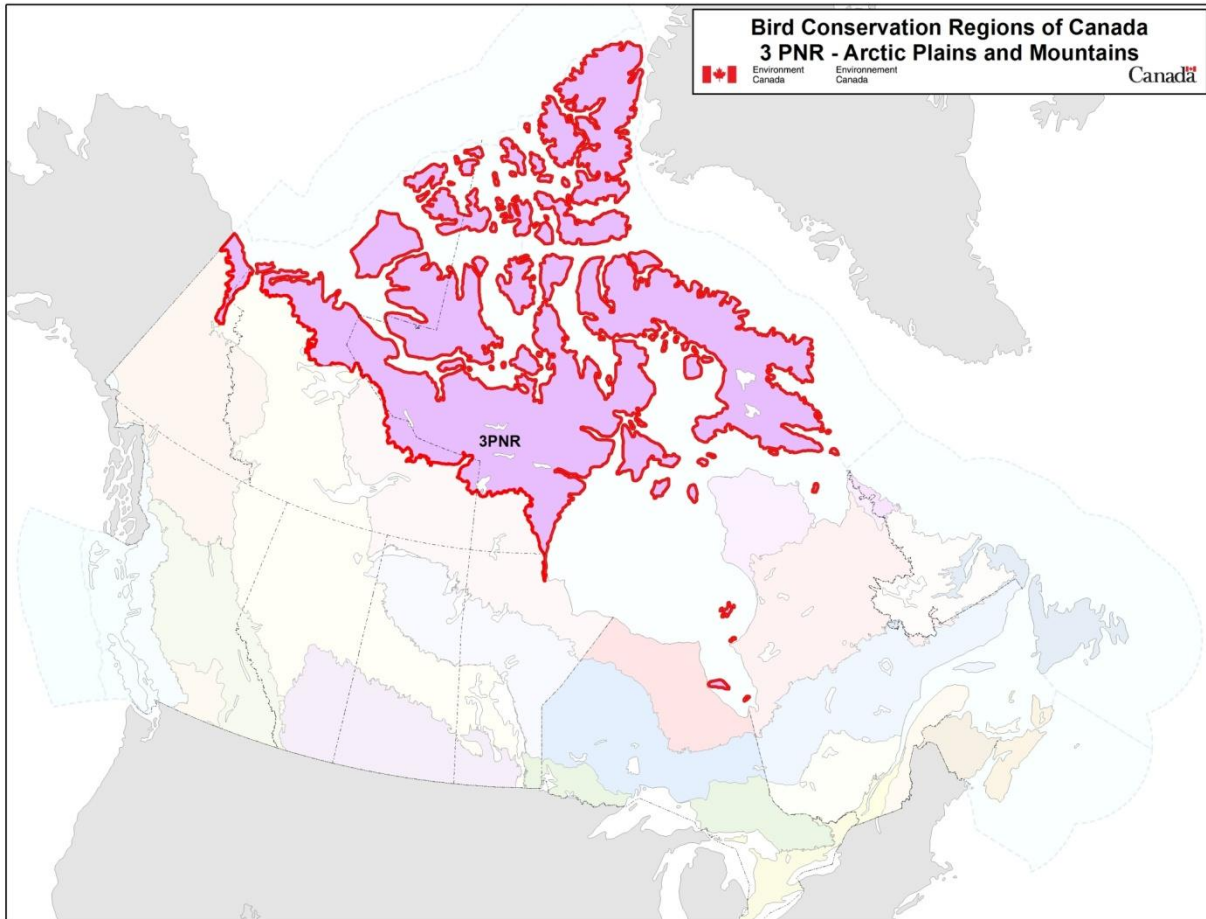
Environment Canada has developed national standards for strategies to ensure consistency of approach across BCRs. Bird Conservation Strategies will provide the context from which specific implementation plans can be developed for each BCR, building on the programs currently in place through Joint Ventures or other partnerships. Landowners including Aboriginal peoples will be consulted prior to implementation.

Conservation objectives and recommended actions from the conservation strategies will be used as the biological basis to develop guidelines and beneficial management practices that support compliance with regulations under the *Migratory Birds Convention Act, 1994*.

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Bird Conservation Strategy for Bird Conservation Region 3 Prairie and Northern Region: Arctic Plains and Mountains



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Executive Summary

Bird Conservation Region (BCR) 3, Arctic Plains and Mountains, covers an area of more than 2 900 000 km² and spans the continent from Alaska to Labrador. The habitats within this area are varied, from sparse taiga forests at the treeline, to wet coastal meadows of sedges and grasses, to gravel barrens and glaciers. The majority of this BCR falls within Nunavut and the Northwest Territories, with smaller portions in Quebec, Labrador and the Yukon. This strategy covers all of BCR 3 contained within Environment Canada's Prairie and Northern Region, the small portion in the Yukon, and the five associated marine ecoregions. We refer to this area as BCR 3 PNR.

These conservation strategies serve as a framework for implementing bird conservation nationally and also identify international conservation issues for Canada's priority birds. Objective and replicable methods were used to identify priority species, define habitat associations, set population targets, assess and rank threats, set conservation objectives, and address these objectives with conservation actions. This strategy is not intended to be highly prescriptive, but rather is intended to guide future implementation efforts undertaken by various partners and stakeholders.

We evaluated 159 species of birds that occur in the terrestrial and marine habitats of BCR 3 PNR, and determined that 65 met the criteria for priority status. More than 70% of these species used wetland habitats, although shrub habitats (especially heath tundra), bare areas (including a variety of coastal habitats, gravel barrens and cliffs) and aquatic habitats (freshwater and marine) were also important.

Population objectives were set on the basis of observed trends; however, inadequate monitoring information was a pervasive issue: we were unable to assign a quantitative population objective for 34% of the priority species. For 35% of priority species, there was sufficient evidence of declines that we recommend increasing the population size. Management for a majority of species would be improved with better information on population size, trend and range. Recommendations are made for the priority species most in need of improved monitoring.

The threats assessment identified many activities or issues potentially causing harm to BCR 3 PNR's priority birds. Given the limited footprint of development in the region and the migratory habits of almost all arctic-breeding birds, a majority of these threats are outside of the BCR. Pollution, habitat loss and degradation, and legal and illegal hunting (primarily outside of North America) are among the most important threats. Even within the BCR, some of the most important threats stem indirectly from human activities elsewhere; issues such as anthropogenic climate change, degradation of tundra habitats from abundant waterfowl (a result of southern land-use changes), and long-range transport and deposition of contaminants all negatively impact arctic wildlife but are not caused by activities in the North.

Conservation actions are recommended to address threats both within and outside BCR 3 PNR. Within the BCR, many recommended actions relate to law and policy, including continued enforcement of existing regulations, development of new regulations or beneficial management practices, and strengthening of legislation. Actions involving direct management or protection of species or habitats were recommended in fewer cases because such direct management would be difficult to achieve on the scale required for such a large planning unit. For some issues, it was determined that additional research, monitoring or other information could increase our ability to address threats. Suggestions to acquire this information are provided.

Introduction: Bird Conservation Strategies

Context

This document is one of a suite of Bird Conservation Region Strategies (BCR strategies) that have been drafted by Environment Canada for all regions of Canada. These strategies respond to Environment Canada's need for integrated and clearly articulated bird conservation priorities to support the implementation of Canada's migratory birds program, both domestically and internationally. This suite of strategies builds on existing conservation plans for the four "bird groups" (waterfowl,¹ waterbirds,² shorebirds³ and landbirds⁴) in most regions of Canada, as well as on national and continental plans, and includes birds under provincial/territorial jurisdiction. These new strategies also establish standard conservation planning methods across Canada, and fill gaps, as previous regional plans do not cover all areas of Canada or all bird groups.

These strategies present a compendium of required actions based on the general philosophy of achieving scientifically based desired population levels as promoted by the four pillar initiatives of bird conservation. Desired population levels are not necessarily the same as minimum viable or sustainable populations, but represent the state of the habitat/landscape at a time prior to recent dramatic population declines in many species from threats known and unknown. The threats identified in these strategies were compiled using currently available scientific information and expert opinion. The corresponding conservation objectives and actions will contribute to stabilizing populations at desired levels.

The BCR strategies are not highly prescriptive. In most cases, practitioners will need to consult additional information sources at local scales to provide sufficient detail to implement the recommendations of the strategies. Tools such as beneficial management practices will also be helpful in guiding implementation. Partners interested in participating in the implementation of these strategies, such as those involved in the habitat Joint Ventures established under the North American Waterfowl Management Plan, are familiar with the type of detailed implementation planning required to coordinate and undertake on-the-ground activities.

¹ NAWMP Plan Committee 2004

² Milko et al. 2003

³ Donaldson et al. 2000

⁴ Rich et al. 2004

Strategy Structure

Section 1 of this strategy presents general information about the BCR and the subregion, with an overview of the six elements⁵ that provide a summary of the state of bird conservation at the sub-regional level. Section 2 provides more detail on the threats, objectives and actions for priority species grouped by each of the broad habitat types in the subregion. Section 3 presents additional widespread conservation issues that are not specific to a particular habitat or were not captured by the threat assessment for individual species, as well as research and monitoring needs, and threats to migratory birds while they are outside of Canada. The approach and methodology are summarized in the appendices, but details are available in a separate document (Kennedy et al. 2012). A national database houses all the underlying information summarized in this strategy and is available from [Environment Canada](#).

⁵ The six elements are: Element 1 – priority species assessment; Element 2 – habitats important to priority species; Element 3 – population objectives; Element 4 – threat assessment; Element 5 – conservation objectives; Element 6 – recommended actions.

Characteristics of Bird Conservation Region 3

BCR 3 covers an area from the treeline to the northernmost tip of Ellesmere Island (Fig. 1a,b), and spans the breadth of the continent from the North Slope of Alaska to the Atlantic coast of Labrador. It encompasses an area of more than 2 900 000 km². Within Canada, a majority of BCR 3 falls within Nunavut and the Northwest Territories, and is therefore within the boundaries of Environment Canada's Prairie and Northern Region (PNR). In addition, five marine ecoregions are associated with BCR 3 PNR: Hudson Bay Complex, Arctic Basin, Eastern Arctic (Lancaster Sound, Baffin Bay – Davis Strait), Arctic Archipelago and Western Arctic (Beaufort-Amundsen-Viscount-Melville-Queen Maud; see Fisheries and Oceans Canada 2009). The North Slope of the Yukon falls within BCR 3 and is considered here; however, the portions of BCR 3 within Quebec and Labrador are considered in separate conservation strategies.

Habitats within this vast area are diverse, but all are influenced by a short growing season and continuous permafrost. The northeast portion of the region is mountainous, with unvegetated, barren rock and glaciers predominating (Fig. 1a,b). Elsewhere in the High Arctic, ground cover is often sparse and in drier areas is dominated by herbs, lichens and dwarf shrubs. At these latitudes, many of the key habitats for birds are marine (Fig. 2a,b). Low-lying wetlands of grasses, sedges and mosses are not widespread but offer important bird habitat where they occur. These wetlands are more common at mid- and low-arctic latitudes, and some areas such as the Great Plain of the Koukdjuak or the Mackenzie Delta offer large expanses of comparatively rich tundra wetlands; these wetlands figure prominently in the network of protected areas and key sites in the region (Fig. 2a,b). Surface water is extensive, and areas of patterned ground are common. Upland habitats at mid- and low-arctic latitudes range from heavily vegetated heath communities to sparse "cryptobiotic crusts" of cyanobacteria, lichens and moss. Shrubs, especially willows, are taller at lower latitudes. At the southern fringe of BCR 3 PNR, small spruce trees are found in sheltered areas; these restricted patches of taiga (i.e., coniferous) habitat are home to a number of species not found elsewhere in the BCR.

Bird diversity in this vast area is low in comparison to more temperate latitudes. Still, a large number of species are reliant on the marine and terrestrial habitats of BCR 3 PNR. In terms of number of species, the bird community is dominated by shorebirds, waterbirds and waterfowl. Although numerous landbirds are found here, few species have their range centred in the Canadian Arctic. This pattern holds across the circumpolar Arctic, where 108 of 162 Arctic specialist species are from the Orders Charadriiformes and Anseriformes (especially from families Scolopacidae [sandpipers and allies], Laridae (gulls) and Alcidae [auks] and subfamilies Mergini [sea ducks] and Anserini [geese]; Gantner and Gaston in prep.).

A small number of species remain in BCR 3 during the non-breeding season, travelling only as far as is necessary to find food. Some seaducks and seabirds migrate east or west to winter in high-latitude marine environments. Some shorebirds and Brant breeding in the High Arctic winter in northern Europe. However, the vast majority of species migrate south, including many shorebirds that travel thousands of kilometres to winter in Central and South America.

These long-range migrations expose arctic-breeding species to a variety of risks throughout the annual cycle. Identifying these risks, both within and outside BCR 3 PNR, is a focus of this conservation strategy.

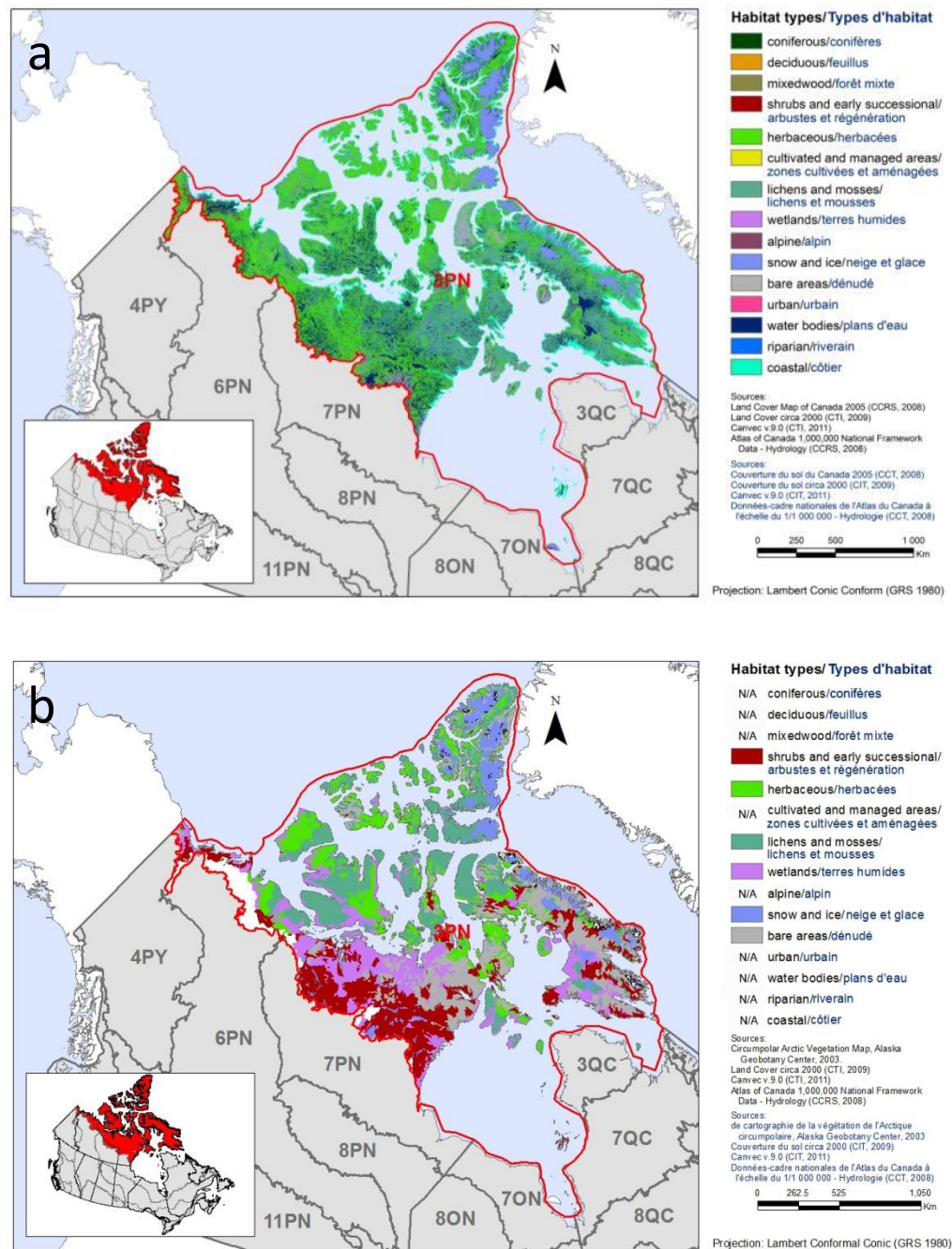


Figure 1. Landcover in BCR 3 PNR as described by the Land Cover Map of Canada (a), and the Circumpolar Arctic Vegetation Map (CAVM; b). The former offers a consistent national classification while the latter is better suited to capturing variation in arctic habitats specifically. A small portion of the southern edge of BCR 3 is outside of the area classified by the CAVM.

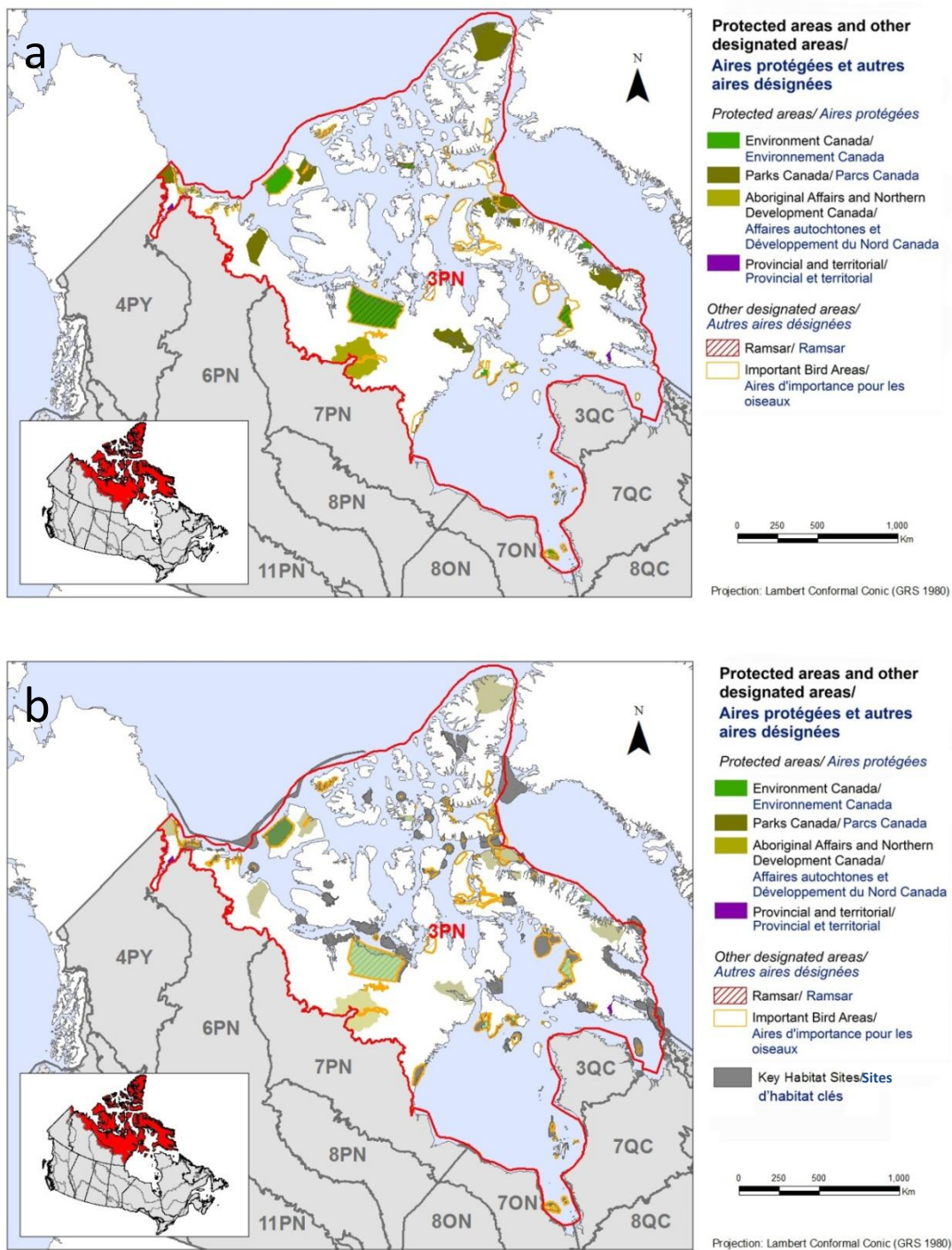


Figure 2. Map of protected and designated areas in BCR 3 PNR (a), and a map including areas considered by Environment Canada to be Key Habitat Sites for migratory birds, including those with no formal protection (b). The areas from the top panel were made partially transparent in the bottom panel so that overlap of key areas and protected areas would be visible.

Section 1: Summary of Results – All Birds, All Habitats

Element 1: Priority Species Assessment

These Bird Conservation Strategies identify “priority species” from all regularly occurring bird species in each BCR subregion (see Appendix 1). Species that are vulnerable due to population size, distribution, population trend, abundance and threats are included because of their “conservation concern”. Some widely distributed and abundant “stewardship” species are also included. Stewardship species are included because they typify the national or regional avifauna and/or because they have a large proportion of their range and/or continental population in the subregion; many of these species have some conservation concern, while others may not require specific conservation effort at this time. Species of management concern are also included as priority species when they are at (or above) their desired population objectives but require ongoing management because of their socio-economic importance as game species or because of their impacts on other species or habitats (see Appendix 2).

The purpose of the prioritization exercise is to focus implementation efforts on the issues of greatest significance for Canadian avifauna. Table 1 provides a full list of all priority species and their reason for inclusion. Tables 2 and 3 summarize the number of priority species in BCR 3 PNR by bird group and by the reason for priority status.

Across all bird groups, 65 of 159 (41%) species/populations were designated as priority taxa (Table 1 and 2). A large fraction of the candidate species, especially for landbirds, did not merit priority status because their populations are concentrated outside of the Arctic. For landbirds, for example, 43/62 species (69%) were estimated to have $\leq 10\%$ of their range within BCR 3. For shorebirds and waterfowl, bird groups with many arctic specialist species, $>50\%$ of candidate species were assigned priority status (Table 2). Nine arctic species are formally assessed as “at risk” by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) or listed under the *Species at Risk Act* (SARA; Table 3). The vast majority of species were assigned priority status based on concern over population size or trend, or threats that they face throughout the year.

Table 1. Priority species in BCR 3 PNR, population objectives, and the reasons for priority status.

Priority species	Population objective	COSEWIC ¹	SARA ²	National/continental concern (landbirds, shorebirds, waterbirds)	Regional concern (landbirds only)	Continental stewardship (landbirds only)	Regional stewardship (landbirds only)	NAWMP ³ continental priority (waterfowl only)	NAWMP WCR rank ⁴ (waterfowl only)	Expert review ⁵ (added to priority list)
Landbirds										
American Pipit	Maintain current									Yes
American Tree Sparrow	Increase 50%									Yes
Bluethroat	Assess/Maintain									Yes
Eastern Yellow Wagtail	Assess/Maintain									Yes
Golden Eagle	Increase 50%				Yes					
Gyr Falcon	Assess/Maintain					Yes	Yes			
Harris's Sparrow	Increase 100%			Yes			Yes			
Hoary Redpoll	Increase 50%					Yes	Yes			
Lapland Longspur	Assess/Maintain					Yes				

¹ Assessed by COSEWIC ([Committee on the Status of Endangered Wildlife in Canada](#)) as: E, Endangered; T, Threatened; SC, Special Concern

² Species listed on Schedule 1 of the Species at Risk Act as E, Endangered; T, Threatened; SC, Special Concern ([Species at Risk Public Registry http://www.registrelep-sararegistry.gc.ca/species/schedules_e.cfm?id=1](http://www.registrelep-sararegistry.gc.ca/species/schedules_e.cfm?id=1)).

³ NAWMP: North American Waterfowl Management Plan (NAWMP Plan Committee 2004)

⁴ The higher of the Waterfowl Conservation Region (WCR) ranks for breeding or non-breeding needs presented in the NAWMP Management Plan

⁵ Expert review indicates that a species was added to the priority list as a result of expert opinion

Table 1 continued

Priority species	Population objective	COSEWIC ¹	SARA ²	National/continental concern (landbirds, shorebirds, waterbirds)	Regional concern (landbirds only)	Continental stewardship (landbirds only)	Regional stewardship (landbirds only)	NAWMP ³ continental priority (waterfowl only)	NAWMP WCR rank ⁴ (waterfowl only)	Expert review ⁵ (added to priority list)
Peregrine Falcon (<i>anatum/tundrius</i>)	Assess/Maintain [†]	SC	SC			Yes	Yes			
Rock Ptarmigan	Assess/Maintain					Yes				
Rough-legged Hawk	Assess/Maintain					Yes	Yes			
Rusty Blackbird	Increase 100% [†]	SC	SC	Yes						
Short-eared Owl	Increase 100% [†]	SC	SC	Yes	Yes					
Smith's Longspur	Assess/Maintain			Yes			Yes			
Snow Bunting	Assess/Maintain					Yes				
Snowy Owl	Maintain current					Yes	Yes			
Shorebirds										
American Golden-Plover	Assess/Maintain			Yes						
Black-bellied Plover	Increase 100%			Yes						
Buff-breasted Sandpiper	Increase 50%			Yes						
Common Ringed Plover	Assess/Maintain									Yes
Dunlin	Assess/Maintain			Yes						

[†] This interim population objective will be replaced with the official recovery objective once a recovery document is published for this species under the *Species at Risk Act*.

Table 1 continued

Priority species	Population objective	COSEWIC ¹	SARA ²	National/continental concern (landbirds, shorebirds, waterbirds)	Regional concern (landbirds only)	Continental stewardship (landbirds only)	Regional stewardship (landbirds only)	NAWMP ³ continental priority (waterfowl only)	NAWMP WCR rank ⁴ (waterfowl only)	Expert review ⁵ (added to priority list)
Eskimo Curlew	Recovery objective	E	E	Yes						
Hudsonian Godwit	Increase 100%									Yes
Least Sandpiper	Increase 100%			Yes						
Purple Sandpiper	Assess/Maintain									Yes
Red Knot (<i>islandica</i>)	Assess/Maintain	SC	SC	Yes						
Red Knot (<i>rufa</i>)	Increase 100% [†]	E	E	Yes						
Red Phalarope	Increase 50%			Yes						
Red-necked Phalarope	Increase 100%			Yes						
Ruddy Turnstone	Assess/Maintain			Yes						
Sanderling	Assess/Maintain			Yes						
Semipalmated Sandpiper	Increase 100%			Yes						
Stilt Sandpiper	Increase 100%			Yes						
Surfbird	Assess/Maintain			Yes						
Whimbrel	Assess/Maintain			Yes						

[†] This interim population objective will be replaced with the official recovery objective once a recovery document is published for this species under the *Species at Risk Act*.

Table 1 continued

Priority species	Population objective	COSEWIC ¹	SARA ²	National/continental concern (landbirds, shorebirds, waterbirds)	Regional concern (landbirds only)	Continental stewardship (landbirds only)	Regional stewardship (landbirds only)	NAWMP ³ continental priority (waterfowl only)	NAWMP WCR rank ⁴ (waterfowl only)	Expert review ⁵ (added to priority list)
Waterbirds										
Arctic Tern	Increase 50%			Yes						
Common Loon	Maintain current			Yes						
Ivory Gull	Recovery objective	E	E	Yes						
Pacific Loon	Assess/Maintain			Yes						
Ross's Gull	Recovery objective	T	T	Yes						
Thayer's Gull	Assess/Maintain			Yes						
Thick-billed Murre	Maintain current			Yes						
Yellow-billed Loon	Assess/Maintain			Yes						
Waterfowl⁶										
Brant (Atlantic)	Maintain current							Mod. Low	High	
Brant (Black)	Maintain current							High	Highest	
Brant (Eastern High Arctic)	Maintain current							Mod. High	High	

⁶ These population divisions correspond to those in the most current management plan (NAWMP 2012). However, evolving knowledge of distributions and a trend towards defining management units that reflect breeding aggregations means that these divisions may be lost in future iterations of this strategy (e.g., Leafloor et al. 2012)

Table 1 continued

Priority species	Population objective	COSEWIC ¹	SARA ²	National/continental concern (landbirds, shorebirds, waterbirds)	Regional concern (landbirds only)	Continental stewardship (landbirds only)	Regional stewardship (landbirds only)	NAWMP ³ continental priority (waterfowl only)	NAWMP WCR rank ⁴ (waterfowl only)	Expert review ⁵ (added to priority list)
Brant (Western High Arctic)	Assess/Maintain							High	Highest	
Cackling Goose (Shortgrass Prairie)	Increase 50%							Mod.	High	
Cackling Goose (Tallgrass Prairie)	Maintain current							Mod. Low	High	
Canada Goose (Atlantic)	Maintain current							High	Highest	
Common Eider (<i>borealis</i>)	Increase 50%							High	Highest	
Common Eider (<i>sedentaria</i>)	Increase 50%							High	Highest	
Common Eider (<i>v-nigra</i>)	Increase 50%							High	Highest	
Greater Snow Goose	Decrease							Above Objective	High	
Greater White-fronted Goose	Maintain current							Mod. Low	High	
Harlequin Duck (Eastern)	Maintain current	SC	SC					Mod.	Mod. High	
King Eider	Increase 50%							Mod. High	High	
Lesser Snow Goose (Mid-Continent)	Decrease							Above Objective	High	
Lesser Snow Goose (Western Arctic)	Decrease							Above Objective	High	
Lesser Snow Goose (Western Central Flyway)	Maintain current							Mod.	High	
Long-tailed Duck	Increase 50%							Mod. High	High	

Table 1 continued

Priority species	Population objective	COSEWIC ¹	SARA ²	National/continental concern (landbirds, shorebirds, waterbirds)	Regional concern (landbirds only)	Continental stewardship (landbirds only)	Regional stewardship (landbirds only)	NAWMP ³ continental priority (waterfowl only)	NAWMP WCR rank ⁴ (waterfowl only)	Expert review ⁵ (added to priority list)
Northern Pintail	Increase 50%							High	High	
Ross's Goose	Decrease							Above Objective	High	
Tundra Swan (Eastern)	Maintain current							Mod. Low	High	

Table 2. Summary of priority species, by bird group, in BCR 3 PNR.

Bird group	Total species	Total priority species	Percent listed as priority	Percent of priority list
Landbird	62	17	27%	26%
Shorebird	31	19	61%	29%
Waterbird	28	8	29%	12%
Waterfowl	38	21	55%	32%
All	159	65	41%	100%

Table 3. Number of priority species in BCR 3 PNR by reason for priority status.

Reason for priority listing ¹	Landbirds	Shorebirds	Waterbirds	Waterfowl
COSEWIC ²	3	3	2	1
Federal SARA Listed ³	3	3	2	1
NAWMP ⁴	-	-	-	21
National/Continental Concern	4	16	8	-
Regional Concern	2	-	-	-
National/Continental Stewardship	8	-	-	-
Regional Stewardship	7	-	-	-
Expert Review	4	3	-	-

¹ A single species can be on the priority list for more than one reason. Note that not all reasons for inclusion apply to every bird group (indicated by "-").

² COSEWIC indicates species assessed by the Committee on the Status of Endangered Wildlife in Canada as Endangered, Threatened, or Special Concern.

³ Species listed on Schedule 1 of the *Species at Risk Act* as Endangered, Threatened or Special Concern.

⁴ NAWMP indicates species ranked in the North American Waterfowl Management Plan (NAWMP 2004) as having Moderately High, High or Highest breeding or non-breeding conservation and/or monitoring need in the WCR.

Element 2: Habitats Important to Priority Species

Identifying the broad habitat requirements for each priority species within the BCR allowed species to be grouped by shared habitat-based conservation issues and actions (see Appendix 2 for details on how species were assigned to standard habitat categories). If many priority species associated with the same habitat face similar conservation issues, then conservation action in that habitat may support populations of several priority species. BCR strategies use a modified version of the standard land cover classes developed by the United Nations (Food and Agriculture Organization 2000) to categorize habitats, and species were often assigned to more than one habitat class.

Wetland habitats were used by 72% of priority species, and nearly half of all priority species used three additional habitat categories: shrub/early successional (shrub tundra, including both willow and heath habitat types), bare areas (e.g., rocky coasts or cliffs) or waterbodies, snow and ice (freshwater or marine; Fig. 3). Habitats were further defined on the basis of their location; nearly half of the priority species used habitats that were located in coastal areas, while few species were found in alpine habitats (see Appendix 2). Taiga (i.e., coniferous) habitats, although uncommon in BCR 3 PNR, were used by 8% of priority species.

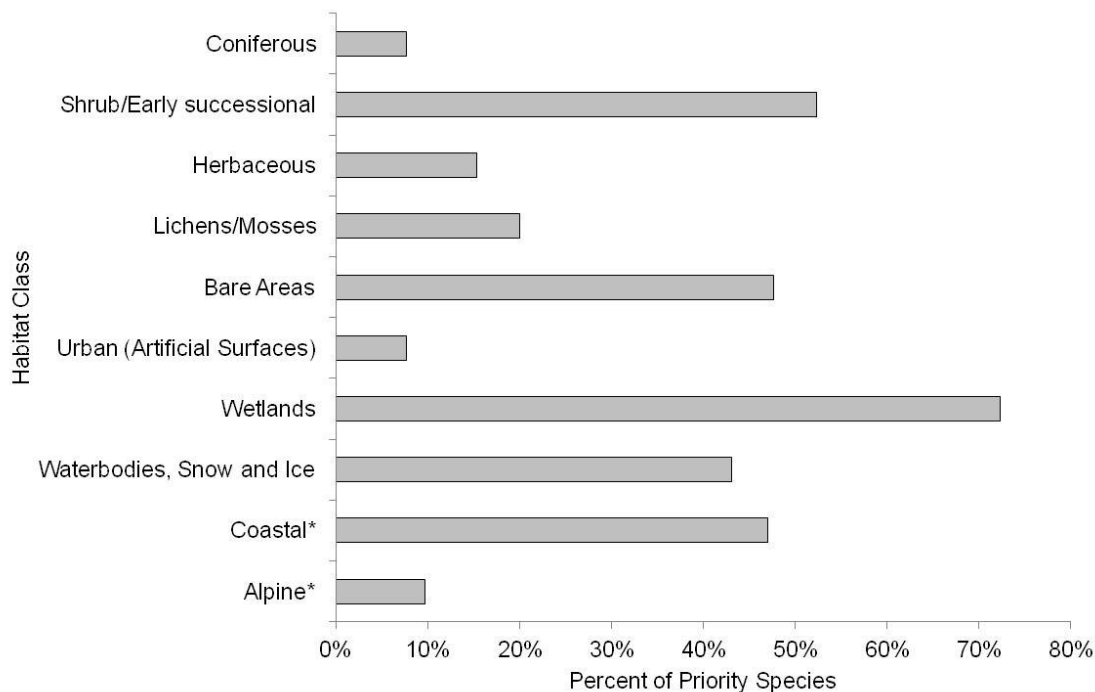


Figure 3. Percent of priority species that are associated with each habitat type in BCR 3 PNR.

The total exceeds 100% because each species may be assigned to more than one habitat (median = 3).

*“Coastal” and “Alpine” are descriptors applied after the habitat category was assigned.

Element 3: Population Objectives

Population objectives allow us to measure and evaluate conservation success. The objectives in this strategy are assigned to categories and are based on a quantitative or qualitative assessment of species' population trends. If the population trend of a species is unknown, the objective is set as "assess and maintain", and a monitoring objective is given (see Appendix 2). For any species listed under SARA or under provincial/territorial endangered species legislation, Bird Conservation Strategies defer to population objectives in available Recovery Strategies and Management Plans. The ultimate measure of conservation success will be the extent to which population objectives have been reached over the next 40 years. Population objectives do not currently factor in feasibility of achievement, but are held as a standard against which to measure progress.

In BCR 3 PNR, incomplete monitoring information (leading to unknown trends) resulted in 22 species (34%) being assigned an objective of "assess/maintain" the population (Fig. 4). Although the lack of detailed monitoring data was a pervasive issue, for 23 (35%) species, evidence for declines was sufficient to make recommendations for increasing population size. Methods are described in Kennedy et al. (2012), but in general, species with large, documented declines were assigned an objective of 100% population increase, whereas those with small or possible declines were assigned an objective of 50% increase. Four populations of white geese are considered to be above their population objectives, and objectives of decreasing current population size were assigned. An additional four species (Ivory Gull, Ross's Gull, Red Knot *rufa* and Eskimo Curlew), are listed under SARA as species at risk, and therefore their population objectives are or will be defined in recovery documents.

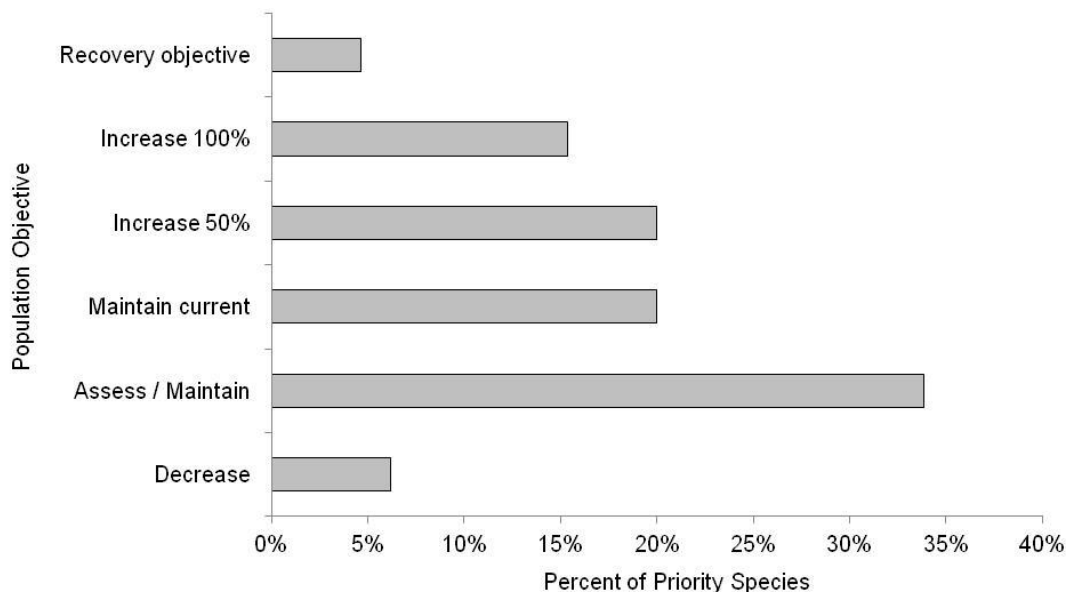


Figure 4. Percent of priority species that are associated with each population objective category in BCR 3 PNR.

Element 4: Threat Assessment for Priority Species

The threat assessment process (see Appendix 2) identifies threats believed to have a population-level effect on individual priority species. These threats are assigned a relative magnitude (Low, Medium, High, Very High), based on their scope (the proportion of the species' range within the subregion that is impacted) and severity (the relative impact on the priority species' population). This allows us to target conservation actions towards threats with the greatest effects on suites of species or in broad habitat classes. Some well-known conservation issues (such as predation by domestic cats or climate change) may not be identified in the literature as significant threats to populations of an individual priority species and therefore may not be captured in the threat assessment. However, they merit attention in conservation strategies because of the large numbers of individual birds affected in many regions of Canada. We have incorporated them in a separate section on Widespread Issues, but, unlike other threats, they are not ranked.

Because of sparse human settlement and limited development in BCR 3 PNR, the dominant threats to priority bird populations differ from those in most other parts of the country. Development has a limited footprint, and agriculture is non-existent. Resource extraction does impact priority birds, but because such activities are on a localized scale, effects are estimated to be low at the population level (Fig. 5). Similarly, harvest and bycatch of priority birds have low impacts on any one population, and are considered a threat of low magnitude overall (Table 4) despite influencing a number of priority species. Among the most important threats to priority birds in BCR 3 are issues that stem indirectly from human activities elsewhere. Issues such as anthropogenic climate change, degradation of tundra habitats from abundant waterfowl (a result of southern land-use changes) and deposition of contaminants transported over long ranges all negatively impact arctic wildlife but have little to do with activities in the North.

It is perhaps not surprising then that a majority of the significant threats to BCR 3 PNR's priority species occur outside of the BCR. While outside the BCR, the Arctic's priority birds are exposed to a diversity of threats including pollution, legal and illegal hunting, and development. These and other threats occurring outside of Canada are discussed in a subsequent section of the strategy (see the Threats Outside Canada section).

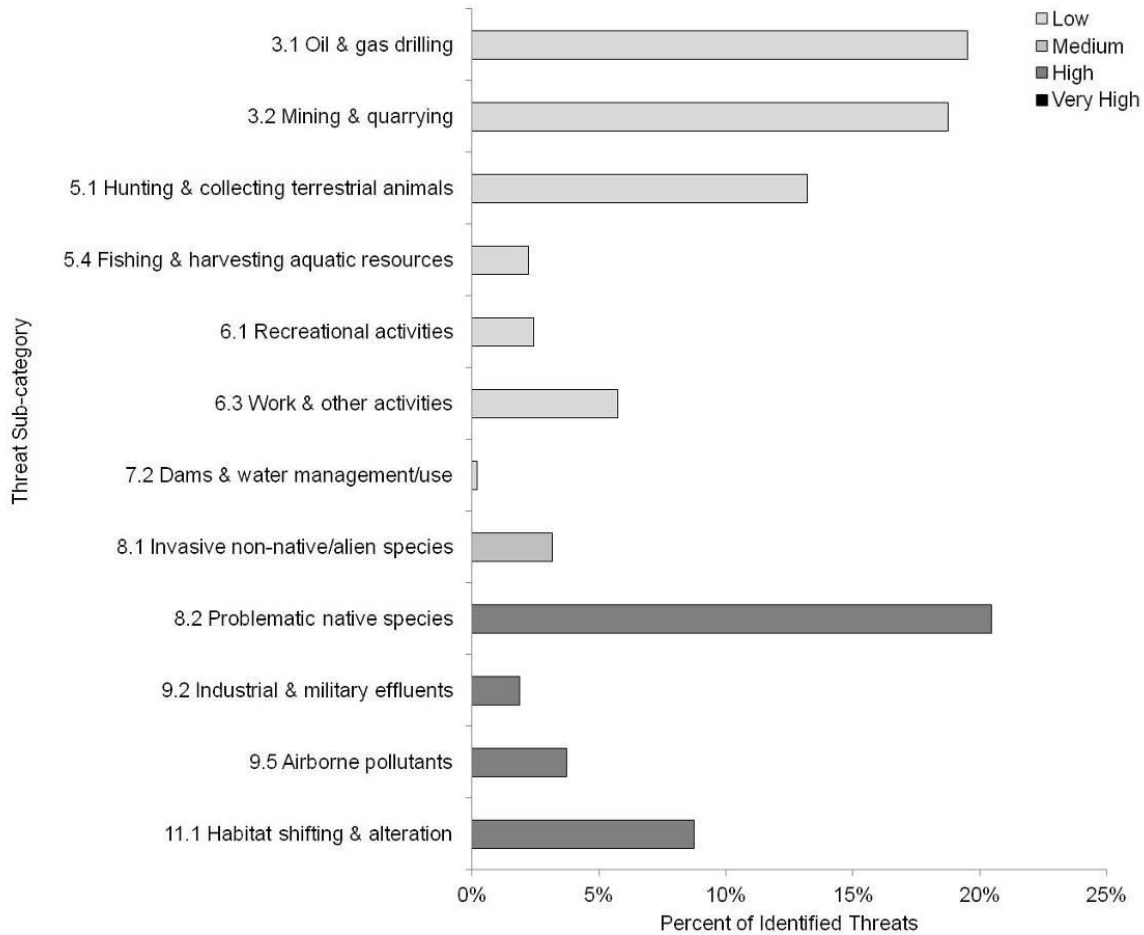


Figure 5. Percent of identified threats to priority species within BCR 3 PNR by threat sub-category.

Each bar represents the percent of the total number of threats identified in each threat sub-category in BCR 3 PNR (for example, if 100 threats were identified in total for all priority species in BCR 3 PNR, and 10 of those threats were in the category 3.1 Oil & gas drilling, the bar on the graph would represent this as 10%). Shading in the bars represents the rolled up magnitude of all threats in each threat sub-category in the BCR. (See Appendix 2 for details on how magnitude was assessed.) “9.2 Industrial & military effluents” refers primarily to accidental oil spills and chronic oil discharge.

Table 4. Relative magnitude of identified threats to priority species within BCR 3 PNR by threat category and broad habitat class.

Overall ranks were generated through a roll-up procedure described in Kennedy et al. (2012). L represents Low Magnitude threats; M = Medium; H = High; VH = Very High. Blank cells indicate that no priority species had threats identified in the threat category/habitat combination.

Threat category	Coniferous	Shrub/Early successional	Herbaceous	Lichens/Mosses	Bare areas	Artificial surfaces	Wetlands	Waterbodies, snow and ice	Overall
Overall	L	M	M	L	M	L	H	H	
1. Residential & Commercial Development									
2. Agriculture & aquaculture									
3. Energy production & mining	L	L	L	L	L	L	L	L	L
4. Transportation & service corridors									
5. Biological resource use		L	L	L	L		L	L	L
6. Human intrusions & disturbance		L	L	L	L	L	L	L	L
7. Natural system modifications								L	L
8. Invasive & other problematic species & genes	L	H	H	M	L	L	H	M	H
9. Pollution		L	L		H	L	L	H	H
11. Climate change & severe weather	L	M	M		M		H	H	H

Element 5: Conservation Objectives

Conservation objectives were designed to address threats and information gaps that were identified for priority species. They describe the environmental conditions and research and monitoring that are thought to be necessary for progress towards population objectives and to understand underlying conservation issues for priority bird species. As conservation objectives are reached, they will collectively contribute to achieving population objectives. Whenever possible, conservation objectives were developed to benefit multiple species and/or respond to more than one threat (see Appendix 2).

For BCR 3 PNR, the largest proportion of objectives relate to ensuring an adequate supply and quality of habitat (38%; Fig. 6). Examples of objectives in this category include the development or implementation of policies relating to habitat conservation, objectives related to maintaining specific habitat features or characteristics, and reduction of pollution or other forms of habitat degradation. Objectives related to an improved understanding of species' ecology or limiting factors were also important, contributing 26% of records. Direct management of individual species accounted for only 11% of records.

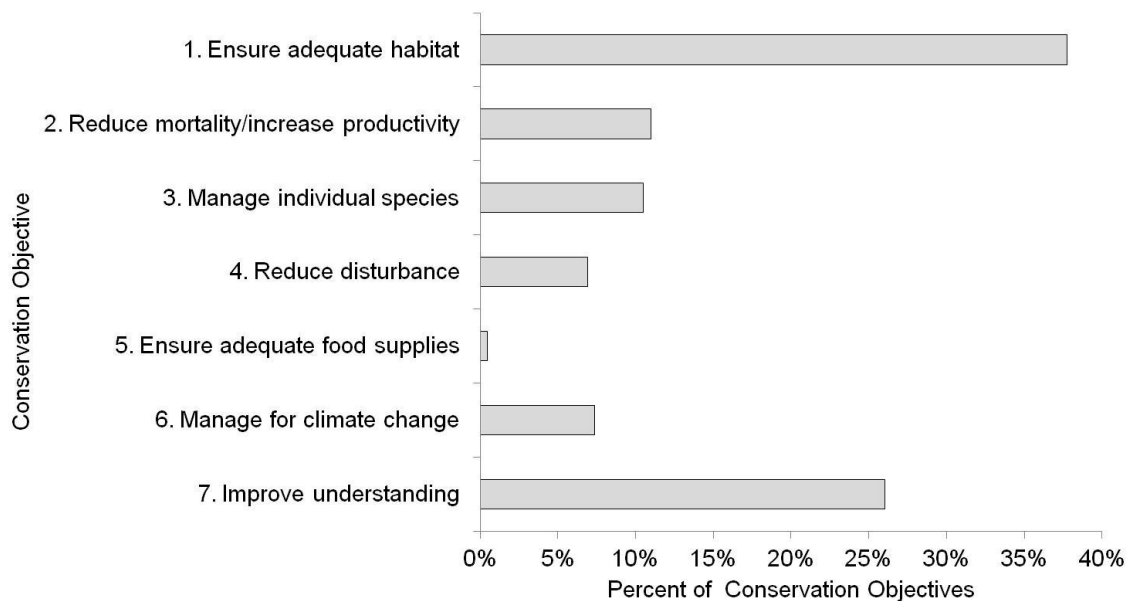


Figure 6. Percent of all conservation objectives assigned to each conservation objective category in BCR 3 PNR.

Element 6: Recommended Actions

Recommended actions indicate on-the-ground activities that will help to achieve the conservation objectives (Fig. 7). Actions are strategic rather than highly detailed and prescriptive (see Appendix 2). Whenever possible, recommended actions benefit multiple species and/or respond to more than one threat. Recommended actions defer to or support those provided in recovery documents for species at risk at the federal, provincial or territorial level, but will usually be more general than those developed for individual species.

The largest proportion of recommended actions for BCR 3 PNR relate to law and policy (sub-categories 5.1 and 5.4), including increasing the enforcement of existing regulations, developing new regulations or beneficial management practices, and strengthening legislation. Actions involving management or protection of sites or habitats were recommended in 21% of cases. Direct management of species was recommended in only 18% of cases, a lower proportion than for some other regions because it would be difficult to achieve on the scale required for such a large and remote area. For some issues, it was determined that additional research or monitoring information was needed in order to devise appropriate conservation actions. Additional detail on suggested conservation actions is provided in subsequent sections.

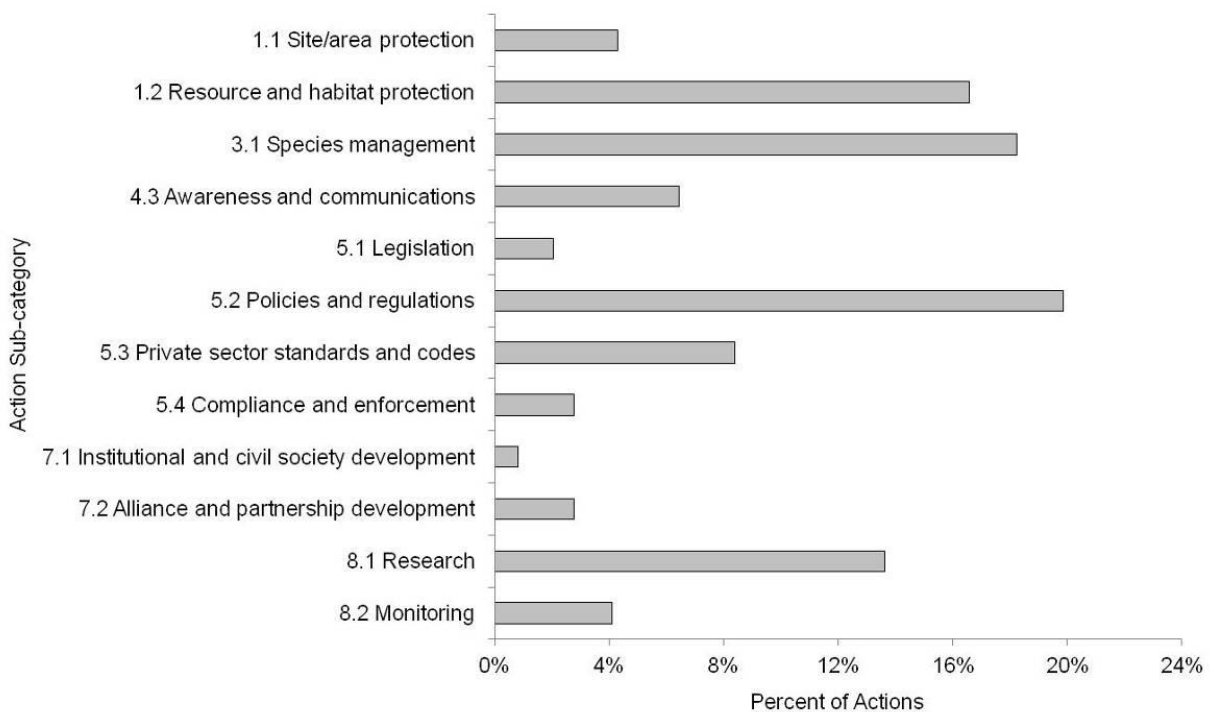


Figure 7. Percent of recommended actions assigned to each sub-category in BCR 3 PNR.

“8.1 Research” and “8.2 Monitoring” refers to cases where additional species-specific information is required. For a discussion of broad-scale research and monitoring requirements, see the section on Research and Population Monitoring Needs.

Section 2: Conservation Needs by Habitat

The following sections provide more detailed information on priority species, their threats and objectives within each of the broad habitat classes that occur in BCR 3 PNR. Where appropriate, habitat information is provided at a finer scale than the broad habitat categories in order to coincide with other land management exercises in the region. Some species do not appear in the threats tables because their low-level threats have not been assigned objectives or actions and/or identified threats are addressed in the Widespread Issues section of the strategy.

Because many of the threats facing birds across Canada are related to loss or degradation of habitat, habitat classes offer a convenient unit of organization for this detailed information. However, some threats influence the survival or fecundity of priority species through non-habitat related mechanisms. When these threats are artificially organized by habitat classes (based on the habitat use of affected species), some duplication necessarily occurs. More general, widespread issues, such as those that stem from climatic change or air-borne pollutants, affect species in many or all habitats. Although these issues are included in the threat “roll-ups” by habitat, the threats, objectives and actions related to them are discussed in the Widespread Issues section.

The habitat classes used below were selected because they offer a consistent classification scheme that can be applied across all BCRs in Canada. However, these categories are in some cases difficult to link to the habitat categories traditionally applied to arctic habitats. Below, we provide some summary statistics for quantities of each habitat type available in the BCR, based on a conversion of the Circumpolar Arctic Vegetation Map (CAVM 2003) to the categories used here. Maps based on the Land Cover Map of Canada are provided to show the extent of each habitat type. Because these two classification schemes differ, and neither is ideally suited to describing the variation in habitats of relevance to birds in the Arctic, these maps and summary statistics should be treated as a guideline only.

In some cases, appropriate conservation actions were difficult to define because of inadequate information on species’ ranges, population status or responses to a threat. These specific information gaps are presented in the tables below, while the more general needs for research, distribution and status monitoring are discussed in a subsequent section of the strategy (see Research and Population Monitoring Needs).

Coniferous

Coniferous habitats are rare in BCR 3 PNR, confined to the southern edge of the planning unit at the interface between the boreal and tundra biomes (Fig. 8). Five priority species are found regularly in this sparsely treed taiga, including the COSEWIC-listed (Special Concern) Rusty Blackbird and four other landbirds (Table 5). Among these, Smith's Longspur and Harris's Sparrow breed primarily in this ecotone, American Tree-Sparrow is more abundant in boreal habitats to the south, and Hoary Redpoll is more abundant in tundra habitats farther north.

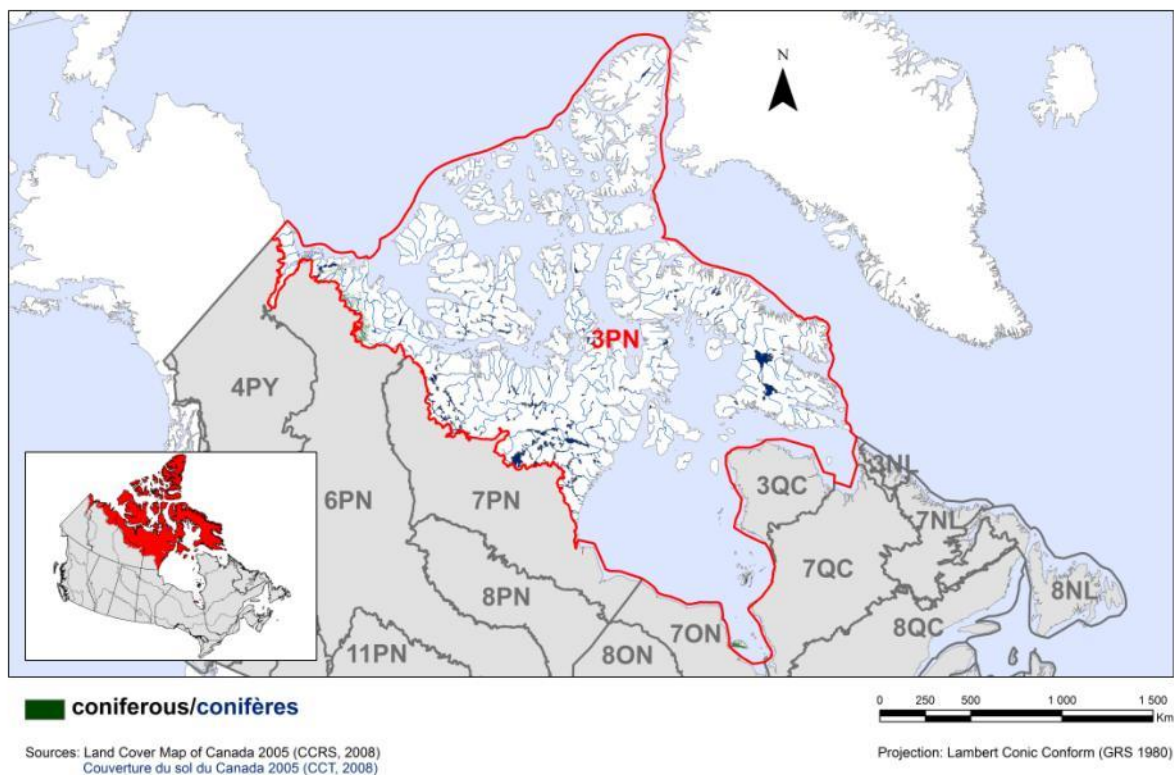


Figure 8. Map of coniferous habitat in BCR 3 PNR.

Threats to species within coniferous habitats were all of a low magnitude, and because the habitat was used by relatively few priority species, overall threat rankings (i.e., “rolled-up”) were low (Fig. 9, Table 4). The threats identified were related to loss and degradation of habitat due to mining, oil and gas extraction, and seismic exploration (threat sub-categories 3.2 and 3.1), and also the impacts of predator populations locally subsidized by development activities (sub-category 8.2). Oil and gas development and exploration in terrestrial habitats of BCR 3 are currently limited in extent, but have been more widespread in the past (see additional details below, in Lichens/Mosses). Because the threats are of low magnitude, no conservation objectives or actions were assigned to priority species in this habitat. An additional widespread issue affecting these species generally is the northward progression of the treeline as a result of a changing climate (sub-category 11.1); this may benefit species using coniferous habitats, have

unknown effects on ecotone obligate species, and adversely affect those inhabiting tundra primarily (see Widespread Issues).

Table 5. Priority species that use coniferous habitats, a description of the habitat used, population objectives and reasons for priority status.

Priority species	Habitat description	Population objective	Reason for priority status				
			At risk	CC	S	NAWMP	Expert review
American Tree Sparrow	Sparse open coniferous forest at treeline	Increase 50%					Yes
Harris's Sparrow	Sparse open coniferous forest at treeline	Increase 100%		Yes	Yes		
Hoary Redpoll	Sparse taiga forest at treeline	Increase 50%			Yes		
Rusty Blackbird	Sparse taiga forest at treeline	Increase 100%	Yes	Yes			
Smith's Longspur	Sparse open forest at treeline	Assess/Maintain		Yes	Yes		

Note: Reasons for inclusion in the priority species list are as follows: At Risk: the species is assessed as either Endangered, Threatened or Special Concern by COSEWIC or listed as such under SARA; CC: the species meets conservation concern criteria for its bird group; S: the species meets stewardship criteria for its bird group; NAWMP: the species has NAWMP priority of Moderately High, High or Highest in the BCR; Expert Review: added to the list following expert review.

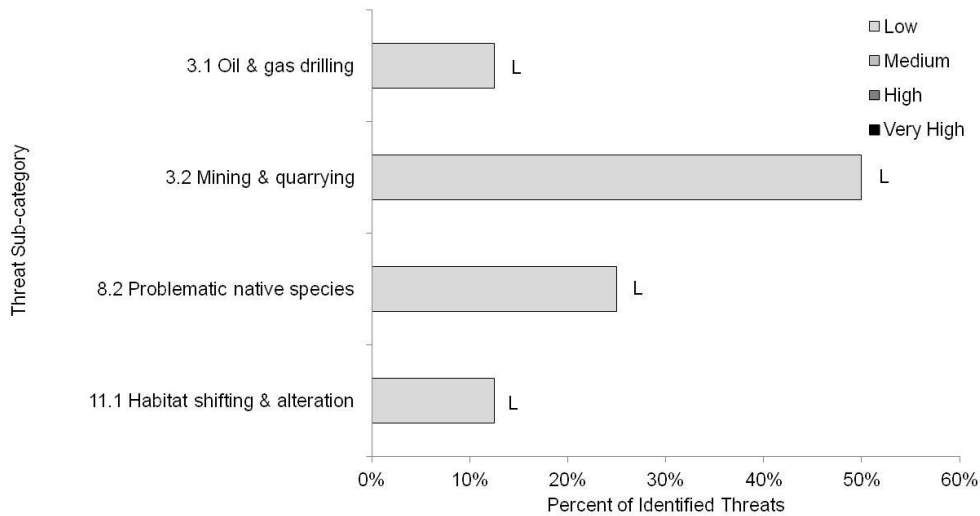


Figure 9. Percent of identified threats to priority species in coniferous habitats in each threat sub-category.

Each bar represents the percent of the total number of threats identified in each threat sub-category in coniferous habitats (for example, if 100 threats were identified in total for all priority species in coniferous habitats, and 10 of those threats were in the category 3.1 Oil & gas drilling, the bar on the graph would represent this as 10%). The bars are divided to show the distribution of Low, Medium, High and Very High rankings of individual threats within each threat sub-category (for example, the same threat may have been ranked H for one species and L for another; the shading illustrates the proportion of rankings in the sub-category). The overall magnitude of the sub-threat in coniferous habitat is shown at the end of each bar (also presented in **Table 4**). **Note:** Threats of all magnitudes are included in this figure, although threats ranked as low were not assigned conservation objectives or recommended actions.

Shrub/Early Successional

The habitats classified as Shrub/Early Successional in BCR 3 PNR vary from heath tundras of the mid- and High Arctic to tall willow thickets of the Low Arctic. Despite the category name, these habitats are climax communities in Arctic regions. Shrub habitats vary in topography from flat to heavily hummocked and are found from sea level to alpine elevations. The majority of the shrub habitat in BCR 3 PNR is of the heath/dwarf shrub variety, accounting for 17% of the terrestrial landcover of the region (based on CAVM 2003). In addition to being widespread, heath/dwarf shrub habitats are also heavily used by priority species; 30 priority species (46%) use these habitats to some degree, including landbirds, shorebirds and waterfowl (Fig. 3, Table 6). An additional 5% of the region is covered with tall shrubs such as erect willows, but these habitats are used by fewer priority species (6 species). Heath shrub habitats are poorly differentiated in our habitat classification; Figure 10 shows the (limited) extent of tall shrubs.

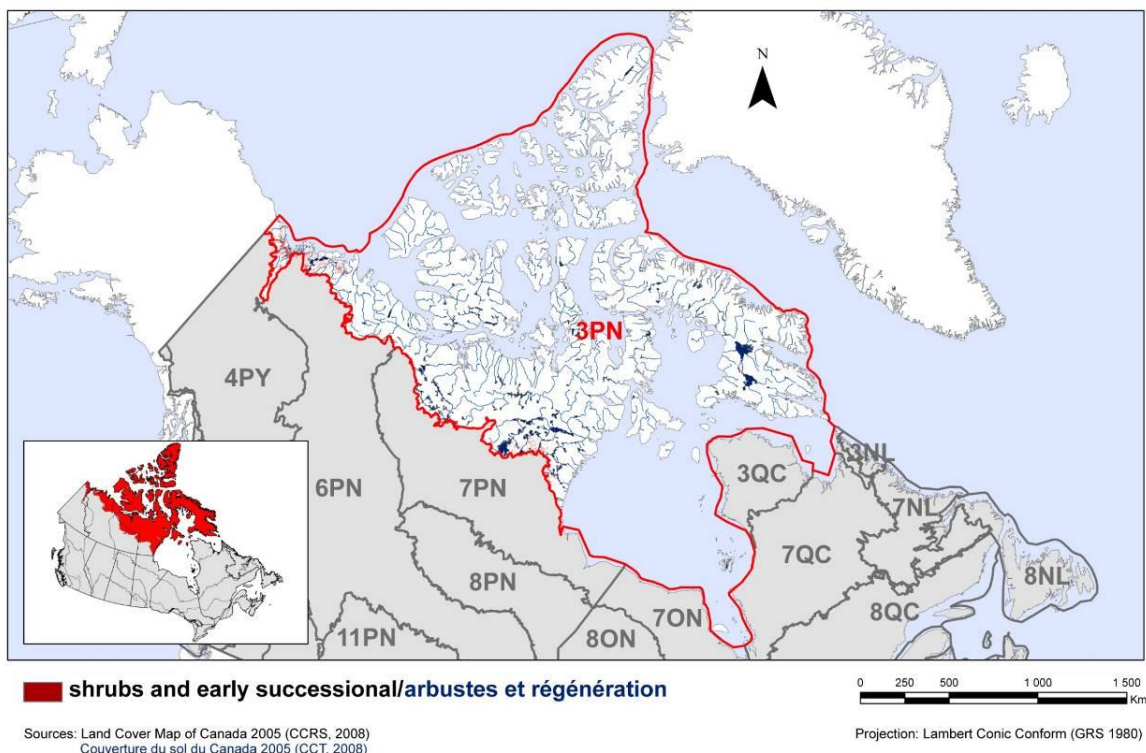


Figure 10. Map of shrub and early successional habitat in BCR 3 PNR.

Importantly, heath habitats are heavily used by several species of geese that are considered to be above their population abundance objectives. These species' heavy grazing and grubbing leads to reduced plant richness and diversity and a more exposed substrate (Alisauskas et al. 2006). For Lesser Snow Geese, breeding in this degraded habitat can lead to reduced gosling size and potentially reduced reproductive success (Pezzanite et al. 2005). Effects of this habitat degradation on other birds are largely unknown. Small-scale and moderate degradation of habitats had variable effects on habitat use by shorebirds (Sammler et al. 2008), but large-scale, severe degradation could lead to reduced shorebird densities and reduced foraging success. A reduced sward height may make the nests and chicks of small birds more visible to avian and

mammalian predators (Klima and Jehl 1998). Although effects of this overgrazing are most pronounced in wetlands (see below), other tundra habitats including shrub habitats are also impacted.

High goose abundance was considered to be a high-magnitude threat for the goose populations themselves, and a low-magnitude threat for the large number of other species potentially affected. Within shrub habitats (and rolled-up across all habitats), this threat was ranked as high magnitude (threat sub-category 8.2 Fig. 11, Table 4). Several low magnitude threats from mining, oil and gas development, and subsistence harvest (sub-categories 3.2, 3.1, and 5.1) also affected priority species in this habitat. Priority species in shrub habitats may also be affected by widespread issues including climate-related habitat change (sub-category 11.1) and atmospheric deposition of pollutants (sub-category 9.5); these are discussed in the Widespread Issues section.

The conservation actions recommended for shrub habitats focus heavily on information needs (Table 7). At present, the carrying capacity for arctic goose breeding areas has not been established (Arctic Goose Joint Venture Technical Committee 2008). Moreover, population objectives for waterfowl are currently based only on desirable levels for the waterfowl themselves, and are not modified to ensure that the full diversity of tundra nesting species is conserved. The waterfowl conservation community is currently working to address this by developing population objectives that better accommodate all species (NAWMP 2012).

Table 6. Priority species that use shrub and early successional habitats, a description of the habitat used, population objectives and reasons for priority status.

Priority species	Habitat description	Population objective	Reason for priority status				
			At risk	CC	S	NAWMP	Expert review
American Golden-Plover	Drier upland tundra, especially heath with exposed substrate	Assess/Maintain		Yes			
American Pipit	Heath tundra; mixed upland tundra	Maintain current					Yes
American Tree Sparrow	Willow, alder and birch thickets in wet areas; open shrub tundra	Increase 50%					Yes
Bluethroat	Low shrub tundra	Assess/Maintain					Yes
Buff-breasted Sandpiper	Upland tundra with <i>Dryas</i> heath; dry sedge and shrub tundra	Increase 50%		Yes			
Cackling Goose (Shortgrass Prairie)	Dwarf willow habitats	Increase 50%				Yes	
Cackling Goose (Tallgrass Prairie)	Dwarf willow habitats	Maintain current				Yes	
Canada Goose (Atlantic)	Dwarf willow habitats	Maintain current				Yes	
Eastern Yellow Wagtail	Low shrub tundra	Assess/Maintain					Yes
Eskimo Curlew	Heath tundra	Recovery objective	Yes	Yes			
Golden Eagle	Shrub tundra in rugged terrain	Increase 50%					
Greater Snow Goose	Dry hummocky tundra with dwarf willow	Decrease				Yes	
Greater White-fronted Goose	Dwarf shrub tundra; medium height shrub tundra; heath tundra	Maintain current				Yes	
Gyrfalcon	Shrub tundra in rugged terrain	Assess/Maintain			Yes		
Harris's Sparrow	Dwarf birch/willow shrublands	Increase 100%		Yes	Yes		
Hoary Redpoll	Open willow and alder shrub tundra near treeline; dry heath with dwarf shrub	Increase 50%			Yes		
Lapland Longspur	Hummocky heath tundra	Assess/Maintain			Yes		
Least Sandpiper	Dry tussock-heath tundra	Increase 100%		Yes			
Lesser Snow Goose (Mid-Continent)	Sparse medium high shrubs	Decrease				Yes	

Table 6 continued

Priority species	Habitat description	Population objective	Reason for priority status				
			At risk	CC	S	NAWMP	Expert review
Peregrine Falcon (<i>anatum/tundrius</i>)	Shrub tundra in rugged terrain	Assess/Maintain	Yes		Yes		
Purple Sandpiper	Upland heath tundra	Assess/Maintain					Yes
Red Knot (<i>islandica</i>)	Upland dwarf shrub/heath tundra	Assess/Maintain	Yes	Yes			
Red Knot (<i>rufa</i>)	Upland dwarf shrub/heath tundra	Increase 100%	Yes	Yes			
Rock Ptarmigan	Hummocky heath tundra; dry upland tundra with dwarf shrubs and lichens	Assess/Maintain			Yes		
Ross's Goose	Heath/dwarf shrub tundra	Decrease				Yes	
Ruddy Turnstone	Sparsely vegetated tundra habitats along coasts; well drained, well vegetated (e.g. Dryas) tundra near moist areas	Assess/Maintain		Yes			
Rusty Blackbird	Open willow and alder shrub tundra near treeline	Increase 100%	Yes	Yes			
Sanderling	Upland dwarf shrub/heath tundra	Assess/Maintain		Yes			
Semipalmated Sandpiper	Dry sedge and shrub tundra	Increase 100%		Yes			
Short-eared Owl	Dwarf shrub heath	Increase 100%	Yes	Yes			
Smith's Longspur	Shrub tundra	Assess/Maintain		Yes	Yes		
Snowy Owl	Hummocky heath/shrub tundra; dry upland tundra	Maintain current			Yes		
Stilt Sandpiper	Drier willow tundra	Increase 100%		Yes			
Surfbird	High-altitude dwarf shrub tundra	Assess/Maintain		Yes			

Note: Reasons for inclusion in the priority species list are as follows: At Risk: the species is assessed as either Endangered, Threatened or Special Concern by COSEWIC or listed as such under SARA; CC: the species meets conservation concern criteria for its bird group; S: the species meets stewardship criteria for its bird group; NAWMP: the species has NAWMP priority of Moderately High, High or Highest in the BCR; Expert Review: added to the list following expert review.

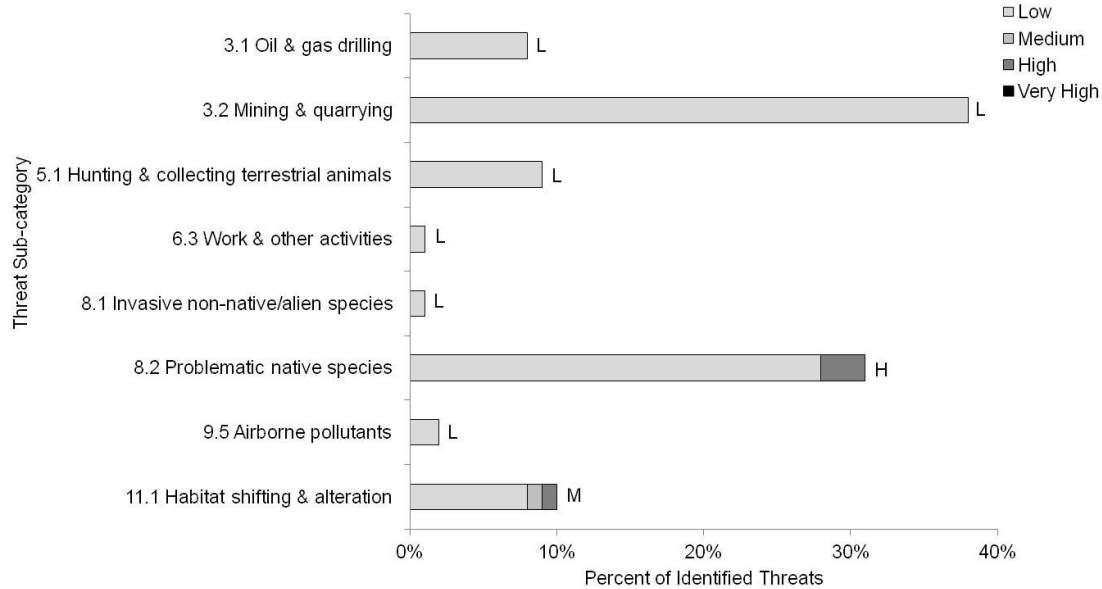


Figure 11. Percent of identified threats to priority species in shrub and early successional habitats in each threat sub-category.

Each bar represents the percent of the total number of threats identified in each threat sub-category in coniferous habitats (for example, if 100 threats were identified in total for all priority species in coniferous habitats, and 10 of those threats were in the category 3.1 Oil & gas drilling, the bar on the graph would represent this as 10%). The bars are divided to show the distribution of Low, Medium, High and Very High rankings of individual threats within each threat sub-category (for example, the same threat may have been ranked H for one species and L for another; the shading illustrates the proportion of rankings in the sub-category). The overall magnitude of the sub-threat in coniferous habitat is shown at the end of each bar (also presented in Table 4).

Note: Threats of all magnitudes are included in this figure, although threats ranked as low were not assigned conservation objectives or recommended actions.

Table 7. Threats addressed, conservation objectives, recommended actions and priority species affected for shrub and early successional habitats in BCR 3 PNR.

Threats addressed	Threat category	Objectives	Objective category	Recommended actions	Action category	Priority species affected [†]
Abundant arctic geese are degrading their breeding, foraging, moulting, and staging habitats, with negative effects on their own populations and those of species that share their habitats	8.2 Problematic native species	For goose populations that are above their objectives, return populations to levels allowing the recovery of tundra habitats to pre-disturbance conditions	3.2 Reduce competition with problematic native species	Consider efforts in addition to existing conservation harvests and increased bag limits to reduce goose populations to NAWMP objectives.	3.1 Species management	Greater Snow Goose, Lesser Snow Goose (Mid-Continent), Ross's Goose
				Develop new population objectives that are sustainable and limit degradation of tundra habitats.	8.1 Research	
Northward progression of treeline, encroachment of shrubs and drying of moist tundra will impact birds inhabiting the tundra/taiga interface	11.1 Habitat shifting & alteration	Incorporate scenarios of global climate change into management	6.3 Manage populations for resilience to increased mortality from climate change	Work with territorial partners to develop a long-term protected areas strategy that recognises ongoing and future changes in habitats	1.1 Site/area protection	Cackling Goose (Shortgrass Prairie), Snowy Owl
Shallow tundra wetlands, a preferred foraging habitat, will be affected by deepening active layer and changing precipitation regime. Coastal inundation from sea level rise may flood coastal habitats				Develop quantitative models of predicted habitat change and consequences on the species, and incorporate into management plans	8.1 Research	
				Determine relevance of established protected areas to priority species under scenarios of predicted change	3.1 Species management	

[†] Priority species not mentioned in the table are absent for one of the following reasons: 1) no identified threats in this habitat, or 2) identified threats in this habitat are of low magnitude.

Herbaceous

The habitats classified as herbaceous in BCR 3 PNR include well-drained meadows of sedges and grasses in coastal or inland areas, as well as some well-vegetated upland habitats. Such habitats cover approximately 12% of the land area of BCR 3 PNR (based on CAVM 2003), and are used by 10 priority species (Table 8). The categories used in the Land Cover Map of Canada do not relate directly to the habitat categories used in the BCR strategies; Figure 12 shows the extent of well-drained grass/sedge habitats, as well as some habitats more accurately described as wetlands and others more accurately described as shrub-dominated (see also Fig. 1).

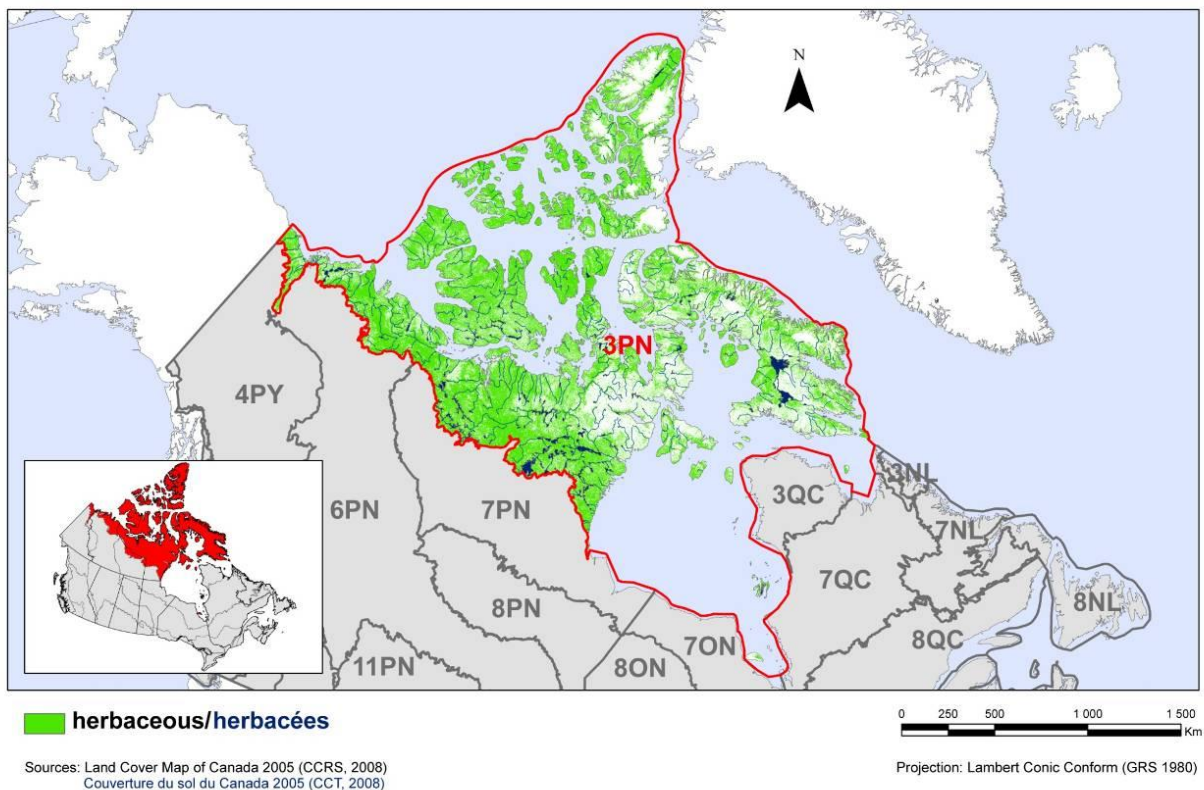


Figure 12. Map of herbaceous habitat in BCR 3 PNR.

Well-drained gramminoid tundra is used extensively by arctic geese as breeding and foraging habitat, including all priority populations of the Snow Goose. As in other habitats used by Snow Geese, intensive grazing and grubbing by these abundant species reduces the quality of the habitat for the geese themselves as well as other priority species. The prevalence of arctic geese in this habitat led to an overall high magnitude of threats in sub-category 8.2 Problematic native species in herbaceous habitats (Fig. 13, Table 4). Priority birds using herbaceous habitats are also threatened by climate change, but this threat is discussed in a subsequent section (see Widespread Issues).

A significant proportion of threats, all of a low magnitude (Table 9), were related to subsistence harvest (sub-category 5.1). Subsistence harvest of waterfowl in BCR 3 PNR is culturally significant, but generally considered to comprise only a small proportion of total harvest. Geese are the most heavily harvested species, and their secure population status suggests that this harvest is sustainable. Thus, harvest constitutes a “threat” insofar as it increases mortality, but it is not a conservation issue requiring intervention. Because of the cultural importance, maintaining these harvest opportunities should continue to be given high priority in species’ management plans. Levels of subsistence harvest across much of BCR 3 PNR have been estimated through hunter surveys and other means (e.g., Nunavut Wildlife Management Board 2004), but improved knowledge of harvest levels would allow it to be more formally incorporated into management plans than it is at present (AGJV 2008).

Ptarmigan are harvested so extensively that they have been nearly extirpated near some communities (Montgomerie and Holder 2008) however, the subsistence harvest of ptarmigan is assumed to be sustainable at the population level. Similarly, Arctic Terns frequently nest in grass or moss tundra, and subsistence harvest of their eggs may be significant near communities (M. Mallory pers. comm., Forbes et al. 1992, Gilchrist and Robertson 1999), though population level effects are assumed to be low. Disturbance from ecotourists, egg and down collectors (sub-category 6.1), and researchers (sub-category 6.3) was also found to be potentially affecting priority species in herbaceous habitats, but as for many threats, effects at the population level are likely small.

Table 8. Priority species that use herbaceous habitats, a description of the habitat used, population objectives and reasons for priority status.

Priority species	Habitat description	Population objective	Reason for priority status				
			At Risk	CC	S	NAWMP	Expert review
Arctic Tern	Open grassy/peaty moss tundra	Increase 50%		Yes			
Brant (Eastern High Arctic)	Sedge meadows, in coastal or inland areas	Maintain current				Yes	
Brant (Western High Arctic)	Sedge meadows, in coastal or inland areas	Assess/Maintain				Yes	
Greater Snow Goose	Gently rolling sedge/grass tundra, well inland	Decrease				Yes	
Lapland Longspur	Dry grassland tundra	Assess/Maintain			Yes		
Lesser Snow Goose (Mid-Continent)	Closed short grassland	Decrease				Yes	
Lesser Snow Goose (Western Arctic)	Inland, well-drained sedge/grass tundra	Decrease				Yes	
Lesser Snow Goose (Western Central Flyway)	Inland, well-drained sedge/grass tundra	Maintain current				Yes	
Rock Ptarmigan	Herbaceous tundra	Assess/Maintain			Yes		
Short-eared Owl	Dry grassland tundra	Increase 100%	Yes	Yes			

Note: Reasons for inclusion in the priority species list are as follows: At Risk: the species is assessed as either Endangered, Threatened or Special Concern by COSEWIC or listed as such under SARA; CC: the species meets conservation concern criteria for its bird group; S: the species meets stewardship criteria for its bird group; NAWMP: the species has NAWMP priority of Moderately High, High or Highest in the BCR; Expert Review: added to the list following expert review.

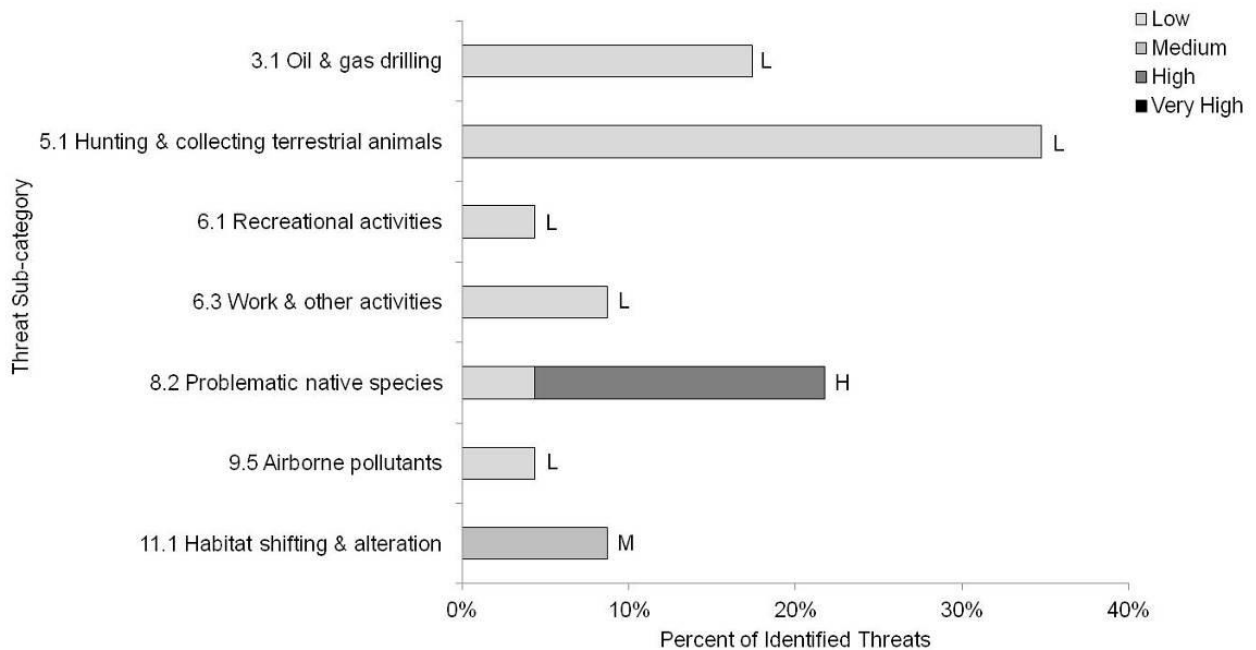


Figure 13. Percent of identified threats to priority species in herbaceous habitats in each threat sub-category.

Each bar represents the percent of the total number of threats identified in each threat sub-category in coniferous habitats (for example, if 100 threats were identified in total for all priority species in coniferous habitats, and 10 of those threats were in the category 3.1 Oil & gas drilling, the bar on the graph would represent this as 10%). The bars are divided to show the distribution of Low, Medium, High and Very High rankings of individual threats within each threat sub-category (for example, the same threat may have been ranked H for one species and L for another; the shading illustrates the proportion of rankings in the sub-category). The overall magnitude of the sub-threat in coniferous habitat is shown at the end of each bar (also presented in Table 4).

Note: Threats of all magnitudes are included in this figure, although threats ranked as low were not assigned conservation objectives or recommended actions.

Table 9. Threats addressed, conservation objectives, recommended actions and priority species affected for herbaceous habitats in BCR 3 PNR.

Threats addressed	Threat category	Objectives	Objective category	Recommended actions	Action category	Priority species affected [†]
Abundant arctic geese are degrading their breeding, foraging, moulting, and staging habitats, with negative effects on their own populations and those of species that share their habitats	8.2 Problematic native species	For goose populations that are above their objectives, return populations to levels allowing the recovery of tundra habitats to pre-disturbance condition	3.2 Reduce competition with problematic native species	Consider efforts in addition to existing conservation harvests and increased bag limits to reduce goose populations to NAWMP objectives	3.1 Species management	Greater Snow Goose, Lesser Snow Goose (Mid-Continent), Lesser Snow Goose (Western Central Flyway), Lesser Snow Goose (Western Arctic)
				Develop new population objectives that are sustainable and limit degradation of tundra habitats	8.1 Research	
Shallow tundra wetlands, a preferred foraging habitat, will be affected by deepening active layer and changing precipitation regime. Coastal inundation from sea level rise may flood coastal habitats	11.1 Habitat shifting & alteration	Incorporate scenarios of global climate change into management	6.3 Manage populations for resilience to increased mortality from climate change	Develop a long-term protected areas strategy that recognizes ongoing and future changes in habitats	1.1 Site/area protection	Brant (Eastern High Arctic), Brant (Western High Arctic)
				Determine relevance of established protected areas to priority species under scenarios of predicted change	3.1 Species management	
				Develop quantitative models of predicted habitat change and consequences on the species, and incorporate into management plans	8.1 Research	

[†] Priority species not mentioned in the table are absent because there are no identified threats in this habitat.

Lichens/Mosses

Lichens, mosses and cryptobiotic crust are common groundcovers in arctic areas. Habitats assigned to the lichens/mosses class were varied, ranging from moist, moss islets in coastal wetlands, to dry cryptogam tundra, far inland. These habitat types amount to approximately 17% of the land cover of the region (Fig. 14). Thirteen priority species use lichen/moss habitats extensively, with representatives from all four bird groups (Table 10).

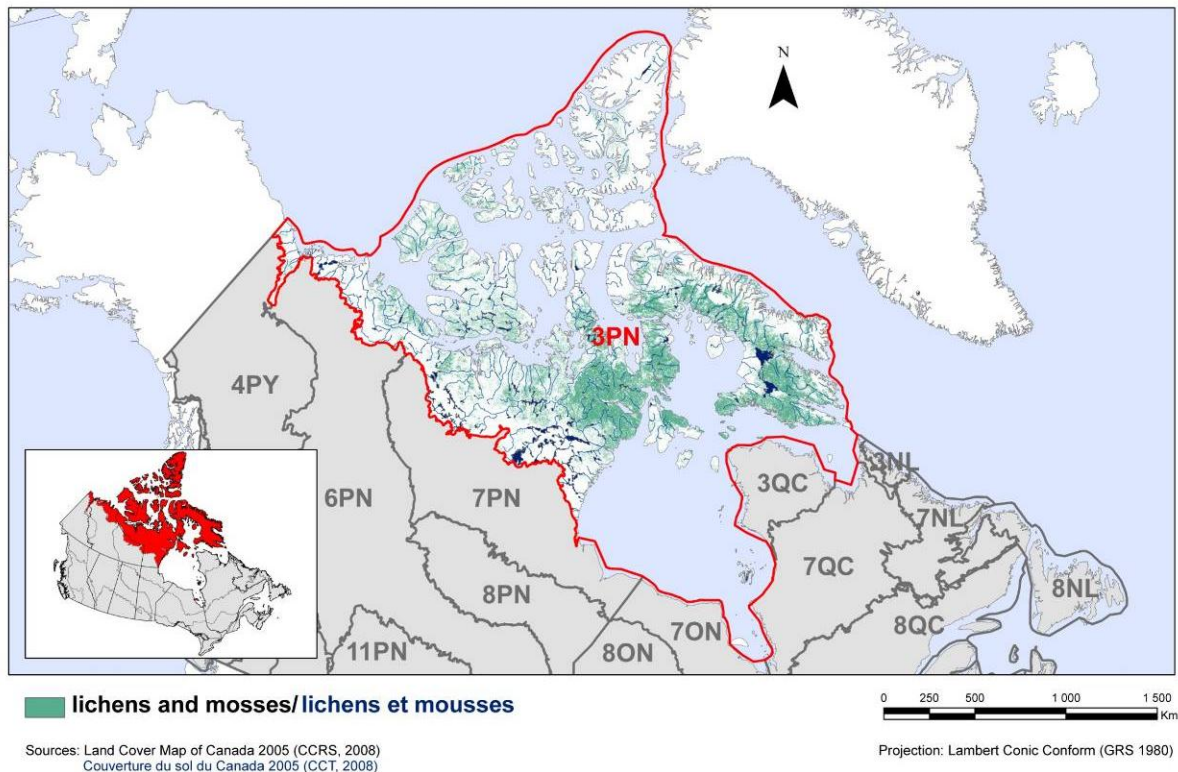


Figure 14. Map of lichen and moss habitat in BCR 3 PNR.

Threats to priority species in this habitat (Fig. 15) were largely shared with those encountered in other habitats, including abundant geese (threat sub-category 8.2; Table 11) and several low-magnitude threats from mining (sub-category 3.2) and oil and gas development (sub-category 3.1). Open pit mining and associated infrastructure leads to a direct loss of habitat. Habitat could also be degraded by road dust and disturbance, but one study in N.W.T., Canada, documents few negative effects within 1 km of the mine footprint (Smith et al. 2005). The potential effects of climate change are addressed in the Widespread Issues section.

Terrestrial oil and gas activities such as seismic exploration still degrade moist moss habitats, despite technological advancements in recent decades (Kemper and Macdonald 2009, Jorgensen et al. 2010). In addition to these direct effects, development can lead to locally enriched populations of predators, indirectly impacting priority birds breeding in the area (Day

1998, Liebezeit et al. 2009). Terrestrial oil and gas development in BCR 3 PNR has been limited in extent to a few areas including the Mackenzie Delta and the Sverdrup Basin. Significant deposits underlay other parts of the Arctic (Beauregard-Tellier 2008), and if an economically viable means of transporting these resources to market materializes, development could increase dramatically. At present, however, the threat from terrestrial oil and gas development is of a low magnitude at the BCR scale.

Table 10. Priority species that use lichen and moss habitats, a description of the habitat used, population objectives and reasons for priority status.

Priority species	Habitat description	Population objective	Reason for priority status				
			At risk	CC	S	NAWMP	Expert review
American Golden-Plover	Mixed moist tundra habitats	Assess/Maintain		Yes			
American Pipit	Lichen/cryptogam tundra	Maintain current					Yes
Black-bellied Plover	Dry tundra with exposed substrate and lichens (cryptogamic crust)	Increase 100%		Yes			
Common Eider (<i>borealis</i>)	Islets in ponds or lakes	Increase 50%				Yes	
Common Eider (<i>sedentaria</i>)	Islets in ponds or lakes	Increase 50%				Yes	
Common Eider (<i>v-nigra</i>)	Islets in ponds or lakes	Increase 50%				Yes	
Hoary Redpoll	Barren inland rocky areas with scattered lichens and vegetation	Increase 50%			Yes		
Purple Sandpiper	Rocky lichen barrens	Assess/Maintain					Yes
Rock Ptarmigan	Sparse, rocky upland tundra	Assess/Maintain			Yes		
Ross's Goose	Upland tundra of lichens and mosses	Decrease				Yes	
Ross's Gull	Gravel reefs with or without moss	Recovery objective	Yes	Yes			
Surfbird	Rocky high-altitude tundra	Assess/Maintain		Yes			
Whimbrel	Dry upland tundra with heath and cryptogamic crust	Assess/Maintain		Yes			

Note: Reasons for inclusion in the priority species list are as follows: At Risk: the species is assessed as either Endangered, Threatened or Special Concern by COSEWIC or listed as such under SARA; CC: the species meets conservation concern criteria for its bird group; S: the species meets stewardship criteria for its bird group; NAWMP: the species has NAWMP priority of Moderately High, High or Highest in the BCR; Expert Review: added to the list following expert review.

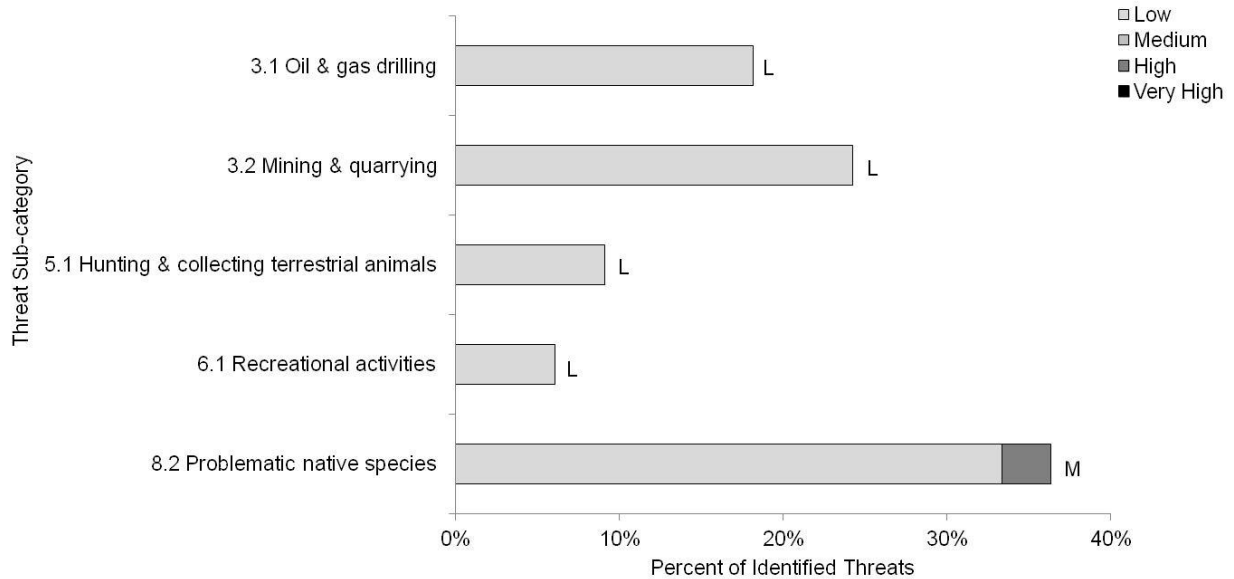


Figure 15. Percent of identified threats to priority species in lichen and moss habitats in each threat sub-category.

Each bar represents the percent of the total number of threats identified in each threat sub-category in coniferous habitats (for example, if 100 threats were identified in total for all priority species in coniferous habitats, and 10 of those threats were in the category 3.1 Oil & gas drilling, the bar on the graph would represent this as 10%). The bars are divided to show the distribution of Low, Medium, High and Very High rankings of individual threats within each threat sub-category (for example, the same threat may have been ranked H for one species and L for another; the shading illustrates the proportion of rankings in the sub-category). The overall magnitude of the sub-threat in coniferous habitat is shown at the end of each bar (also presented in Table 4).

Note: Threats of all magnitudes are included in this figure, although threats ranked as low were not assigned conservation objectives or recommended actions.

Table 11. Threats addressed, conservation objectives, recommended actions and priority species affected for lichen and moss habitats in BCR 3 PNR.

Threats addressed	Threat category	Objectives	Objective category	Recommended actions	Action category	Priority species affected [†]
Abundant arctic geese are degrading their breeding, foraging, moulting, and staging habitats, with negative effects on their own populations and those of species that share their habitats	8.2 Problematic native species	For goose populations that are above their objectives, return populations to levels allowing the recovery of tundra habitats to pre-disturbance conditions	3.2 Reduce competition with problematic native species	Consider efforts in addition to existing conservation harvests and increased bag limits to reduce goose populations to NAWMP objectives.	3.1 Species management	Ross's Goose
				Develop new population objectives that are sustainable and limit degradation of tundra habitats	8.1 Research	

[†] Priority species not mentioned in the table are absent because 1) there are no identified threats in this habitat, or 2) identified threats in this habitat are of low magnitude.

Bare Areas

The category “bare areas” encompasses all terrestrial habitats that are devoid of vegetation. A majority of the bare areas used by priority birds are coastal (including mudflats and rocky habitats), sandy beaches and marine islets. However, some bare inland habitats are also included, such as the gravel barrens used by Sanderlings, inland cliffs used by nesting raptors, and the rocky prominences surrounded by glaciers (“nunataks”) used by nesting Ivory Gulls. Because of this diversity, habitats classified as bare areas are used by a large number of species; 31 priority species (48%), representing all bird groups, use some type of bare habitat for breeding or foraging (Table 12). Satellite data in the Circumpolar Arctic Vegetation Map (CAVM 2003) suggest that bare areas account for approximately 19% of the landcover of the region (Fig. 1), but the Land Cover Map of Canada under-represents this extent (Fig. 16).

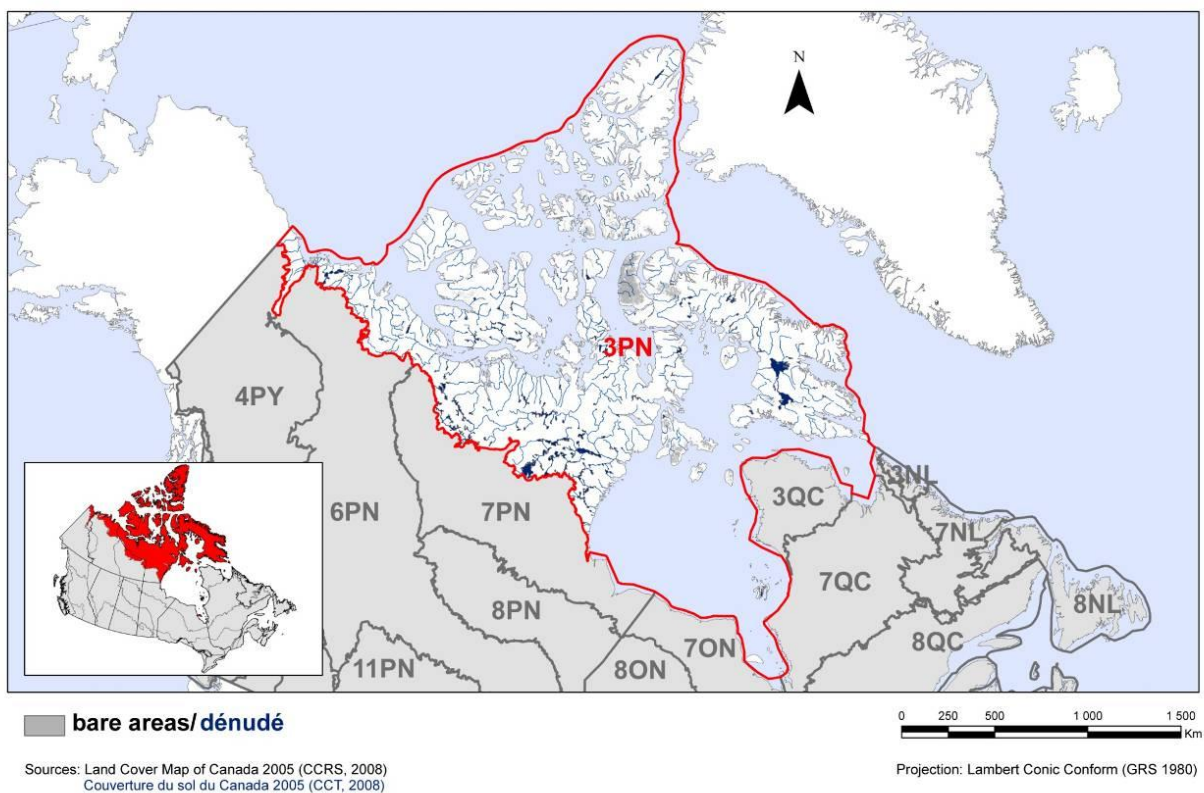


Figure 16. Map of bare habitat in BCR 3 PNR.

Threats facing priority birds in bare habitats are diverse (Fig. 17; Table 13). Several low-magnitude threats from mining and oil and gas development (threat sub-categories 3.1 and 3.2) are shared with other habitats and have been described previously. The range of the Common Ringed Plover in Canada is small, yet it overlaps with a significant proposed mine development at Mary River, Baffin Island. Two species using bare habitats (Ivory Gull and Gyrfalcon) are known to be affected by low-level over-flights that may be associated with resource exploration or environmental surveys and research (sub-category 6.3; Platt 1977, Haney and MacDonald 1995). Similarly, disturbance from aircraft, boats and humans at bird colonies (sub-category 6.1)

can have significant impacts on reproductive success by causing eggs or chicks to fall from breeding ledges (for example, in the case of Thick-billed Murres; Curry and Murphy 1995, Gaston and Hipfner 2000), or leave eggs vulnerable to predators when parents temporarily desert their nests (for example, in the case of eiders and Brant). Disturbance from researchers (sub-category 6.3) may also affect priority bird species, but in all cases, the population-level effects of these disturbances are assumed to be low. Two important threats to species using this habitat, deposition of airborne contaminants (sub-category 9.5) and climate change (sub-category 11.1), are discussed in a subsequent section (see Widespread Issues).

The Pacific Common Eider faces a potential threat of very high magnitude: accidental oil discharge in its Western Arctic breeding and staging grounds (sub-category 9.2). High concentrations of nesting Pacific Eiders are found on several islands in the western Beaufort Sea, where oil and gas development is ongoing (Sea Duck Joint Venture 2003). Staging eiders congregate in flocks of tens of thousands in the Southeast Beaufort, where oil development may soon increase. The species is especially vulnerable while foraging at sea (see Widespread Issues), but accidental oil spills and pollution of coastal habitats could be catastrophic for the species if key nesting or staging areas are affected (Goudie et al. 2000, Dickson and Gilchrist 2002).

Table 12. Priority species that use bare areas, a description of the habitat used, population objectives and reasons for priority status.

Priority species	Habitat description	Population objective	Reason for priority status				
			At risk	CC	S	NAWMP	Expert review
Arctic Tern	Rocky/gravel coastal habitats with little to no vegetation	Increase 50%		Yes			
Brant (Atlantic)	Rocky habitats near high tide line	Maintain current				Yes	
Brant (Eastern High Arctic)	Rocky offshore islands	Maintain current				Yes	
Brant (Western High Arctic)	Rocky offshore islands	Assess/Maintain				Yes	
Cackling Goose (Shortgrass Prairie)	Intertidal mudflats	Increase 50%				Yes	
Cackling Goose (Tallgrass Prairie)	Intertidal mudflats	Maintain current				Yes	
Canada Goose (Atlantic)	Intertidal mudflats	Maintain current				Yes	

Table 12 continued

Priority species	Habitat description	Population objective	Reason for priority status				
			At risk	CC	S	NAWMP	Expert review
Common Eider (<i>borealis</i>)	Small, well drained marine islands; rocky coastal habitats	Increase 50%				Yes	
Common Eider (<i>sedentaria</i>)	Small, well drained marine islands; rocky coastal habitats	Increase 50%				Yes	
Common Eider (<i>v-nigra</i>)	Small, well drained marine islands; rocky coastal habitats	Increase 50%				Yes	
Common Ringed Plover	Sandy or gravel beaches; rocky coastal habitats	Assess/Maintain					Yes
Dunlin	Saline coastal mudflats	Assess/Maintain		Yes			
Eskimo Curlew	Intertidal mudflats	Recovery objective	Yes	Yes			
Golden Eagle	Coastal and inland cliffs; sandy bluffs and river valleys	Increase 50%					
Gyr Falcon	Coastal and inland cliffs; sandy bluffs and river valleys	Assess/Maintain			Yes		
Harlequin Duck (Eastern)	Coastal habitats	Maintain current	Yes			Yes	
Hudsonian Godwit	Coastal mudflats	Increase 100%					Yes
Ivory Gull	Nunataks; flat gravel areas	Recovery objective	Yes	Yes			
Peregrine Falcon (<i>anatum/tundrius</i>)	Coastal and inland cliffs	Assess/Maintain	Yes		Yes		
Purple Sandpiper	Rocky intertidal habitats; coastal mudflats	Assess/Maintain					Yes
Red Knot (<i>islandica</i>)	Sparsely vegetated rock/gravel barrens	Assess/Maintain	Yes	Yes			
Red Knot (<i>rufa</i>)	Sparsely vegetated beach ridges; rock/gravel barrens; intertidal mudflats	Increase 100%	Yes	Yes			
Ross's Goose	Exposed rocky tundra	Decrease				Yes	
Rough-legged Hawk	Coastal and inland cliffs; sandy bluffs and river valleys	Assess/Maintain			Yes		
Sanderling	Sparsely vegetated beach ridges; rock/gravel barrens; intertidal flats	Assess/Maintain		Yes			
Semipalmated Sandpiper	Sparsely vegetated intertidal habitats	Increase 100%		Yes			
Snow Bunting	Rocky patches and boulder scree, near well vegetated areas for foraging; among rocks at seabird colonies	Assess/Maintain			Yes		

Table 12 continued

Priority species	Habitat description	Population objective	Reason for priority status				
			At risk	CC	S	NAWMP	Expert review
Surfbird	Rocky coastal habitats	Assess/Maintain		Yes			
Thayer's Gull	Coastal cliffs with ledges, typically facing sea but also inland; isolated rock islets	Assess/Maintain		Yes			
Thick-billed Murre	Coastal cliffs with ledges, typically bare rock but also exposed peat and grass	Maintain current		Yes			
Whimbrel	Coastal mudflats	Assess/Maintain		Yes			

Note: Reasons for inclusion in the priority species list are as follows: At Risk: the species is assessed as either Endangered, Threatened or Special Concern by COSEWIC or listed as such under SARA; CC: the species meets conservation concern criteria for its bird group; S: the species meets stewardship criteria for its bird group; NAWMP: the species has NAWMP priority of Moderately High, High or Highest in the BCR; Expert Review: added to the list following expert review.

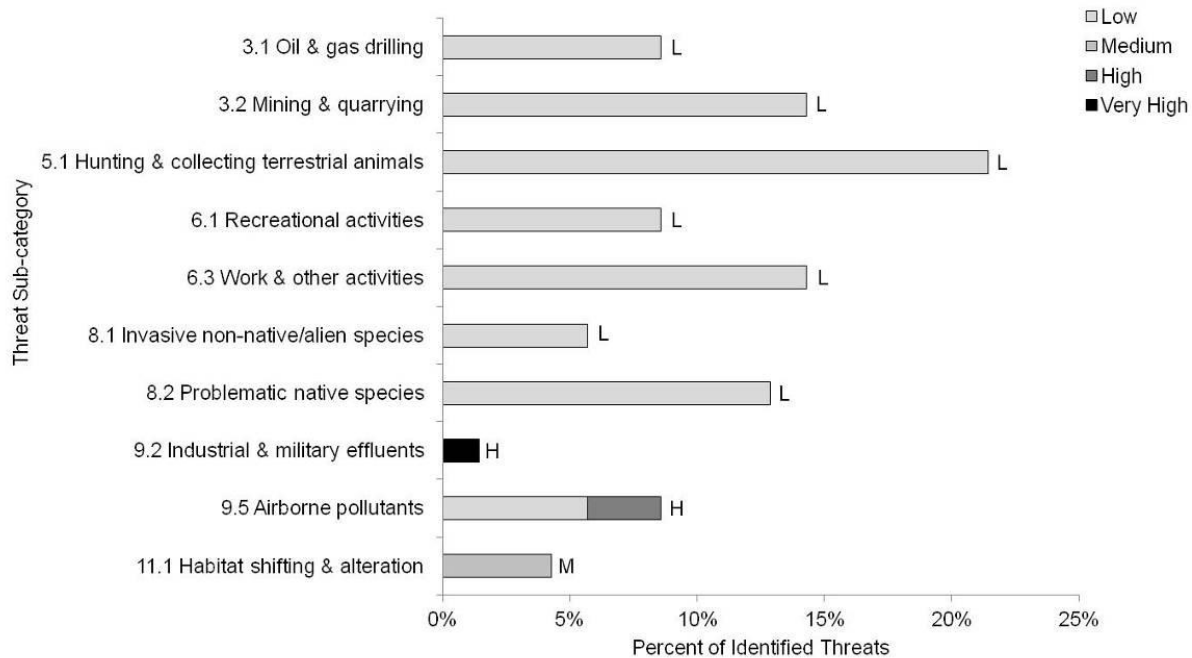


Figure 17. Percent of identified threats to priority species in bare habitats in each threat sub-category.

Each bar represents the percent of the total number of threats identified in each threat sub-category in coniferous habitats (for example, if 100 threats were identified in total for all priority species in coniferous habitats, and 10 of those threats were in the category 3.1 Oil & gas drilling, the bar on the graph would represent this as 10%). The bars are divided to show the distribution of Low, Medium, High and Very High rankings of individual threats within each threat sub-category (for example, the same threat may have been ranked H for one species and L for another; the shading illustrates the proportion of rankings in the sub-category). The overall magnitude of the sub-threat in coniferous habitat is shown at the end of each bar (also presented in Table 4).

Note: Threats of all magnitudes are included in this figure, although threats ranked as low were not assigned conservation objectives or recommended actions.

Table 13. Threats addressed, conservation objectives, recommended actions and priority species affected for bare habitats in BCR 3 PNR.

Threats addressed	Threat category	Objectives	Objective Category	Recommended actions	Action category	Priority species affected [†]
Potential risk of accidental oil pollution	9.2 Industrial & military effluents	Prevent accidental spills	2.3 Reduce mortality and/or sub-lethal effects from oil pollution	Develop proactive regulations to prevent accidental oil spills with consideration of the increased sensitivity of arctic marine ecosystems	5.2 Policies and regulations	Common Eider (<i>v-nigra</i>)
		Increase capacity to respond to accidental spills		Develop oil-spill response infrastructure in areas where it is required	7.1 Institutional and civil society development	
Arctic birds at high trophic levels may be exposed to harmful levels of contaminants including heavy metals, organochlorines and brominated compounds	9.5 Airborne pollutants	Establish levels of exposure and toxicological thresholds for priority species in the Canadian Arctic	7.4 Improve understanding of causes of population declines	Support the Arctic Monitoring and Assessment Program of the Arctic Council	5.1 Legislation	Ivory Gull, Thayer's Gull
		Encourage continued reductions of air-borne pollutants through implementation of international agreements	2.2 Reduce mortality and/or sub-lethal effects from exposure to contaminants	Consider toxicological threshold for birds when identifying new targets for clean air agreements	7.2 Alliance and partnership development	
Shallow tundra wetlands, a preferred foraging habitat, will be affected by deepening active layer and changing precipitation regime. Coastal inundation from sea level rise may flood coastal habitats	11.1 Habitat shifting & alteration	Incorporate scenarios of global climate change into management	6.3 Manage populations for resilience to increased mortality from climate change	Develop a long-term protected areas strategy that recognises ongoing and future changes in habitats	1.1 Site/area protection	Brant (Atlantic), Brant (Eastern High Arctic), Brant (Western High Arctic)
				Determine relevance of established protected areas to priority species under scenarios of predicted change	3.1 Species management	
				Develop quantitative models of predicted habitat change and consequences on the species, and incorporate into management plans	8.1 Research	

[†] Priority species not mentioned in the table are absent for one of the following reasons: 1) no identified threats in this habitat, or 2) identified threats in this habitat are of low magnitude.

Urban and Artificial Surfaces

Urban areas and other human-made structures are classified as “urban and artificial surfaces”. The footprint of human development is extremely small in BCR 3 PNR relative to other BCRs (Fig. 18), and only five priority species use these artificial habitats regularly (Table 14). Raptors perch on human-made structures, and occasionally nest on human-made towers, buildings and rock faces of mine pits, while Snow Buntings commonly nest under and around buildings.

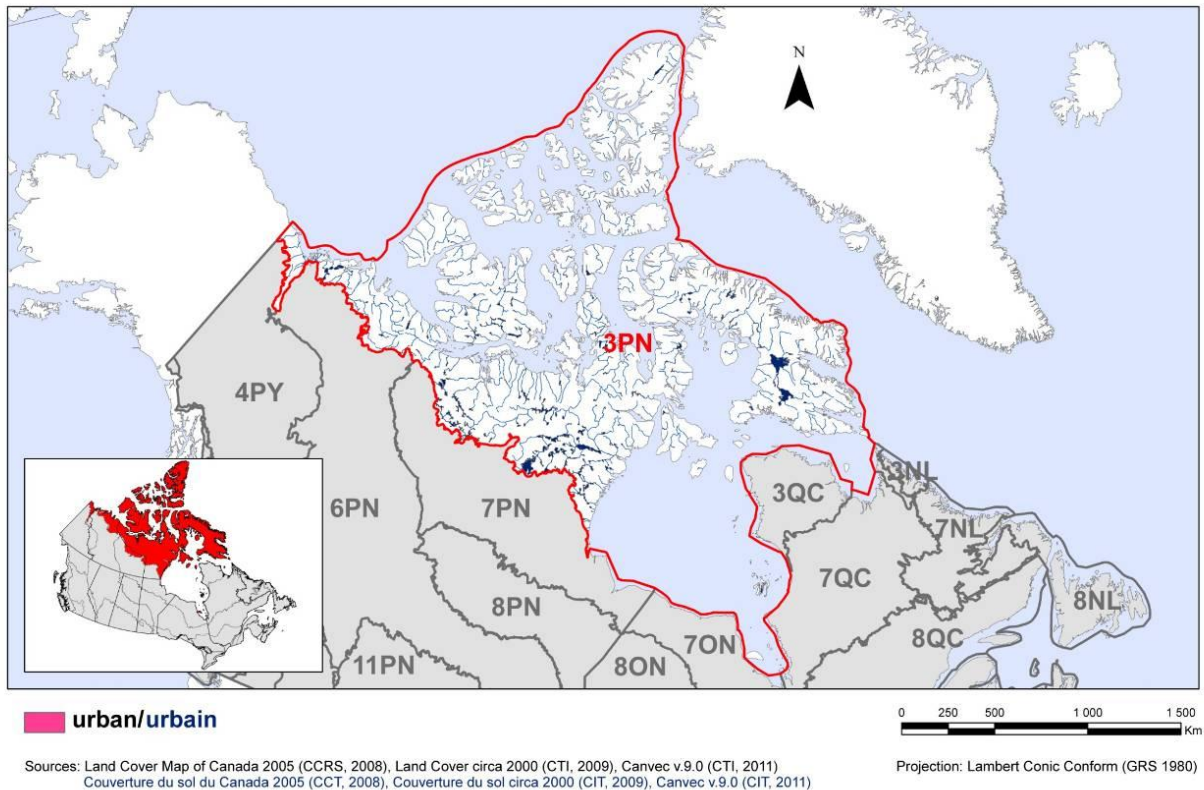


Figure 18. Map of urban and artificial habitat in BCR 3 PNR.

Because of the rarity and scarce use of these artificial habitats, threats to priority species here are all classified as having a low overall magnitude (Fig. 19). Therefore, there are no conservation objectives or recommended actions for threats to priority species in this habitat. When breeding in developed areas, individual birds or nests may be directly harmed by resource extraction activities. The disturbance from mining or oil and gas activity (threat sub-categories 3.2 and 3.1) may also impact individuals, but single, short-term disturbances during incubation or early brood-rearing did not significantly affect nest success, brood size or re-occupancy of the nesting site in the subsequent year for Rough-legged Hawks (Swem 1996). Indeed, birds of prey may benefit from the artificial lighting, food subsidies and nesting substrate offered by oil and gas infrastructure.

The raptors that occur in these urban and artificial habitats are persecuted elsewhere in their range, but it is unlikely that mortality from this source is significant at the population level in BCR 3 PNR. Consequently, no objectives or actions are provided.

Table 14. Priority species that use urban and artificial habitats, a description of the habitat used, population objectives and reasons for priority status.

Priority species	Habitat description	Population objective	Reason for priority status				
			At risk	CC	S	NAWMP	Expert review
Golden Eagle	Human-made structures (rarely)	Increase 50%					
Gyr Falcon	Human-made structures (rarely)	Assess/Maintain			Yes		
Peregrine Falcon (<i>anatum/tundrius</i>)	Human-made structures (rarely)	Assess/Maintain	Yes		Yes		
Rough-legged Hawk	Human-made structures (rarely)	Assess/Maintain			Yes		
Snow Bunting	Human-made structures	Assess/Maintain			Yes		

Note: Reasons for inclusion in the priority species list are as follows: At Risk: the species is assessed as either Endangered, Threatened or Special Concern by COSEWIC or listed as such under SARA; CC: the species meets conservation concern criteria for its bird group; S: the species meets stewardship criteria for its bird group; NAWMP: the species has NAWMP priority of Moderately High, High or Highest in the BCR; Expert Review: added to the list following expert review.

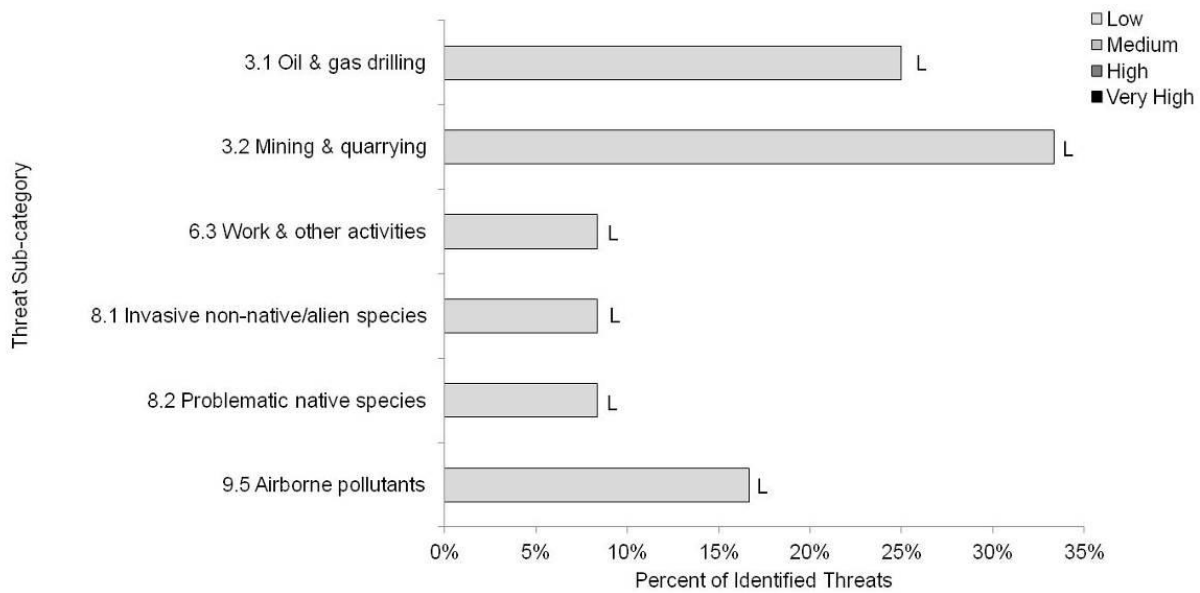


Figure 19. Percent of identified threats to priority species in urban and artificial habitats in each threat sub-category.

Each bar represents the percent of the total number of threats identified in each threat sub-category in coniferous habitats (for example, if 100 threats were identified in total for all priority species in coniferous habitats, and 10 of those threats were in the category 3.1 Oil & gas drilling, the bar on the graph would represent this as 10%). The bars are divided to show the distribution of Low, Medium, High and Very High rankings of individual threats within each threat sub-category (for example, the same threat may have been ranked H for one species and L for another; the shading illustrates the proportion of rankings in the sub-category). The overall magnitude of the sub-threat in coniferous habitat is shown at the end of each bar (also presented in Table 4).

Note: Threats of all magnitudes are included in this figure, although threats ranked as low were not assigned conservation objectives or recommended actions.

Wetlands

Among terrestrial arctic habitats, wetlands host the greatest abundance and diversity of birds. Of our 65 priority species, 47 (72%) use wetland habitats regularly (Table 15), making wetlands the most heavily used habitat type by priority species (Fig. 3). Areas classified as wetlands account for 21% of the BCR (Fig. 20) and include a variety of habitat types. Low-lying areas near the coast are used by numerous species and often feature patterned ground such as strangmoor, polygons and tussocks. Saltmarsh and other wetlands with a marine influence are also key habitats for priority species. Even wetlands far from the coast are used by priority species, including taiga bogs and muskeg.

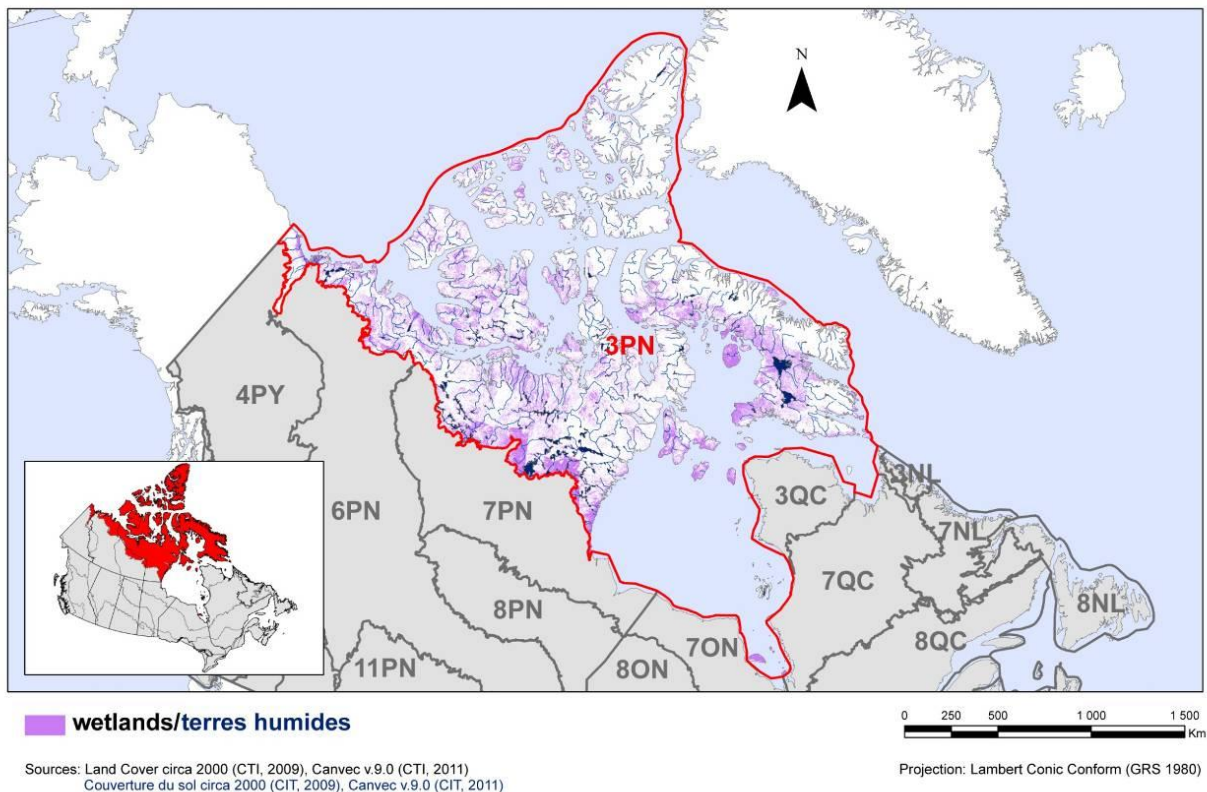


Figure 20. Map of wetland habitat in BCR 3 PNR.

An important threat to these low-lying areas is climatic change (threat sub-category 11.1 in Fig. 21). Shallow tundra wetlands will be affected by a deepening active layer and a changing precipitation regime, and coastal areas will be affected by erosion and inundation due to a rising sea level (ACIA 2005). These and other threats related to climate change are discussed elsewhere in the strategy (see Widespread Issues).

Wetlands are heavily used by arctic geese as breeding, moulting and staging habitat. The adverse effects of their heavy grazing and grubbing (digging with their bills to consume the grasses'

rhizomes) can be pronounced in wetland habitats (see Box 1), and is a significant threat to both the geese themselves and to other species using the wetlands (sub-category 8.2). Staging and breeding areas along the western and southern coasts of Hudson and James Bay are particularly vulnerable and show the greatest degree of degradation (Fig. 22); almost all intertidal marshes in the Hudson Bay lowlands have been severely disturbed by the grubbing, which occurs primarily while geese are staging during the spring migration northward (Abraham and Jefferies 1997, Abraham et al. 2012). Areas around breeding colonies in the Queen Maud Gulf and on Southampton Island also show extensive degradation (Abraham et al. 2012 and references therein), primarily due to overgrazing but also some grubbing. To the north and west, habitat degradation from foraging geese is less pronounced. For example on Banks Island, N.W.T., only the Egg River colony shows significant degradation, and in the High Arctic, habitat degradation is evident near Greater Snow Goose breeding colonies at Bylot Island, Nunavut, but to a lesser extent than for sites farther south (Abraham et al. 2012 and references therein).

Effects of overgrazing and grubbing by geese on other species are not well documented, but the large scale and severe degradation observed in some locations must affect tundra birds generally, and even moderate degradation has been linked to a reduced abundance of shorebirds and landbirds (e.g., Latour et al. 2010). For other birds, an increased presence of geese can lead to reduced vegetative cover for nest concealment, increased exposure to predators (which respond functionally and numerically to the local abundance of geese), and reduced availability of plant and invertebrate forage. Identifying the carrying capacity of these habitats, and managing population sizes of arctic geese for the benefit of all priority birds, is a critical conservation need in wetland habitats (Table 16). This important threat, along with the locally increased populations of predators in the vicinity of resource extraction sites, led to an overall magnitude of "high" for threat sub-category 8.2 (Problematic native species) in wetland habitats.



Box 1. Vegetation that has been protected from grazing and grubbing by geese in the La Pérouse Bay area of Manitoba. This image provides a startling example of the severity of habitat degradation from abundant geese.

Photo © Ken Abraham.

The shallow wetlands of the Arctic are also very sensitive to human-induced disturbance of their hydrological characteristics. Resource development can alter these characteristics in a variety of ways. Oil and gas extraction can lead to subsidence, seismic exploration can lead to channelization and disruption of water flow patterns, and infrastructure and road dust can alter permafrost dynamics (Jorgensen et al. 2010). Despite technological advancements in seismic exploration, these activities continue to degrade tundra habitats (Kemper and Macdonald 2009). These and other secondary effects greatly expand the area impacted by resource extraction activities. Still, as described above, the current extent of terrestrial oil and gas exploration and development in the region is very small. Consequently, threats related to sub-categories 3.1 and 3.2 are considered to be of a low magnitude at the population level.

A large number of species using wetlands are harvested by subsistence hunters (sub-category 5.1), especially waterfowl and ptarmigan. In general, data for rates of subsistence harvest of waterfowl are limited. Geese are the species most heavily harvested by subsistence hunters, and their secure population status suggests that this harvest is sustainable. Subsistence harvest of Tundra Swans in Canada is not adequately monitored, but is believed to be <5000 swans (<5% of population; The Ad Hoc Eastern Population Tundra Swan Committee 2007). Subsistence harvest of Northern Pintail within BCR 3 PNR is assumed to be small (Austin and Miller 1995); fewer than 100 harvested individuals per year was reported from the Inuvialuit Settlement Region (Inuvialuit Harvest Study 2003). Harvest rates of eiders may be more significant. Harvest of adult King Eiders at Holman represents 4–7% of the western subpopulation (Canadian Wildlife Service Waterfowl Committee 2008), and the additional harvest of eggs and down is not monitored. Eiders are an extremely important resource for residents of several other communities, where they may also be harvested in winter at polynyas. Ptarmigan are hunted so extensively that they have been nearly extirpated near some communities (Montgomerie and Holder 2008); however, the subsistence harvest of ptarmigan is assumed to be sustainable at the population level.

Table 15. Priority species that use wetland habitats, a description of the habitat used, population objectives and reasons for priority status.

Priority species	Habitat description	Population objective	Reason for priority status				
			At risk	CC	S	NAWMP	Expert review
American Golden-Plover	Moist grass/sedge meadows	Assess/Maintain		Yes			
Black-bellied Plover	Moist to wet graminoid tundra	Increase 100%		Yes			
Bluethroat	Wet tundra meadows	Assess/Maintain					Yes
Brant (Atlantic)	Sedge meadows in coastal areas; coastal saltmarsh	Maintain current				Yes	
Brant (Black)	Sedge meadows in coastal areas; coastal saltmarsh	Maintain current				Yes	
Buff-breasted Sandpiper	Moist grass/sedge meadows; strangmoor	Increase 50%		Yes			
Cackling Goose (Shortgrass Prairie)	Lowland sedge/grass marshes; coastal saltmarsh	Increase 50%				Yes	
Cackling Goose (Tallgrass Prairie)	Lowland sedge/grass marshes; coastal saltmarsh	Maintain current				Yes	
Canada Goose (Atlantic)	Lowland sedge/grass marshes; coastal saltmarsh	Maintain current				Yes	
Dunlin	Polygon tundra/strangmoor; low, wet graminoid tundra	Assess/Maintain		Yes			
Eastern Yellow Wagtail	Wet tundra meadows	Assess/Maintain					Yes
Eskimo Curlew	Sedge/grass meadows with birch	Recovery objective	Yes	Yes			
Golden Eagle	Moist, flat sedge/grass tundra	Increase 50%					
Greater Snow Goose	Wet moss/grass polygon tundra	Decrease				Yes	
Greater White-fronted Goose	Lowland tundra, sedge/moss meadows; polygon tundra/strangmoor; taiga bogs at treeline	Maintain current				Yes	
Gyr Falcon	Moist, flat sedge/grass tundra	Assess/Maintain			Yes		
Harris's Sparrow	Wet grass/sedge meadows	Increase 100%		Yes	Yes		
Hudsonian Godwit	Wet grass and sedge meadows; muskeg habitats at treeline; mixed dwarf or medium height shrub tundra with sedge and grass	Increase 100%					Yes
King Eider	Grass and sedge meadows	Increase 50%				Yes	

Table 15 continued

Priority species	Habitat description	Population objective	Reason for priority status				
			At risk	CC	S	NAWMP	Expert review
Lapland Longspur	flat to hummocked wet sedge/grass meadows	Assess/Maintain			Yes		
Least Sandpiper	Moist sedge/grass tundra	Increase 100%		Yes			
Lesser Snow Goose (Mid-Continent)	Wet, low-lying coastal tundra with abundant ponds; tidal marshes	Decrease				Yes	
Lesser Snow Goose (Western Arctic)	Wet, low-lying coastal tundra with abundant ponds; saltmarsh	Decrease				Yes	
Lesser Snow Goose (Western Central Flyway)	Wet, low-lying coastal tundra with abundant ponds; saltmarsh	Maintain current				Yes	
Long-tailed Duck	Edges of ponds with emergent vegetation, shallow wetlands	Increase 50%				Yes	
Northern Pintail	Meadows of wet sedge and grass; edges of ponds with emergent vegetation; shallow wetlands	Increase 50%				Yes	
Pacific Loon	Wet mossy shorelines	Assess/Maintain		Yes			
Peregrine Falcon (<i>anatum/tundrius</i>)	Moist, flat, sedge/grass tundra	Assess/Maintain	Yes		Yes		
Purple Sandpiper	Wet polygon tundra	Assess/Maintain					Yes
Red Knot (<i>islandica</i>)	Sparse marshy tundra	Assess/Maintain	Yes	Yes			
Red Knot (<i>rufa</i>)	Lush coastal marsh tundra	Increase 100%	Yes	Yes			
Red Phalarope	Low, wet graminoid tundra	Increase 50%		Yes			
Red-necked Phalarope	Low-centre polygon tundra; low, wet graminoid tundra	Increase 100%		Yes			
Rock Ptarmigan	Moist sedge/grass tundra	Assess/Maintain			Yes		
Ross's Goose	Wet meadows; sedge marsh tundra	Decrease				Yes	
Ross's Gull	Sedge tussocks in wet moss habitats with small pools	Recovery objective	Yes	Yes			
Rough-legged Hawk	Moist, flat sedge/grass tundra	Assess/Maintain			Yes		
Sanderling	Lush coastal marsh tundra	Assess/Maintain		Yes			
Semipalmated Sandpiper	Moist sedge/grass and heath tundra	Increase 100%		Yes			

Table 15 continued

Priority species	Habitat description	Population objective	Reason for priority status				
			At risk	CC	S	NAWMP	Expert review
Short-eared Owl	Moist coastal grasslands	Increase 100%	Yes	Yes			
Smith's Longspur	Wet grass/sedge meadows	Assess/Maintain		Yes	Yes		
Snow Bunting	Wet sedge/grass meadows	Assess/Maintain			Yes		
Snowy Owl	Lowland wet meadows	Maintain current			Yes		
Stilt Sandpiper	Wet to moist sedge-tundra meadows; strangmoor	Increase 100%		Yes			
Tundra Swan (Eastern)	Low, wet coastal meadows/marshes, including delta areas and polygon tundra	Maintain current				Yes	
Whimbrel	Wet grass and sedge meadows; muskeg habitats at treeline; mixed dwarf shrub tundra with sedge and grass	Assess/Maintain		Yes			
Yellow-billed Loon	Gently sloping, wet mossy shorelines	Assess/Maintain		Yes			

Note: Reasons for inclusion in the priority species list are as follows: At Risk: the species is assessed as either Endangered, Threatened or Special Concern by COSEWIC or listed as such under SARA; CC: the species meets conservation concern criteria for its bird group; S: the species meets stewardship criteria for its bird group; NAWMP: the species has NAWMP priority of Moderately High, High or Highest in the BCR; Expert Review: added to the list following expert review.

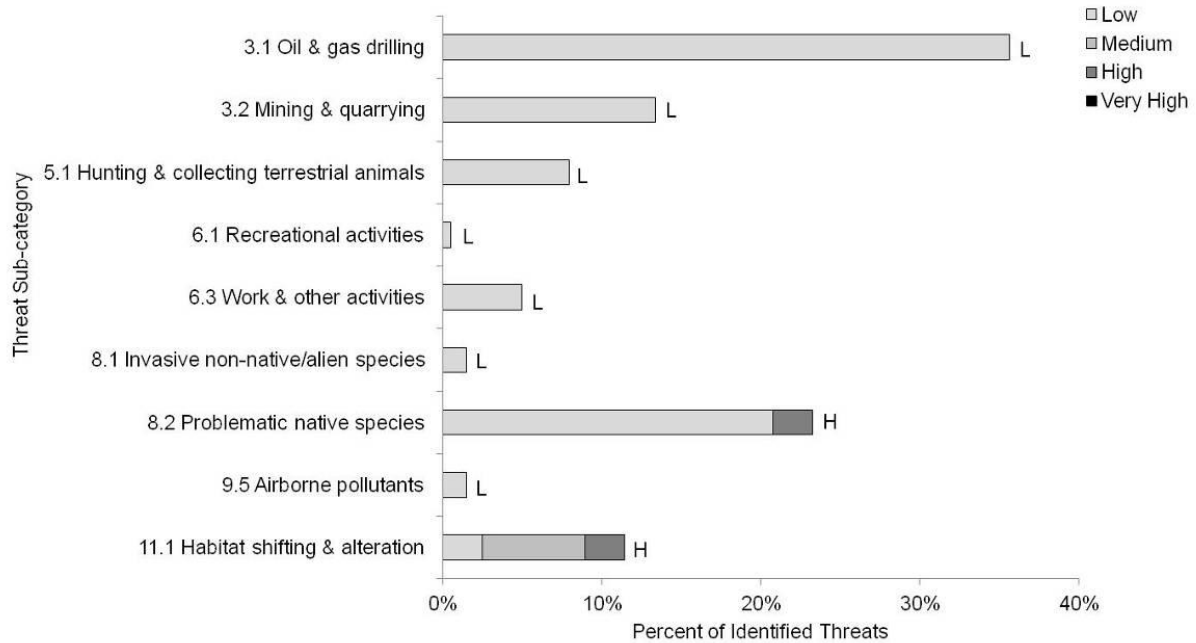


Figure 21. Percent of identified threats to priority species in wetland habitats in each threat sub-category.

Each bar represents the percent of the total number of threats identified in each threat sub-category in coniferous habitats (for example, if 100 threats were identified in total for all priority species in coniferous habitats, and 10 of those threats were in the category 3.1 Oil & gas drilling, the bar on the graph would represent this as 10%). The bars are divided to show the distribution of Low, Medium, High and Very High rankings of individual threats within each threat sub-category (for example, the same threat may have been ranked H for one species and L for another; the shading illustrates the proportion of rankings in the sub-category). The overall magnitude of the sub-threat in coniferous habitat is shown at the end of each bar (also presented in Table 4).

Note: Threats of all magnitudes are included in this figure, although threats ranked as low were not assigned conservation objectives or recommended actions.

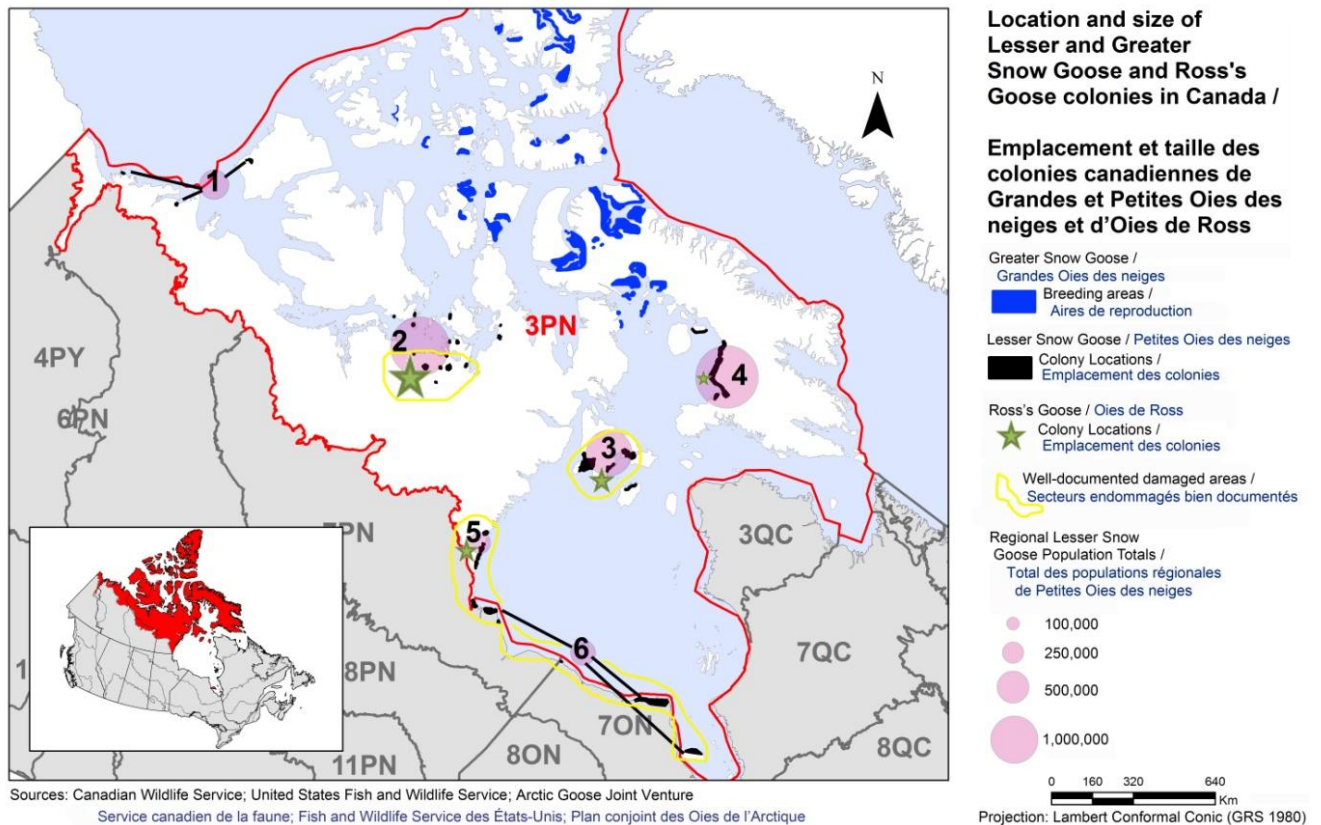


Figure 22. Summary of the breeding distribution of light geese and locations of some areas of well documented habitat degradation.

The size of Lesser Snow Goose colonies was established through aerial photo counts undertaken primarily between 2005 and 2009 (K. Meeres Pers. Comm.), and the colonies displayed here are believed to account for perhaps 25% of the population (J. Leafloor Pers. comm.). Ross's Geese are difficult to distinguish from Lesser Snow Geese where they breed sympatrically; they are most abundant in the Central Arctic but also breed extensively in other locations in recent decades. Greater Snow Geese form looser and smaller breeding aggregations than the other two species (see Batt 1998). They breed extensively across mid- and high-arctic latitudes, with the largest aggregation (circa. 15% of the population) on Bylot Island, NU. Areas encircled in yellow represent areas where habitat degradation is well documented and extensive, including by both heavy grazing and grubbing (the latter especially along the Hudson Bay coast). Although the degradation is less severe, heavy grazing and some exposed substrate occur within most breeding colonies of Lesser Snow and Ross's Geese.

Table 16. Threats addressed, conservation objectives, recommended actions and priority species affected for wetland habitats in BCR 3 PNR.

Threats addressed	Threat category	Objectives	Objective category	Recommended actions	Action category	Priority species affected [†]
Abundant arctic geese are degrading their breeding, foraging, moulting, and staging habitats, with negative effects on their own populations and those of species that share their habitats	8.2 Problematic native species	For goose populations that are above their objectives, return populations to levels allowing the recovery of tundra habitats to pre-disturbance conditions	3.2 Reduce competition with problematic native species	Consider efforts in addition to existing conservation harvests and increased bag limits to reduce goose populations to NAWMP objectives.	3.1 Species management	Greater Snow Goose, Lesser Snow Goose (Mid-Continent), Lesser Snow Goose (Western Central Flyway), Lesser Snow Goose (Western Arctic), Ross's Goose
				Develop new population objectives that are sustainable and limit degradation of tundra habitats	8.1 Research	
Northward progression of treeline, encroachment of shrubs and drying of moist tundra will impact birds inhabiting the tundra/taiga interface	11.1 Habitat shifting & alteration	Incorporate scenarios of global climate change into management	6.3 Manage populations for resilience to increased mortality from climate change	Work with territorial partners to develop a long-term protected areas strategy that recognises ongoing and future changes in habitats	1.1 Site/area protection	Hudsonian Godwit, Least Sandpiper, Snowy Owl, Stilt Sandpiper, Whimbrel
				Determine relevance of established protected areas to priority species under scenarios of predicted change	3.1 Species management	
				Develop quantitative models of predicted habitat change and consequences on the species, and incorporate into management plans	8.1 Research	
Shallow tundra wetlands, a preferred foraging habitat,	11.1 Habitat shifting &	Incorporate scenarios of global climate	6.3 Manage populations for	Work with territorial partners to develop a	1.1 Site/area protection	American Golden-Plover, Black-bellied Plover, Brant (Atlantic),

Table 16 continued

Threats addressed	Threat category	Objectives	Objective category	Recommended actions	Action category	Priority species affected [†]
will be affected by deepening active layer and changing precipitation regime. Coastal inundation from sea level rise may flood coastal habitats	alteration	change into management	resilience to increased mortality from climate change	long-term protected areas strategy that recognises ongoing and future changes in habitats		Brant (Black), Buff-breasted Sandpiper, Cackling Goose (Shortgrass Prairie), Cackling Goose (Tallgrass Prairie), Canada Goose (Atlantic), Dunlin, Red Knot (rufa), Red Phalarope, Red-necked Phalarope, Semipalmated Sandpiper
				Determine relevance of established protected areas to priority species under scenarios of predicted change	3.1 Species management	
				Develop quantitative models of predicted habitat change and consequences on the species, and incorporate into management plans	8.1 Research	

[†] Priority species not mentioned in the table are absent for one of the following reasons: 1) no identified threats in this habitat, 2) identified threats in this habitat are of low magnitude, or 3) identified threats are addressed in the Widespread Issues section.

Waterbodies, Snow and Ice

This habitat category includes a variety of freshwater and marine habitats, such as ponds, lakes, nearshore and pelagic waters, and sea ice. Numerous species of waterbirds, waterfowl and shorebirds nest near ponds or on small islands within them (Table 17). Although the area of these freshwater ponds and lakes in BCR 3 PNR is significant (Fig. 23), the area of the marine ecoregions is vast, extending from James Bay to the North Pole, and Davis Strait to Alaska. During the breeding season, most marine species remain close to land and forage in nearshore waters. Some marine habitats in BCR 3 PNR are used by priority species year-round. Thick-billed Murres may winter offshore in Davis Strait, and a number of seabirds and seabirds spend the winter foraging in polynyas or ice leads.

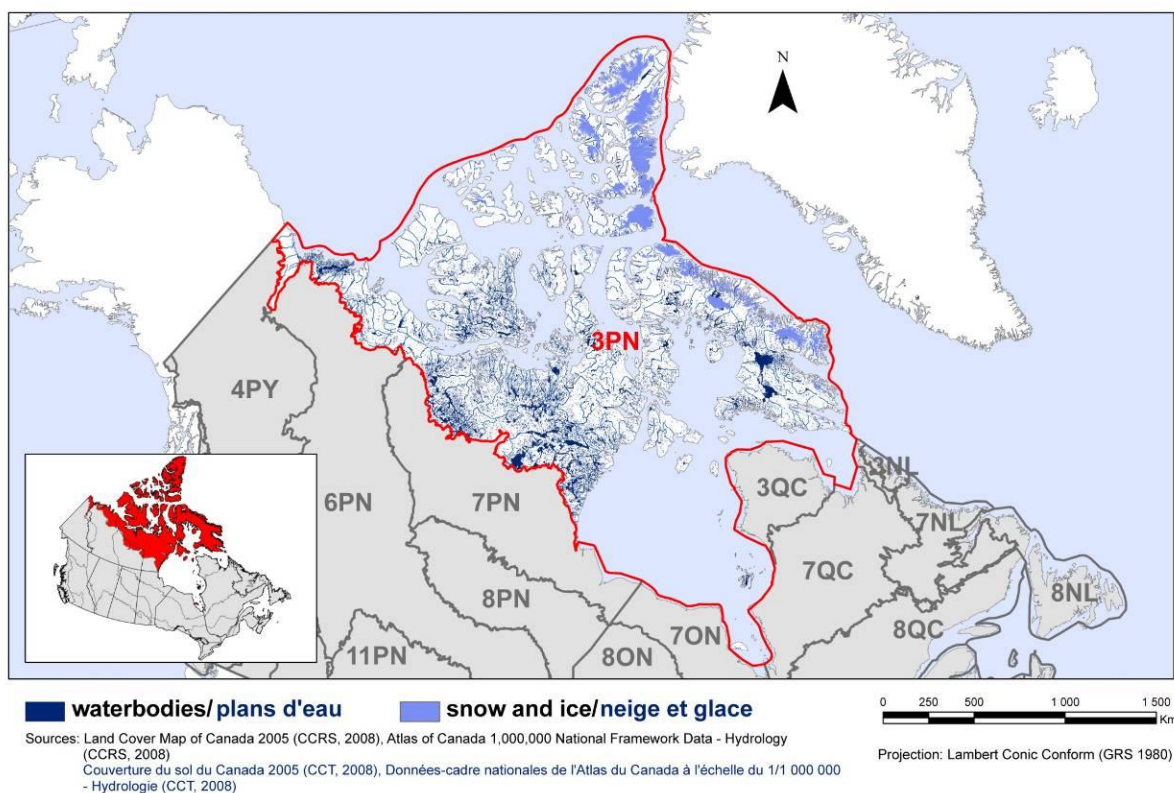


Figure 23. Map of waterbodies, snow and ice habitat in BCR 3 PNR.

Many of the threats to species in freshwater pond/lake habitats are similar to those in the adjacent terrestrial habitats (Table 18). Disruption of permafrost and surface water flow from resource extraction/exploration activities can adversely affect hydrological characteristics of ponds and lakes. Diamond deposits are sometimes underneath shallow lakes, which must be drained to access them. Diamond mining is currently a significant industry at the border of BCR 7 PNR and BCR 3 PNR, and intensive exploration is ongoing across the Slave Geological province, extending well into BCR 3. In the last five years, numerous areas with diamond potential have been discovered in the Eastern Arctic, making BCR 3 PNR the most active area

for kimberlite and diamond discoveries in Canada. Still, a limited footprint of resource extraction/exploration activities in the region means that threat sub-categories 3.1 and 3.2 have a low magnitude overall (Fig. 24).

The threats to priority species in marine habitats are in many cases strictly marine, and as such are restricted to this habitat category. For example, invasive alien species could be introduced into the southeast Beaufort Sea or Hudson Strait through illegal dumping of ballast water from the international barges and ships supporting oil and gas development in the Mackenzie Delta (Environment Canada 2006, sub-category 8.1). Disruption of ice edge and polynya habitats by ice breaking, for example in the Foxe Basin and Hudson Strait in support of mineral development, could also have profound impacts on marine birds should the projects proposed in this area proceed. For example, the movement of Thick-billed Murres from Foxe Basin through Hudson Strait in fall appears to be influenced by the timing of freeze-up, and their return influenced by timing of break-up in spring (Gaston et al. 2012); changes in the availability of open water from ice breaking could alter this pattern with unknown consequences for the birds. Climate change (sub-category 11.1) is also rapidly affecting sea ice habitats in BCR 3 PNR, and is discussed in the Widespread Issues section of the strategy.

Bycatch in commercial and subsistence fisheries is a potential threat to several species (sub-category 5.4). Eiders are known to be susceptible to monofilament gill nets (Goudie et al. 2000), but the rate of bycatch in BCR 3 PNR is unknown. Loons are regularly caught in subsistence fishing nets (Parmelee et al. 1967), but again, quantitative estimates of take are not available. Commercial fisheries in Nunavut are primarily factory-trawls for shrimp and turbot in Baffin Bay and Davis Strait (Government of Nunavut 2005), and trawling results in less severe bycatch of seabirds versus long-lining. Still, as commercial fisheries in Nunavut expand in the future, developing and enforcing regulations to minimise bycatch may significantly benefit priority birds (for recommendations related to long-lining, see FAO 1999).

Among the most significant threats to priority birds in marine habitats are chronic oil pollution and the risk of accidental spills (sub-category 9.2), as well as deposition of air-borne contaminants. These threats are discussed in the Widespread Issues section. An assessment of Canada's ability to respond to oil spills in the Arctic is underway (through the Department of Fisheries and Oceans' [Health of the Oceans](#)). Addressing the deficiencies identified by this process should be a high priority for the relevant federal departments, including Transport Canada, Fisheries and Oceans Canada, and Environment Canada.

Table 17. Priority species that use waterbodies, snow and ice habitats, a description of the habitat used, population objectives and reasons for priority status.

Priority species	Habitat description	Population objective	Reason for priority status				
			At risk	CC	S	NAWMP	Expert review
Arctic Tern	Nearshore and offshore marine waters	Increase 50%		Yes			
Brant (Atlantic)	Inland lakes with islands	Maintain current				Yes	
Brant (Black)	Inland lakes with islands	Maintain current				Yes	
Brant (Eastern High Arctic)	Inland lakes with islands and mossy shorelines	Maintain current				Yes	
Brant (Western High Arctic)	Inland lakes with islands and mossy shorelines	Assess/Maintain				Yes	
Cackling Goose (Shortgrass Prairie)	Ponds with small moss covered islets	Increase 50%				Yes	
Cackling Goose (Tallgrass Prairie)	Ponds with small moss covered islets	Maintain current				Yes	
Canada Goose (Atlantic)	Ponds with small moss covered islets	Maintain current				Yes	
Common Eider (borealis)	Nearshore marine waters	Increase 50%				Yes	
Common Eider (sedentaria)	Nearshore marine waters, polynyas and ice leads	Increase 50%				Yes	
Common Eider (v-nigra)	Nearshore marine waters, polynyas and ice leads	Increase 50%				Yes	
Common Loon	Large lakes with gentle shoreline nest sites, often deep and containing fish; nearshore marine waters	Maintain current		Yes			
Greater Snow Goose	Ponds separated by dry ridges of upland vegetation	Decrease				Yes	
Gyr Falcon	Recurring polynyas and floe edges	Assess/Maintain			Yes		
Harlequin Duck (Eastern)	Riparian habitats near fast flowing streams; nearshore waters for moulting and staging	Maintain current	Yes			Yes	
Ivory Gull	Sea-ice habitats	Recovery objective	Yes	Yes			
King Eider	Shallow ponds with emergent vegetation; nearshore marine waters; sea-ice habitats, polynyas and ice leads	Increase 50%				Yes	

Table 17 continued

Priority species	Habitat description	Population objective	Reason for priority status				
			At risk	CC	S	NAWMP	Expert review
Long-tailed Duck	deep ponds and lakes; nearshore marine waters, recurring polynyas and floe edges	Increase 50%				Yes	
Northern Pintail	Nearshore marine waters	Increase 50%				Yes	
Pacific Loon	Large ponds or lakes with gently sloping shoreline nesting sites; nearshore marine waters	Assess/Maintain		Yes			
Red Phalarope	Coastal waterbodies; continental shelf waters	Increase 50%		Yes			
Red-necked Phalarope	Inshore marine areas; coastal ponds	Increase 100%		Yes			
Ross's Goose	Ponds and lakes (nests on small islands within, moults nearby for safety)	Decrease				Yes	
Snowy Owl	Recurring polynyas and floe edges	Maintain current			Yes		
Thayer's Gull	Coastal marine areas, open water leads and polynyas	Assess/Maintain		Yes			
Thick-billed Murre	Nearshore and pelagic waters	Maintain current		Yes			
Tundra Swan (Eastern)	Ponds/lakes in coastal areas	Maintain current				Yes	
Yellow-billed Loon	Large ponds or lakes (>8 ha.) with gently sloping shoreline nesting sites; nearshore marine waters	Assess/Maintain		Yes			

Note: Reasons for inclusion in the priority species list are as follows: At Risk: the species is assessed as either Endangered, Threatened or Special Concern by COSEWIC or listed as such under SARA; CC: the species meets conservation concern criteria for its bird group; S: the species meets stewardship criteria for its bird group; NAWMP: the species has NAWMP priority of Moderately High, High or Highest in the BCR; Expert Review: added to the list following expert review.

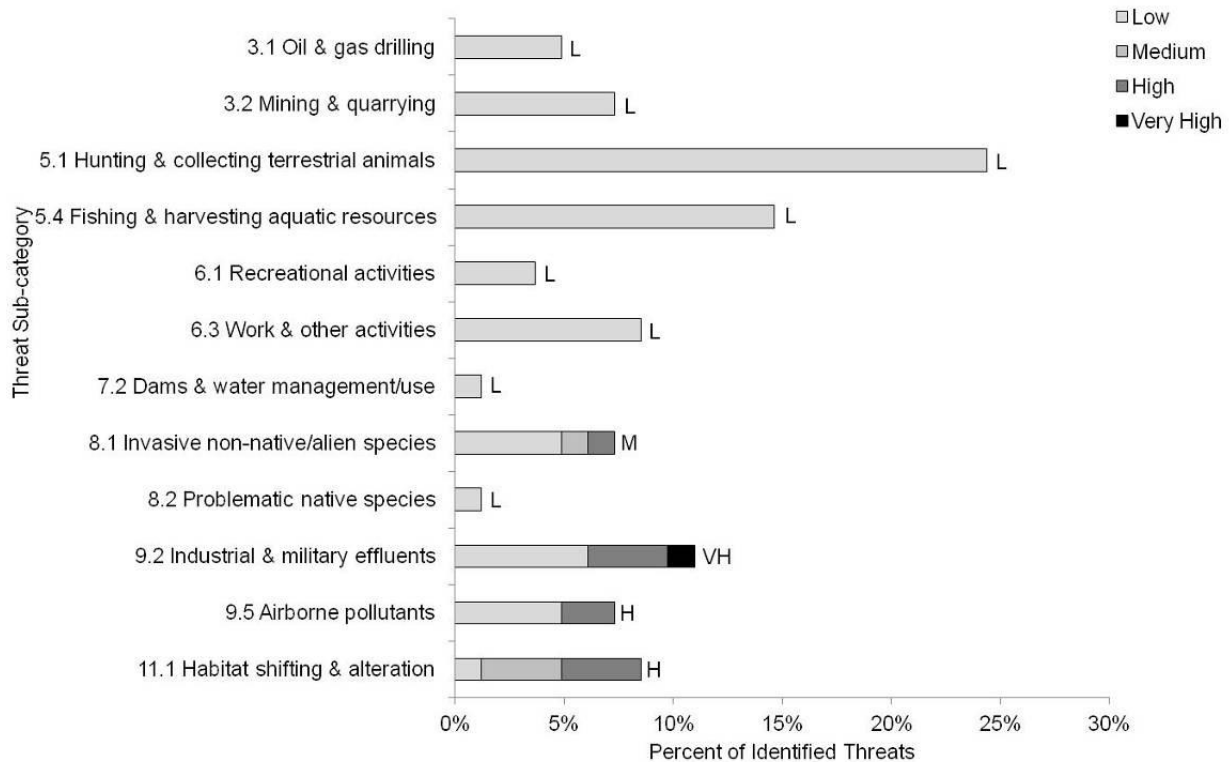


Figure 24. Percent of identified threats to priority species in waterbodies, snow and ice habitats in each threat sub-category.

Each bar represents the percent of the total number of threats identified in each threat sub-category in coniferous habitats (for example, if 100 threats were identified in total for all priority species in coniferous habitats, and 10 of those threats were in the category 3.1 Oil & gas drilling, the bar on the graph would represent this as 10%). The bars are divided to show the distribution of Low, Medium, High and Very High rankings of individual threats within each threat sub-category (for example, the same threat may have been ranked H for one species and L for another; the shading illustrates the proportion of rankings in the sub-category). The overall magnitude of the sub-threat in coniferous habitat is shown at the end of each bar (also presented in Table 4).

Note: Threats of all magnitudes are included in this figure, although threats ranked as low were not assigned conservation objectives or recommended actions.

Table 18. Threats addressed, conservation objectives, recommended actions and priority species affected for waterbodies, snow and ice habitats in BCR 3 PNR.

Threats addressed	Threat category	Objectives	Objective category	Recommended actions	Action category	Priority species affected
Offshore oil and gas development and increased arctic marine shipping increase the risk of invasive species in marine habitats of the Southeast Beaufort Sea, a key staging site for eiders in the Western Arctic	8.1 Invasive non-native/alien species	Prevent release of invasive species into the Beaufort Sea	3.5 Prevent and control the spread of invasive and exotic species	Consider whether current regulations are adequate to prevent release of invasive species through discharge of untreated ballast	5.4 Compliance and enforcement	Common Eider (<i>v-nigra</i>), King Eider
Chronic oil pollution including accumulation of contaminants in benthic invertebrates and other prey items	9.2 Industrial & military effluents	Manage unavoidable sources of chronic oil pollution for the benefit of birds	2.3 Reduce mortality and/or sub-lethal effects from oil pollution	Develop strict policies to limit oil pollution, commensurate with the sensitivity of arctic marine ecosystems	5.2 Policies and regulations	Common Eider (<i>v-nigra</i>)
		Prevent illegal activities that result in chronic oil pollution	2.3 Reduce mortality and/or sub-lethal effects from oil pollution	Continue to enforce regulations prohibiting the dumping of oily wastes	5.4 Compliance and enforcement	
Potential risk of accidental oil pollution	9.2 Industrial & military effluents	Prevent accidental spills	2.3 Reduce mortality and/or sub-lethal effects from oil pollution	Develop proactive regulations to prevent accidental oil spills that consider the increased sensitivity of arctic marine ecosystems	5.2 Policies and regulations	Common Eider (<i>v-nigra</i>), King Eider, Long-tailed Duck
		Increase capacity to respond to accidental spills	2.3 Reduce mortality and/or sub-lethal effects from oil pollution	Develop oil-spill response infrastructure in areas where it is required	7.1 Institutional and civil society development	
Arctic birds at high trophic levels may be exposed to harmful levels of contaminants including heavy metals, organochlorines and brominated compounds	9.5 Airborne pollutants	Encourage continued reductions of air-borne pollutants through implementation of international agreements	2.2 Reduce mortality and/or sub-lethal effects from exposure to contaminants	Consider toxicological threshold for birds when identifying new targets for clean air agreements	5.1 Legislation	Ivory Gull, Thayer's Gull

Table 18 continued

Threats addressed	Threat category	Objectives	Objective category	Recommended actions	Action category	Priority species affected
		Establish levels of exposure and toxicological thresholds for priority species in the Canadian Arctic	7.4 Improve understanding of causes of population declines	Support the Arctic Monitoring and Assessment Program of the Arctic Council	7.2 Alliance and partnership development	
Changing ice conditions in the Arctic affect birds that depend on sea ice habitats in general, and polynyas/flow leads in particular	11.1 Habitat shifting & alteration	Incorporate scenarios of global climate change into management	6.3 Manage populations for resilience to increased mortality from climate change	Manage harvest or other sources of mortality appropriately in light of predicted habitat changes	3.1 Species management	Common Eider (<i>sedentaria</i>), Common Eider (<i>v-nigra</i>), Ivory Gull, Thick-billed Murre
				Develop quantitative models of predicted habitat change and consequences on the species, and incorporate into management plans	8.1 Research	
Shallow tundra wetlands, a preferred foraging habitat, will be affected by deepening active layer and changing precipitation regime. Coastal inundation from sea level rise may flood coastal habitats.	11.1 Habitat shifting & alteration	Incorporate scenarios of global climate change into management	6.3 Manage populations for resilience to increased mortality from climate change	Develop a long-term protected areas strategy that recognises ongoing and future changes in habitats	1.1 Site/area protection	
				Determine relevance of established protected areas to priority species under scenarios of predicted change	3.1 Species management	Cackling Goose (Shortgrass Prairie), Canada Goose (Atlantic)
				Develop quantitative models of predicted habitat change and consequences on the species, and incorporate into management plans	8.1 Research	

† Priority species not mentioned in the table are absent for one of the following reasons: 1) no identified threats in this habitat, or 2) identified threats in this habitat are of low magnitude.

Section 3: Additional Issues

Widespread Issues

Some well-known conservation issues may not be identified in the literature as significant threats to populations of an individual priority species and therefore may not be captured in the threat assessment. However, these issues, while they may or may not be limiting factors for any individual species or population, contribute to avian mortality or decreases in fecundity across many species and thus warrant conservation attention. Usually these issues transcend habitat types and are considered “widespread”. Examples of these issues include:

- Predation by domestic cats
- Collisions with human-made structures (buildings, cars, utility/telecommunications towers and lines, etc.)
- Pollution/pesticides/oil spills
- Climate change

Because the widespread issues do not fit well into the standard presentation format used in the BCR strategies, they are presented separately here. The mortality estimates included here are largely based on draft reports that were available within Environment Canada when this strategy was produced; the numbers may change as the final scientific papers are peer-reviewed and published. Human-related avian mortality across all sectors was standardized and compared in Calvert et al. 2013.

Some of the widespread issues occurring elsewhere in the country are not a significant source of mortality for the birds of BCR 3 PNR. For example, predation by domestic cats is among the most significant sources of landbird mortality in heavily populated regions, resulting in the death of 100–350 million birds annually in Canada (Blancher 2013), but is a trivial source of mortality in BCR 3 PNR. Similarly, mortality from birds striking the windows of houses and other buildings must certainly occur in BCR 3, but only a small number of priority landbirds are susceptible, and the population-level effects of this mortality are likely negligible. Collisions with communications towers and vehicles might affect a greater diversity of species, but vehicles are restricted to the widely scattered communities, and estimates suggest that mortality at the few communications towers should be small (Longcore et al. 2012). In contrast, some widespread issues such as climate change are, and will continue to be, more acute in arctic regions than elsewhere in the country.

Pollution

Pollution caused by industrial chemicals, pesticides and heavy metals can have both direct and indirect effects on survival and reproduction in birds. Sometimes the effects of exposure to pollutants are unexpected and do not result in immediate, measurable impacts on bird populations (Eeva and Lehikoinen 2000, Franceschini et al. 2008, North American Bird Conservation Initiative, U.S. Committee 2009, Mineau 2010). However, persistent exposure can

result in sharp declines in bird populations, as happened with Peregrine Falcons in eastern Canada prior to the ban of DDT. See Table 19 for conservation objectives and actions.

Many of the harmful pollutants that are released in large quantities elsewhere in the country, such as agricultural pesticides, are not used widely in BCR 3 PNR. Industrial chemicals such as PCBs may be released near communities and development sites (including Dew Line Stations), but the effects are localized and, in many cases, site remediation is underway. Within BCR 3 PNR the more widespread risk of pollution comes from chemicals transported over long distances, entering into arctic environments through atmospheric deposition, ocean currents and river outlets (e.g., Macdonald et al. 2000, Braune et al. 2005). Through the process of bioaccumulation, some pollutants may threaten species at high trophic levels in particular.

Toxic Chemicals and Heavy Metals

Toxic organic chemicals and heavy metals released into the environment can also negatively impact bird populations. While some industrial chemicals such as PCBs are regulated, there is concern about new chemicals such as flame retardants (PBDE) that are used in computers, car parts and upholstery, and whose effects on wildlife are largely unknown (Environment Canada 2003). Scavengers experience toxic effects when they ingest lead shotgun pellets or bullet fragments embedded in carcasses of game animals, and loons and other waterbirds are exposed to lead from shotgun pellets, sinkers and jigs that they ingest either while collecting grit for their gizzards or by eating bait fish with line and sinker still attached (Scheuhammer and Norris 1996, Scheuhammer et al. 2003). In some areas, lead poisoning from sinkers and jigs can account for approximately half of the mortality of adult Common Loons on their breeding grounds (Scheuhammer and Norris 1996). Birds are also susceptible to bioaccumulation of other toxic metals such as methylmercury, selenium and others when they consume prey that has been exposed to these substances. See Table 19 for conservation objectives and actions.

The presence of PBDEs in arctic wildlife may be increasing (Braune et al. 2007). Heavy metals such as mercury and cadmium remain a concern for some species (e.g., Braune et al. 2006), but the pathways by which they enter arctic systems are not well understood (Macdonald et al. 2000). Moreover, these pathways of release and accumulation may change with a changing climate, as could the physiological effects of contaminant exposure (e.g., Schiedek et al. 2007). Data exist for only a handful of species in BCR 3 PNR, but the effects of pollutants on arctic wildlife are potentially widespread.

Oil Pollution

Oil may enter the environment either accidentally, through deliberate dumping, or in contained tailings ponds. It may be a single large event, as occurred in the Gulf of Mexico in 2010, or numerous smaller events. Annual estimates are that between 217 800 and 458 600 birds are killed by ship-source oil spills annually (Calvert et al. 2013). Typically, diving birds are most at risk of oiling; however, any birds that come into contact with oil are vulnerable. Oil can impact birds through direct effects such as hypothermia (resulting from lost waterproofing of feathers following oil contamination), toxicity (from ingesting oil as they preen or by inhaling volatile organic compounds) and indirect effects, such as reduced prey availability and decreased

quality of habitat. While techniques exist to clean and rehabilitate oiled birds, many birds die before, during and after rescue attempts (Brown and Lock 2003). See Table 19 for a summary and the conservation objectives.

Chronic oil pollution and the risk of accidental spills are among the most significant threats to priority birds in the marine habitats of BCR 3 PNR (see Table 4, Fig. 24). Oil and gas exploration and development, as well as marine shipping, are increasing in the Arctic. Chronic oil pollution can lead to oiling of individual birds, but may also threaten birds indirectly. For example, some species, including Common and King Eiders, forage on benthic invertebrates where hydrocarbons can accumulate to dangerous levels (Woodin et al. 1997). Accidental oil spills always pose a substantial risk to wildlife, but this consequence is magnified in the Arctic; managing oil spills in the remote and ice-covered waters of BCR 3 PNR is especially challenging, and cold water temperatures, ice cover and periods of darkness limit the decomposition of oil.

The Southeast Beaufort Sea is an area where the potential consequences of oil pollution are particularly high. Numerous species of waterbirds stage here, and oil and gas development is increasing. For example, much of the Canadian population of Pacific Common Eiders stages in areas of interest for oil development (a threat of “very high” magnitude for this species), and could be placed at risk in the event of a spill (Goudie et al. 2000, Dickson and Gilchrist 2002, SDJV 2003). Development of offshore oil resources in West Greenland could also threaten Canada’s priority marine birds. This area is important for seabirds and waterfowl during the non-breeding season, and is adjacent to Baffin Bay, used by some of BCR 3’s seabirds throughout the year.

Table 19. Conservation objectives and actions associated with bird mortality from contaminants.

Threats addressed	Threat category	Objective	Objective category	Recommended actions	Action category	Example priority species affected
Mortality from ingestion of lead shot or tackle.	5.1 Hunting & collecting terrestrial animals 5.4 Fishing & harvesting aquatic resources	Reduce mortality and sub-lethal effects of lead shot and fishing tackle on birds	2.2 Reduce mortality and/or sub-lethal effects from exposure to contaminants.	Work with hunters, anglers and industry to eliminate the exposure of birds to shot, sinkers and jigs made of lead. Continue to enforce the use of non-toxic shot in waterfowl hunting, and encourage adoption of non-toxic alternatives in target shooting, upland game bird hunting, and fishing.	4.3 Awareness and communications 5.4 Compliance and enforcement	Waterfowl, Loons
Mortality from heavy metals and other contaminants.	9.2 Industrial & military effluents	Reduce mortality from heavy metals and other contaminants	2.2 Reduce mortality and/or sub-lethal effects from exposure to contaminants.	Work with industry and policy makers to reduce the quantity of heavy metals and other contaminants released into the environment.	5.3 Private sector standards and codes 5.2 Policies and regulations	All priority spp., but especially seabirds and waterbirds
Mortality of waterbirds from oil pollution.	9. Pollution	Reduce mortality from oil pollution	2.3 Reduce mortality and/or sublethal effects of oil pollution. 5.1 Maintain natural food webs and prey sources.	Improve monitoring and enforcement capacity to reduce chronic oil pollution from illegal dumping of bilge waste and cleaning of oil tanks. Improve education/outreach to make sure that the oil industry and its regulators are aware of the potential impacts on birds and take measures to prevent exposure of birds to oil.	5.4 Compliance and enforcement 4.3 Awareness and communications	Seabirds, waterbirds, seaducks, coastal shorebirds
Population effects of pollution are unknown.	12.1 information lacking	Improve understanding of population effects of pollution	7.4 Improve understanding of causes of population declines.	Evaluate the affects of PBDEs and other chemicals on vital rates in birds. Evaluate the extent to which pesticides are reducing prey availability for aerial insectivores. Improve the ability to monitor and understand the effects of contaminant concentrations in birds. Continue to acquire information on oiling of waterbirds through programs like Birds Oiled at Sea.	8.1 Research 8.2 Monitoring	All species

Climate Change

The effects of climate change are already measurable in many bird habitats and have resulted in range shifts and changes in the timing of migration and breeding in some species (National Audubon Society 2009, North American Bird Conservation Initiative, U.S. Committee 2009). Birds in all habitats will be affected by climate change. The most vulnerable are predicted to be those that are dependent on oceanic ecosystems and those found in coastal, island, grassland, arctic and alpine habitats (North American Bird Conservation Initiative, U.S. Committee 2010). Changing climate may also facilitate the spread of disease, the introduction of new predators and the invasion of non-native species that alter habitat structure and community composition (North American Bird Conservation Initiative, U.S. Committee 2009, Faaborg et al. 2010). See Tables 20 and 21 for a summary of impacts of climate change and conservation objectives.

A recent exercise used bioclimatic modelling to predict changes in bird species ranges based on anticipated climate change for different time periods and under different emissions scenarios (Lawler et al. unpublished; Lawler et al. 2009). Bioclimatic models use statistical associations between the current range of a species and a suite of climate variables to predict future ranges under new climate conditions. The study focused on bird species currently found within BCRs in Canada. The results suggest that bird species turnover in Canada will be highest in northern BCRs as species ranges continue to shift northward in the coming decades. In BCR 3 PNR, the model predicts a gain of 33 species, a loss of 10 species for a total turnover (species gains + species losses) of 32%.

In BCR 3 PNR, climatic warming has already resulted in measurable habitat and ecological change, and the threat was ranked as high magnitude overall (Table 4). Sea ice has decreased in thickness and extent, potentially affecting ice-associated species such as the endangered Ivory Gull (COSEWIC 2006). For Thick-billed Murres, a nearly two-week mismatch between timing of breeding and timing of peak food abundance is associated with reduced growth of nestlings (Gaston et al. 2009). Not all effects are negative, however. For example, the Thick-billed Murre may benefit from reduced ice cover when breeding in particularly ice-rich areas at the northern fringe of its range (Gaston et al. 2005). For many other predicted changes, effects on birds in BCR 3 PNR are likely but have not yet been documented (Table 20).

A deepening active layer and altered precipitation regime could drastically affect shallow tundra wetlands (ACIA 2005), a preferred foraging habitat for shorebirds. This deepening active layer could draw down the water table and lead to drying of shallow wetlands (e.g., Glooschenko et al. 1994). At the same time, coastal areas, another preferred foraging habitat, could be inundated and eroded due to a rising sea level (ACIA 2005). The predicted increase in frequency and severity of storm surges could also result in inundation of low-lying areas, such as was observed in the Beaufort Sea in 1999 when seawater was carried an unprecedented 30 km inland with a 2.5 m storm surge (Pisaric et al. 2011). The introduction of seawater into these freshwater wetlands and terrestrial habitats can cause extensive habitat degradation, and the wave action can lead to coastal erosion and other habitat change.

For insectivorous birds, altered timing of insect emergence and a mismatching of environmental cues can mean that birds' chicks do not hatch at the optimal time for foraging. Changes to polynya dynamics could adversely affect the Common and King Eiders that winter in these restricted and unique habitats (Robertson and Gilchrist 1998; Canadian Wildlife Service Waterfowl Committee 2008). Increasing irregularity of microtine (i.e., vole and lemming) cycles, a potential consequence of changing snow conditions, could impact birds such as Snowy Owls that prey on small mammals (Post et al. 2009).

An additional widespread issue affecting tundra species generally is the northward progression of the treeline and the resulting "shrubification" of previously open habitats. This large-scale habitat change may benefit species using coniferous or erect shrub habitats, such as Harris's Sparrow, but will adversely affect those that prefer open tundra (Table 20).

To maintain healthy bird populations in the face of a changing climate, conservation must be carefully planned and must be implemented so as to buffer birds from the negative impacts of climate change wherever possible (Faaborg et al. 2010).

Table 20. Examples of the current and anticipated effects of climate change on bird populations in Canada and some affected bird species.

Note: The species shown here do not represent an exhaustive list; rather, they provide examples of species for which the effects of climate change have been suggested or documented.

Potential and realized effects of climate Change	Examples of species negatively affected
Mismatch between peak breeding periods and peak food abundance	Marine: Thick-billed Murre Terrestrial: Stilt Sandpiper, Lapland Longspur
Extended breeding season	Snow Bunting, Red Knot
Advances in treeline: net gain of taiga, loss of tundra	Positive: Harris's Sparrow Negative: Rock Ptarmigan
Thawing of permafrost and increased evaporation will result in vegetation shifts and loss of wetlands in arctic habitats. Advance of shrub tundra	Red Phalarope, Red-necked Phalarope
Increase in severe weather events	Terrestrial: Lapland Longspur, American Tree Sparrow Marine: Thick-billed Murre, Thayer's Gull
Sea level rise	Ruddy Turnstone, Red Phalarope
Increased incidence of disease, either directly as range increases with changing temperature, or indirectly with increases in the range of vectors	Common Eider, Peregrine Falcon
Introduction of new predators and competitors	White-rumped Sandpiper, Snow Bunting, Lapland Longspur
Range shifts to the north, displacement from inundated coastal habitats	Dunlin, Semipalmated Sandpiper
Changes in ocean temperature and currents impact marine productivity and food webs	Thick-billed Murre, other seabirds
Changes in sea ice distribution and extent	Ivory Gull, Thayer's Gull, Thick-billed Murre
Altered polynya dynamics	Common Eider (<i>sedentaria</i>), King Eider, Ivory Gull, Gyrfalcon

Table 21. Proposed conservation objectives and actions to address climate change.

Threats addressed	Threat sub-category	Objective	Objective category	Recommended actions	Action category	Priority species affected
Climate change impacts habitat and negatively affects survival and productivity of birds	11.1 Habitat shifting and alteration	Reduce greenhouse gas emissions Mitigate the effects of climate change on bird habitat	6.1 Support efforts to reduce greenhouse gas emissions 6.2 Manage for habitat resilience as climate changes	Support efforts to reduce greenhouse gas emissions. Manage for habitat resilience to allow ecosystems to adapt despite disturbances and changing conditions. Minimize anthropogenic stressors (such as development or pollution) to help maintain resilience. Manage buffer areas and the matrix between protected areas to enhance movement of species across the landscape. Manage ecosystems to maximize carbon storage and sequestration while simultaneously enhancing bird habitat. Incorporate predicted shifts in habitat into landscape level plans (e.g., when establishing protected areas ensure the maintenance of north-south corridors to facilitate northward range shifts of bird species).	5.2 Policies and regulations 1.1 Site/area protection 2.1 Site/area management	All
Population-level effects of climate change are unknown	12.1 Information lacking	Improve understanding of climate change on birds and their habitats	7.5 Improve understanding of potential effects of climate change	Evaluate which species are most vulnerable to climate change. Investigate the cumulative effects of climate change. Investigate behavioural responses to climate change (such as range shifts, changes in demographic rates, and changes in timing of breeding and migration) through long-term studies. Continue to monitor bird populations so changes in numbers and distributions can be identified. Undertake monitoring to evaluate the effectiveness of mitigation activities.	8.1 Research 8.2 Monitoring	All

Research and Population Monitoring Needs

Population Monitoring

Overview of Birds' Population Status in BCR 3 PNR

A central goal of this conservation strategy is to restore bird populations to natural abundances and distributions throughout the region. The population objectives presented here are intended to return priority bird populations to the levels of the 1960s and 1970s, a baseline promoted by many of North America's bird conservation initiatives. In order to define these objectives, priority bird populations were assessed in terms of long-term population trend and also in terms of current population size relative to the desired baseline. The population objectives presented below are based on a quantitative or qualitative assessment of the best monitoring information available for each priority species or population.

The quality of monitoring information varies markedly among species and regions. In some cases, it was not possible to define quantitative population objectives; the objective for these species is instead to maintain the current abundance and assess the population status and trend (i.e., "Assess/Maintain" in Fig. 4). Through improved monitoring, the number of species assigned this objective can be reduced in future iterations of this strategy.

At present, there are few long-term survey data collected within BCR 3 PNR; 22 priority species (34%) were deemed to have insufficient population monitoring to assign an objective (Fig. 4). Many of these are non-game species that breed primarily in the Arctic and winter outside of areas covered by large-scale North American surveys such as the Christmas Bird Count. Some of these species winter at sea, where it would be logistically challenging to survey them. Some of these poorly monitored species are shorebirds that migrate through North America to winter in Central and South America. Surveys of shorebirds at migration stopover sites and on the wintering grounds have provided some indications of population status (e.g., Bart et al. 2007), but estimates of trend from these surveys are complicated by a variety of serious potential biases. Improved monitoring for shorebirds and landbirds in the Arctic could significantly improve our knowledge of population status and trends in the future.

Although our knowledge of population trend is incomplete for many species, evidence for declines was sufficient to assign quantitative population objectives for 22 species (34%). In some cases, the knowledge of declines reflects effective long-term monitoring programs while in other cases it resulted from declines so large that they were identified despite poor monitoring. Several species of shorebirds, for example, appear to have declined significantly relative to the 1960s and 1970s based on surveys at migratory stopover locations, although the exact magnitude of the declines remains uncertain. Some game species, for example populations of Common and King Eider, the Long-tailed Duck and the Northern Pintail, are considered to be below their population objectives despite active management of harvests.

Some species have declined to such an extent that they have been assessed as species of conservation concern by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) or listed under SARA. The Rusty Blackbird, at the northern edge of its range in BCR 3, and the Short-eared Owl are listed under SARA as Special Concern owing to large apparent declines in their population sizes. For the Red Knot, the *rufa* population wintering in South America has declined by more than 80% and has recently been listed as Endangered under SARA. Declines in the *islandica* subspecies (SARA listed as Special Concern) that winters in Europe have been more modest (COSEWIC 2007). The Ivory Gull is an Endangered species that has declined by more than 80% since the 1980s (COSEWIC 2006), while the Threatened Ross's Gull population in Canada numbers perhaps only 100 individuals (M. Mallory, pers. comm. 2012). The Eskimo Curlew may already be extinct, or is at a minimum exceedingly rare (COSEWIC 2009).

For 17 species (27%), monitoring information suggested that populations were near or above their target population levels. A majority of arctic goose populations are secure, and 4 populations of white geese were deemed to be sufficiently above their population objectives that actions to reduce their numbers might be warranted. The increased abundance of arctic geese is a significant threat to numerous other arctic birds and appears as a threat in several habitat types.

Monitoring Needs

In Table 22, we attempt to identify the species where the quality or quantity of survey information hinders management. Where possible, we suggest what needs to be done to improve our knowledge. We first list those priority species in BCR 3 PNR for which we do not have sufficient data to reliably estimate population trend. We list species as inadequately surveyed if their population trend was determined to be "unknown" in Element 3 (see also Kennedy et al. 2012), or if trend estimates were based on limited or non-systematically collected data. For many species, poor knowledge of population size also complicates objective setting and assessment of priority areas. All priority landbirds and shorebirds, and all waterbirds except Ross's and Ivory Gulls fit these criteria. For ducks, species with no quantitative population objective provided in NAWMP (2004) were considered to need additional information on population status. For Arctic Geese, an assessment of information needs was undertaken by the Arctic Goose Joint Venture (AGJV 2008). Species for which "Status or Assessment" was assigned a medium or high "Information Need Priority" were added here, while those assigned low priority for this information need by the AGJV were not.

Adequate knowledge of species' ranges is also critical for effective conservation, and in BCR 3, the range of many species is poorly documented. Below, we also list species for which knowledge of range is considered to be inadequate for effective conservation. The N.W.T./Nun. checklist program provides a wealth of invaluable data but does not cover the entirety of many species' ranges. The Arctic Surveys of the Program for Regional and International Shorebird Monitoring (PRISM) will provide range-wide surveys of shorebirds and landbirds, but the program has not yet been fully implemented. Thus all species of shorebirds and landbirds were considered to have inadequate information on breeding range at present. The breeding range

of the colonial Thick-billed Murre is well studied, and targeted surveys for the rare Ivory Gull and Ross's Gull are carried out regularly. Thus, range for these species is comparatively well known. The breeding range of Arctic ducks is poorly documented, and all duck species could therefore benefit from additional information on breeding range in the Arctic. For arctic geese, quality of information varies. Species for which "Population Definition or Delineation" was assigned a medium or high "Information Need Priority" by the Arctic Goose Joint Venture (AGJV 2008) were added here, while those assigned low priority for this information need by the AGJV were not.

Additional recommendations for monitoring were provided by Environment Canada's recent Avian Monitoring Review (AMR Steering Committee 2012). This review identified general monitoring needs for each of the four main bird groups:

Landbirds

- develop options for on-the-ground monitoring across boreal Canada;
- evaluate the ability of migration monitoring and checklist surveys to contribute to Environment Canada's monitoring needs; and
- evaluate the feasibility and cost-effectiveness of improving demographic monitoring to help understand causes of population change.

Shorebirds

- complete a first round of Arctic PRISM breeding shorebird surveys to obtain reliable population estimates and baseline distribution information across the Arctic;
- develop more reliable sampling methods for counting shorebirds in migration to address concerns about bias; and
- increase Latin American involvement in monitoring shorebirds on the wintering grounds, including Red Knot.

Waterbirds

- evaluate alternative strategies for filling gaps in coverage for both colonial waterbirds and marsh birds;
- consider both costs and potential reduction in risks; and
- carry out any necessary pilot work to evaluate options.

Waterfowl

- develop strategies to reduce expenditures on the prairie and eastern waterfowl breeding surveys, while retaining acceptable precision in population estimates;
- review the information needs and expenditures for arctic goose and duck banding programs;
- reduce the number of Greater Snow Goose survey components;
- realign resources for eider and scoter monitoring to a more efficient suite of surveys.

Table 22. Priority species for which population status information was lacking for BCR 3 PNR. For the species below, inadequate monitoring information was considered a significant conservation concern; suggested actions to address this lack of monitoring information are provided.

Monitoring need	Objective	Recommended actions	Priority species affected
Knowledge of population size and trend is inadequate for effective management of these species	Determine population size and trend for all priority species in BCR 3 PNR	Implement the Program for Regional and International Shorebird Monitoring (PRISM) Arctic Surveys (applies especially to shorebirds and landbirds)	American Golden-Plover, American Pipit, American Tree Sparrow, Arctic Tern, Black-bellied Plover, Brant (Atlantic), Brant (Western High Arctic), Buff-breasted Sandpiper, Canada Goose (Atlantic), Common Eider (<i>borealis</i>), Common Eider (<i>sedentaria</i>), Common Eider (<i>v-nigra</i>), Common Loon, Common Ringed Plover, Dunlin, Eskimo Curlew, Golden Eagle, Greater Snow Goose, Gyrfalcon, Harris's Sparrow, Hoary Redpoll, Hudsonian Godwit, King Eider, Lapland Longspur, Least Sandpiper, Lesser Snow Goose (Mid-Continent), Lesser Snow Goose (Western Central Flyway), Long-tailed Duck, Pacific Loon, Peregrine Falcon, Purple Sandpiper, Red Knot (<i>islandica</i>), Red Knot (<i>rufa</i>), Red Phalarope, Red-necked Phalarope, Rock Ptarmigan, Ross's Goose, Rough-legged Hawk, Ruddy Turnstone, Rusty Blackbird, Sanderling, Semipalmated Sandpiper, Shortgrass Prairie Cackling Goose, Smith's Longspur, Snow Bunting, Snowy Owl, Stilt Sandpiper, Tallgrass Prairie Cackling Goose, Thayer's Gull, Thick-billed Murre, Whimbrel, Yellow-billed Loon
		Study the effectiveness of PRISM aerial surveys for monitoring widely dispersed waterbirds such as loons and some gulls	
		Design and implement a geographically broad survey program to monitor waterfowl species that are not currently monitored adequately in BCR 3	
		Evaluate outcomes of the Avian Monitoring Review to determine which species are not covered by existing or proposed survey programs, and design targeted programs to address information gaps (applies to all species)	
Knowledge of range for these species in BCR 3 is sufficiently incomplete that it complicates	Establish current range limits for all priority species in BCR 3	Complete the first round of the PRISM Arctic Surveys. Evaluate results and continue to implement surveys if effective.	American Golden-Plover, American Pipit, American Tree Sparrow, Arctic Tern, Black-bellied Plover, Brant (Eastern High Arctic), Brant (Western High Arctic), Buff-breasted Sandpiper, Canada Goose (Atlantic), Common Eider (<i>borealis</i>), Common

Table 22 continued

Monitoring need	Objective	Recommended actions	Priority species affected
monitoring and management		Design and implement a geographically broad survey program to address information gaps in waterfowl breeding ranges	Eider (<i>sedentaria</i>), Common Eider (<i>v-nigra</i>), Common Ringed Plover, Dunlin, Eskimo Curlew, Golden Eagle, Greater White-fronted Goose (Midcontinent), Gyrfalcon, Harlequin Duck (Eastern), Harris's Sparrow, Hoary Redpoll, Hudsonian Godwit, King Eider, Lapland Longspur, Least Sandpiper, Lesser Snow Goose (Western Arctic), Long-tailed Duck, Northern Pintail, Peregrine Falcon, Purple Sandpiper, Red Knot (<i>islandica</i>), Red Knot (<i>rufa</i>), Red Phalarope, Red-necked Phalarope, Rock Ptarmigan, Rough-legged Hawk, Ruddy Turnstone, Rusty Blackbird, Sanderling, Semipalmated Sandpiper, Short-eared Owl, Shortgrass Prairie Cackling Goose, Smith's Longspur, Snow Bunting, Snowy Owl, Stilt Sandpiper, Tallgrass Prairie Cackling Goose, Thayer's Gull, Whimbrel
		Evaluate outcomes of the Avian Monitoring Review to determine which species are not covered by existing or proposed survey programs, and design targeted programs to address information gaps	

Research Needs

The general monitoring needs described above apply to a large number of species. Throughout the strategy, we also identified specific information needs alongside the threats/objectives for which the information was required. These specific information needs were divided into four categories:

- Alliance and Partnership Building – in some rare cases, it was possible to identify the implementation partner best poised to address the information need. In these cases, building the alliance was the prescribed conservation action.
- Monitoring Needs – the information need relates to a lack of context-specific monitoring data; data about harvest for a particular suite of species, for example.
- Science Need/Research Need – the information need relates to the interaction between a species and its environment; information needs that are best addressed through targeted scientific studies.
- Knowledge/Information Tools – these information needs require input from both scientists and policy makers, such as defining or protecting a network of priority areas.

These monitoring needs outline the main areas where a lack of information hindered the ability to understand conservation needs and make conservation recommendations. Research objectives presented here are bigger picture questions, and not necessarily a schedule of studies that are needed to determine the needs of individual species (Table 23). Undertaking research will allow us to improve future iterations of BCR strategies and to focus future implementation, and will also enable the development of new tools for conservation.

Table 23. General research objectives in BCR 3 PNR.

Science/Research need	Recommended actions	Priority species affected
Establish levels of exposure and toxicological thresholds for priority species in the Canadian Arctic	Support the Arctic Monitoring and Assessment Program of the Arctic Council	Arctic Tern, Common Loon, Gyrfalcon, Ivory Gull, Pacific Loon, Peregrine Falcon, Thayer's Gull, Thick-billed Murre
Incorporate scenarios of global climate change into management	Develop quantitative models of predicted habitat change and consequences on the species, and incorporate into management plans	American Golden-Plover, Black-bellied Plover, Brant (Atlantic), Brant (Eastern High Arctic), Brant (Pacific), Brant (Western High Arctic), Buff-breasted Sandpiper, Canada Goose (Atlantic), Common Eider (<i>sedentaria</i>), Common Eider (<i>v-nigra</i>), Dunlin, Harris's Sparrow, Hoary Redpoll, Hudsonian Godwit, Ivory Gull, King Eider, Least Sandpiper, Red Knot (<i>rufa</i>), Red Phalarope, Red-necked Phalarope, Rock Ptarmigan, Rusty Blackbird, Semipalmated Sandpiper, Short-eared Owl, Shortgrass Prairie Cackling Goose, Smith's Longspur, Snowy Owl, Stilt Sandpiper, Tallgrass Prairie Cackling Goose, Whimbrel
Determine current rates of subsistence harvest in BCR 3	Implement a rigorous wildlife harvest survey program to determine current rates of subsistence harvest in BCR 3	Arctic Tern, Brant (Atlantic), Brant (Eastern High Arctic), Brant (Pacific), Brant (Western High Arctic), Canada Goose (Atlantic), Common Eider (<i>sedentaria</i>), Common Eider (<i>v-nigra</i>), Common Loon, Greater Snow Goose, Ivory Gull, King Eider, Lesser Snow Goose (Mid-Continent), Lesser Snow Goose (Western Arctic), Lesser Snow Goose (Western Central Flyway), Long-tailed Duck, Northern Pintail, Pacific Loon, Rock Ptarmigan, Ross's Goose, Shortgrass Prairie Cackling Goose, Snowy Owl, Tallgrass Prairie Cackling Goose, Thayer's Gull, Thick-billed Murre, Tundra Swan (Eastern), White-fronted Goose (Mid-Continent), Yellow-billed Loon

Table 23 continued

Science/Research need	Recommended actions	Priority species affected
Prevent loss of priority habitats	Define key areas for priority birds that still require protection	American Golden-Plover, American Pipit, American Tree Sparrow, Black-bellied Plover, Brant (Atlantic), Brant (Pacific), Buff-breasted Sandpiper, Canada Goose (Atlantic), Common Ringed Plover, Dunlin, Greater Snow Goose, Harris's Sparrow, Hoary Redpoll, Hudsonian Godwit, Lapland Longspur, Least Sandpiper, Lesser Snow Goose (Western Arctic), Lesser Snow Goose (Western Central Flyway), Pacific Loon, Red Phalarope, Red-necked Phalarope, Rock Ptarmigan, Ruddy Turnstone, Semipalmated Sandpiper, Short-eared Owl, Shortgrass Prairie Cackling Goose, Smith's Longspur, Snow Bunting, Snowy Owl, Stilt Sandpiper
Restore plant species richness, sward height and vegetative cover in degraded tundra habitats	Develop new population objectives for arctic waterfowl that are sustainable and limit degradation of breeding habitats. These new population objectives should recognise the habitat needs of all priority bird species.	American Golden-Plover, American Pipit, American Tree Sparrow, Black-bellied Plover, Brant (Atlantic), Brant (Pacific), Buff-breasted Sandpiper, Canada Goose (Atlantic), Common Ringed Plover, Dunlin, Greater Snow Goose, Harris's Sparrow, Hoary Redpoll, Hudsonian Godwit, Lapland Longspur, Least Sandpiper, Lesser Snow Goose (Western Arctic), Lesser Snow Goose (Western Central Flyway), Pacific Loon, Red Phalarope, Red-necked Phalarope, Rock Ptarmigan, Ruddy Turnstone, Semipalmated Sandpiper, Short-eared Owl, Shortgrass Prairie Cackling Goose, Smith's Longspur, Snow Bunting, Snowy Owl, Stilt Sandpiper, Tallgrass Prairie Cackling Goose, Tundra Swan (Eastern), Whimbrel, White-fronted Goose (Mid-Continent), Yellow-billed Loon

Threats Outside Canada

Many bird species found in Canada spend a large portion of their life cycle outside of the country. These species face threats while they are outside Canada; in fact, threats to some migratory species may be most severe outside of the breeding season (Calvert et al. 2009). Of the 65 priority species in BCR 3 PNR, only 6 (9%) spend the winter within the region, and even for these, only a fraction of the population remains at such high latitudes. A number of species winter at temperate latitudes, including elsewhere in Canada, but a large fraction also spend part of their annual cycle—up to half the year or more—outside Canada (Fig. 25).

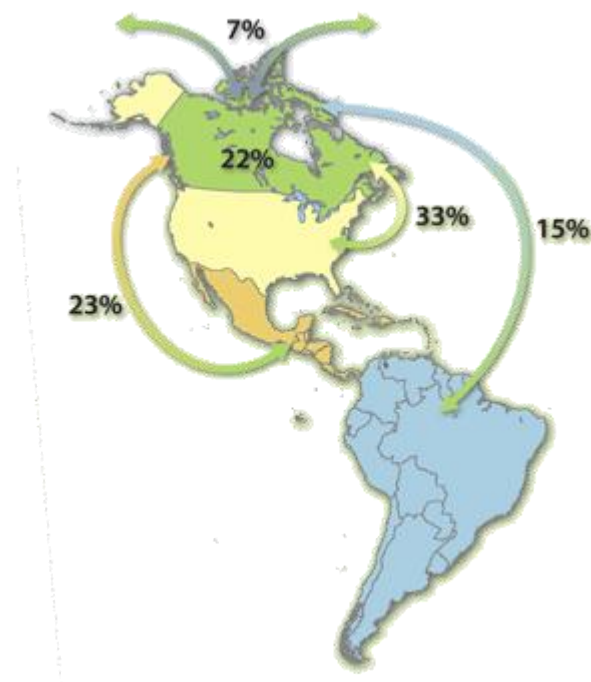


Figure 25. Percent of Canadian breeding birds that migrate to regions outside of Canada for part of their life cycle (North American Bird Conservation Initiative 2012).

Similar to the assessment of threats facing priority species within Canada, we conducted a literature review to identify threats facing priority species while they are outside Canada. A lack of data was a pervasive issue for this exercise. For many species, little is known about threats they face during migration or while on their wintering grounds. Indeed, for some species, their wintering ranges and habitat use are only poorly known, if at all. There is also little information linking specific wintering areas to particular breeding populations, making it difficult to connect declines in breeding populations to potential problems on the wintering grounds. In addition, what data exist on wintering migrant species are heavily biased towards work done in the United States, and little research is available from Mexico, Central and South America. While many of the threats identified in the United States likely affect species throughout their range, unique issues outside of the United States may have been missed. An absence of threats in a region may reflect that the necessary research has not yet been conducted (or may not be published in English). Because information on bird distributions during the non-breeding season

is limited, we were unable to assess the scope and severity of threats to priority species while they are outside of Canada.

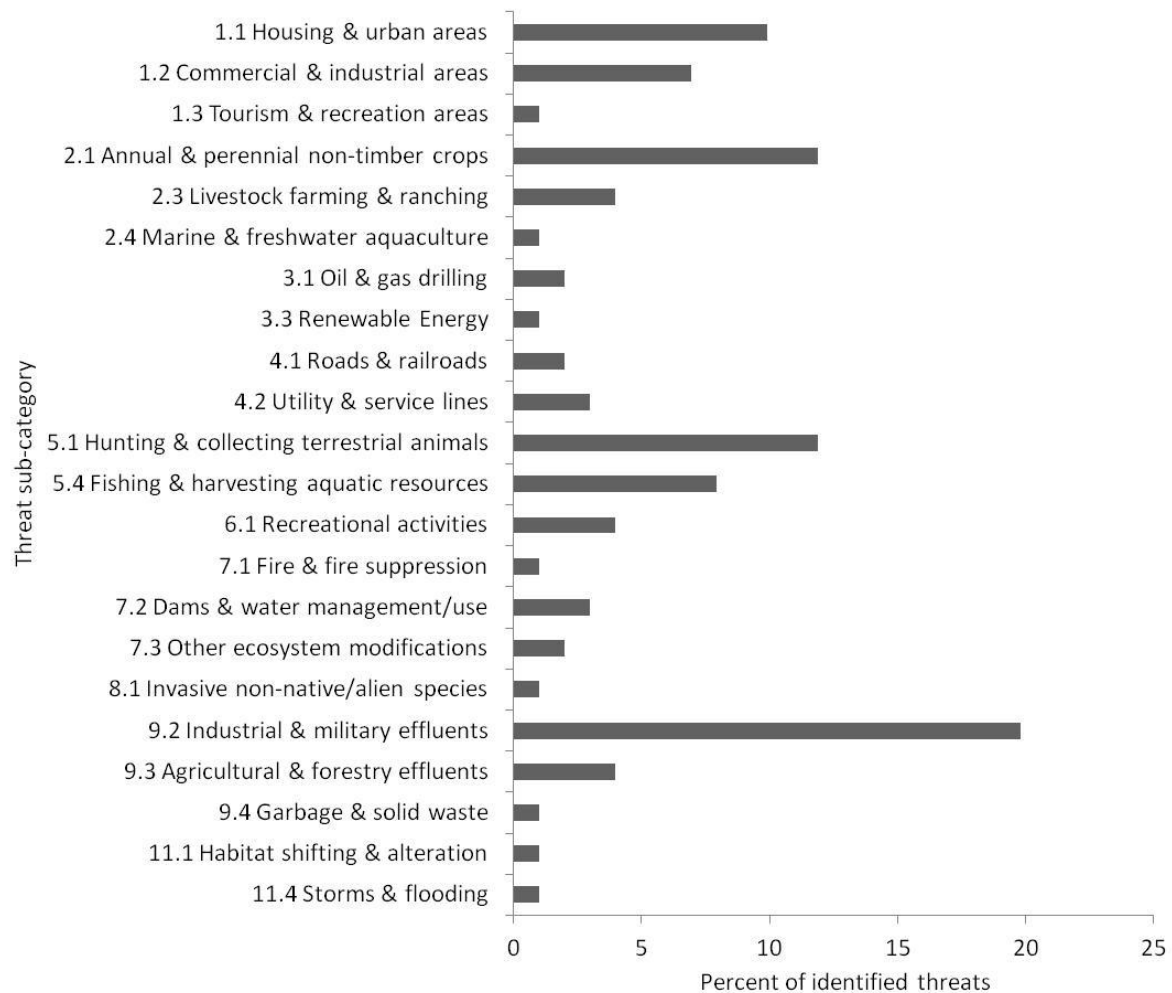


Figure 26. Percent of identified threats to priority species (by threat sub-category) from BCR 3 PNR when they are outside Canada.

Note: Magnitudes could not be assigned for threats outside Canada due to lack of information on scope and severity.

Despite this, some information is available to inform conservation work outside Canada (Fig. 26). The priority species from BCR 3 PNR disperse widely across the Western Hemisphere and beyond during the non-breeding season, and occupy habitats from the alpine steppes of the Andes to marine waters off the coast of Africa. As a result, the threats that they encounter are varied and numerous. Loss or degradation of key migration and wintering habitats was an important threat facing priority birds from BCR 3 PNR. The primary sources of this threat are conversion of grasslands and wetlands for agricultural use (threat sub-category 2.1) and residential development (threat sub-category 1.1). The threat of loss and degradation of winter habitat is great for species that have relatively small and concentrated wintering ranges. Others, such as shorebirds, are especially vulnerable during migration when species

concentrate at just a handful of key migratory stopover sites. Degradation or loss of these sites could have devastating impacts.

In addition to habitat loss, other significant threats encountered by priority birds from BCR 3 PNR include the lethal and sub-lethal impacts of exposure to industrial contaminants (threat sub-category 9.2), primarily oil pollution, but also heavy metals and other contaminants. Waterfowl and shorebirds are particularly affected by these threats. Other large sources of mortality for priority species outside of Canada are related to hunting and fishing (threat sub-categories 5.1 and 5.4), including lead poisoning from ingestion of lead shot, illegal hunting and fisheries bycatch.

Next Steps

The primary aims of BCR strategies are to present Environment Canada's priorities with respect to migratory bird conservation, and to provide a comprehensive overview of the conservation needs of bird populations to practitioners who may then undertake activities that promote bird conservation in Canada and internationally. Users from all levels of government, wildlife management boards, Aboriginal communities, the private sector, academia, NGOs and citizens will benefit from the information. BCR strategies can be used in many different ways, depending on the needs of the user, who may focus on one or more of the elements of the strategy to guide their conservation projects.

BCR strategies will be updated periodically. Errors, omissions and additional sources of information may be provided to [Environment Canada](#) at any time for inclusion in subsequent versions.

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Appendix 1

List of All Bird Species in BCR 3 PNR

Table A1. Complete list of species in BCR 3 PNR, when they are in the BCR (B=breeding, M=migrant, W=winter, C=casual) and their priority status.

Scientific name	Common name	Bird group	Status	Priority
<i>Podiceps grisegena</i>	Red-necked Grebe	Waterbirds	B	
<i>Podiceps auritus</i>	Horned Grebe	Waterbirds	C	
<i>Gavia immer</i>	Common Loon	Waterbirds	B	Yes
<i>Gavia adamsii</i>	Yellow-billed Loon	Waterbirds	B	Yes
<i>Gavia pacifica</i>	Pacific Loon	Waterbirds	B	Yes
<i>Gavia stellata</i>	Red-throated Loon	Waterbirds	B	
<i>Cephus grylle</i>	Black Guillemot	Waterbirds	B,W	
<i>Uria lomvia</i>	Thick-billed Murre	Waterbirds	B,W	Yes
<i>Alca torda</i>	Razorbill	Waterbirds	B	
<i>Alle alle</i>	Dovekie	Waterbirds	B	
<i>Stercorarius pomarinus</i>	Pomarine Jaeger	Waterbirds	B	
<i>Stercorarius parasiticus</i>	Parasitic Jaeger	Waterbirds	B	
<i>Stercorarius longicaudus</i>	Long-tailed Jaeger	Waterbirds	B	
<i>Pagophila eburnea</i>	Ivory Gull	Waterbirds	B,W	Yes
<i>Rissa tridactyla</i>	Black-legged Kittiwake	Waterbirds	B	
<i>Larus glaucooides</i>	Iceland Gull	Waterbirds	B	
<i>Larus thayeri</i>	Thayer's Gull	Waterbirds	B	Yes
<i>Larus hyperboreus</i>	Glaucous Gull	Waterbirds	B	
<i>Larus marinus</i>	Great Black-backed Gull	Waterbirds	S	
<i>Larus argentus</i>	Herring Gull	Waterbirds	B	
<i>Larus californicus</i>	California Gull	Waterbirds	C	
<i>Larus canus</i>	Mew Gull	Waterbirds	B	
<i>Larus philadelphia</i>	Bonaparte's Gull	Waterbirds	C	
<i>Rhodostethia rosea</i>	Ross's Gull	Waterbirds	B,W	Yes
<i>Xema sabini</i>	Sabine's Gull	Waterbirds	B	
<i>Sterna paqradisea</i>	Arctic Tern	Waterbirds	B	Yes
<i>Fulmarus glacialis</i>	Northern Fulmar	Waterbirds	B,W	
<i>Grus canadensis</i>	Sandhill Crane	Waterbirds	B	
<i>Mergus serrator</i>	Red-breasted Merganser	Waterfowl	B	
<i>Anas platyrhynchos</i>	Mallard	Waterfowl	B	
<i>Anas rubripes</i>	American Black Duck	Waterfowl	B	
<i>Anas americana</i>	American Wigeon	Waterfowl	B	
<i>Anas crecca</i>	Green-winged Teal	Waterfowl	B	
<i>Anas clypeata</i>	Northern Shoveler	Waterfowl	B	
<i>Anas acuta</i>	Northern Pintail	Waterfowl	B	Yes

Table A1 continued

Scientific name	Common name	Bird group	Status	Priority
<i>Aythya valisineria</i>	Canvasback	Waterfowl	B	
<i>Aythya marila</i>	Greater Scaup	Waterfowl	B	
<i>Aythya collaris</i>	Ring-necked Duck	Waterfowl	C	
<i>Bucephala clangula</i>	Common Goldeneye	Waterfowl	B	
<i>Bucephala islandica</i>	Barrow's Goldeneye (eastern)	Waterfowl	M	
<i>Clangula hyemalis</i>	Long-tailed Duck	Waterfowl	B	Yes
<i>Histrionicus histrionicus</i> - Eastern population	Harlequin Duck (Eastern)	Waterfowl	B	Yes
<i>Histrionicus histrionicus</i> - Western population	Harlequin Duck (Western)	Waterfowl	C	
<i>Polysticta stelleri</i>	Steller's Eider	Waterfowl	B	
<i>Somateria fischeri</i>	Spectacled Eider	Waterfowl	B	
<i>Somateria mollissima borealis</i>	Common Eider (<i>borealis</i>)	Waterfowl	B	Yes
<i>Somateria mollissima sedentaria</i>	Common Eider (<i>sedentaria</i>)	Waterfowl	B	Yes
<i>Somateria mollissima v-nigra</i>	Common Eider (<i>v-nigra</i>)	Waterfowl	B	Yes
<i>Somateria spectabilis</i>	King Eider	Waterfowl	B	Yes
<i>Melanitta nigra</i>	Black Scoter	Waterfowl	B	
<i>Melanitta fusca</i>	White-winged Scoter	Waterfowl	B	
<i>Melanitta perspicillata</i>	Surf Scoter	Waterfowl	B	
<i>Chen caerulescens caerulescens</i>	Lesser Snow Goose (Western Central Flyway)	Waterfowl	B	Yes
<i>Chen caerulescens caerulescens</i>	Lesser Snow Goose (Mid-Continent)	Waterfowl	B	Yes
<i>Chen caerulescens caerulescens</i>	Lesser Snow Goose (Western Arctic)	Waterfowl	B	Yes
<i>Chen caerulescens atlanticus</i>	Greater Snow Goose	Waterfowl	B	Yes
<i>Chen rossii</i>	Ross's Goose	Waterfowl	B	Yes
<i>Anser albifrons</i>	White-fronted Goose (Mid-Continent)	Waterfowl	B	Yes
<i>Branta canadensis</i>	Canada Goose (Atlantic)	Waterfowl	B	Yes
<i>Branta hutchinsii</i>	Shortgrass Prairie Cackling Goose	Waterfowl	B	Yes
<i>Branta hutchinsii</i>	Tallgrass Prairie Cackling Goose	Waterfowl	B	Yes
<i>Branta bernicla nigricans</i>	Brant (Pacific)	Waterfowl	B	Yes
<i>Branta bernicla</i> ("grey-bellied")	Brant (Western High Arctic)	Waterfowl	B	Yes
<i>Branta bernicla hrota</i>	Brant (Eastern High Arctic)	Waterfowl	B	Yes
<i>Branta bernicla hrota</i>	Brant (Atlantic)	Waterfowl	B	Yes
<i>Cygnus columbianus</i>	Tundra Swan (Eastern)	Waterfowl	B	Yes
<i>Phalaropus fulicarius</i>	Red Phalarope	Shorebirds	B	Yes
<i>Phalaropus lobatus</i>	Red-necked Phalarope	Shorebirds	B	Yes
<i>Gallinago gallinago</i>	Wilson's Snipe	Shorebirds	C	
<i>Limnodromus scolopaceus</i>	Long-billed Dowitcher	Shorebirds	B	
<i>Calidris himantipus</i>	Stilt Sandpiper	Shorebirds	B	Yes
<i>Calidris canutus</i>	Red Knot (<i>rufa</i>)	Shorebirds	B	Yes
<i>Calidris canutus</i>	Red Knot (<i>islandica</i>)	Shorebirds	B	Yes

Table A1 continued

Scientific name	Common name	Bird group	Status	Priority
<i>Calidris maritima</i>	Purple Sandpiper	Shorebirds	B	Yes
<i>Calidris melanotos</i>	Pectoral Sandpiper	Shorebirds	B	
<i>Calidris fuscicollis</i>	White-rumped Sandpiper	Shorebirds	B	
<i>Calidris bairdii</i>	Baird's Sandpiper	Shorebirds	B	
<i>Calidris minutilla</i>	Least Sandpiper	Shorebirds	B	Yes
<i>Calidris alpina</i>	Dunlin	Shorebirds	B	Yes
<i>Calidris pusilla</i>	Semipalmated Sandpiper	Shorebirds	B	Yes
<i>Calidris alba</i>	Sanderling	Shorebirds	B	Yes
<i>Limosa lapponica</i>	Bar-tailed Godwit	Shorebirds	C	
<i>Limosa haemastica</i>	Hudsonian Godwit	Shorebirds	B	Yes
<i>Tringa flavipes</i>	Lesser Yellowlegs	Shorebirds	C	
<i>Tringa solitaria</i>	Solitary Sandpiper	Shorebirds	C	
<i>Tringa incana</i>	Wandering Tattler	Shorebirds	C	
<i>Bartramia longicauda</i>	Upland Sandpiper	Shorebirds	C	
<i>Tryngites subruficollis</i>	Buff-breasted Sandpiper	Shorebirds	B	Yes
<i>Actitis macularia</i>	Spotted Sandpiper	Shorebirds	C	
<i>Numenius phaeopus</i>	Whimbrel	Shorebirds	B	Yes
<i>Numenius borealis</i>	Eskimo Curlew	Shorebirds	B	Yes
<i>Pluvialis squatarola</i>	Black-bellied Plover	Shorebirds	B	Yes
<i>Pluvialis dominica</i>	American Golden-Plover	Shorebirds	B	Yes
<i>Charadrius semipalmatus</i>	Semipalmated Plover	Shorebirds	B	
<i>Charadrius hiaticula</i>	Common Ringed Plover	Shorebirds	B	Yes
<i>Aphriza virgata</i>	Surfbird	Shorebirds	C	Yes
<i>Arenaria interpres</i>	Ruddy Turnstone	Shorebirds	B	Yes
<i>Lagopus lagopus</i>	Willow Ptarmigan	Landbirds	B,W	
<i>Lagopus mutus</i>	Rock Ptarmigan	Landbirds	B,W	Yes
<i>Tympanuchus phasianellus</i>	Sharp-tailed Grouse	Landbirds	C	
<i>Circus cyaneus</i>	Northern Harrier	Landbirds	B	
<i>Accipiter striatus</i>	Sharp-shinned Hawk	Landbirds	B	
<i>Accipiter gentilis</i>	Northern Goshawk	Landbirds	B,W	
<i>Buteo lagopus</i>	Rough-legged Hawk	Landbirds	B,M	Yes
<i>Aquila chrysaetos</i>	Golden Eagle	Landbirds	B	Yes
<i>Haliaeetus leucocephalus</i>	Bald Eagle	Landbirds	B	
<i>Falco rusticolus</i>	Gyrfalcon	Landbirds	B	Yes
<i>Falco peregrinus</i>	Peregrine Falcon (<i>anatum/tundrius</i>)	Landbirds	B	Yes
<i>Falco columbarius</i>	Merlin	Landbirds	B	
<i>Asio flammeus</i>	Short-eared Owl	Landbirds	B	Yes
<i>Nyctea scandiaca</i>	Snowy Owl	Landbirds	B,W	Yes
<i>Surnia ulula</i>	Northern Hawk Owl	Landbirds	B,W	
<i>Picoides dorsalis</i>	Three-toed Woodpecker	Landbirds	C	
<i>Colaptes auratus cafer</i>	Northern Flicker	Landbirds	C	

Table A1 continued

Scientific name	Common name	Bird group	Status	Priority
<i>Sayornis saya</i>	Say's Phoebe	Landbirds	B	
<i>Empidonax alnorum</i>	Alder Flycatcher	Landbirds	C	
<i>Eremophila alpestris</i>	Horned Lark	Landbirds	B,M	
<i>Perisoreus canadensis</i>	Gray Jay	Landbirds	B	
<i>Corvus corax</i>	Common Raven	Landbirds	B	
<i>Euphagus carolinus</i>	Rusty Blackbird	Landbirds	B	Yes
<i>Pinicola enucleator</i>	Pine Grosbeak	Landbirds	C	
<i>Loxia leucoptera</i>	White-winged Crossbill	Landbirds	C	
<i>Leucosticte tephrocotis</i>	Gray-crowned Rosy-Finch	Landbirds	B	
<i>Cardeulis hornemanni</i>	Hoary Redpoll	Landbirds	B,W	Yes
<i>Cardeulis flammea</i>	Common Redpoll	Landbirds	B	
<i>Plectrophenax nivalis</i>	Snow Bunting	Landbirds	B	Yes
<i>Calcarius lapponicus</i>	Lapland Longspur	Landbirds	B,M	Yes
<i>Calcarius pictus</i>	Smith's Longspur	Landbirds	B	Yes
<i>Passerculus sandwichensis</i>	Savannah Sparrow	Landbirds	B	
<i>Zonotrichia querela</i>	Harris's Sparrow	Landbirds	B,M	Yes
<i>Zonotrichia leucophrys</i>	White-crowned Sparrow	Landbirds	B,M	
<i>Spizella arborea</i>	American Tree Sparrow	Landbirds	B,M	Yes
<i>Junco hyemalis</i>	Dark-eyed Junco	Landbirds	C	
<i>Passerella iliaca</i>	Fox Sparrow	Landbirds	B,M	
<i>Tachycineta bicolor</i>	Tree Swallow	Landbirds	B	
<i>Riparia riparia</i>	Bank Swallow	Landbirds	C	
<i>Bombycilla garrulus</i>	Bohemian Waxwing	Landbirds	C	
<i>Lanius excubitor</i>	Northern Shrike	Landbirds	C	
<i>Vernivora celata</i>	Orange-crowned Warbler	Landbirds	B	
<i>Denderoica petechia</i>	Yellow Warbler	Landbirds	C	
<i>Dendroica coronata</i>	Yellow-rumped Warbler	Landbirds	B	
<i>Dendroica striata</i>	Blackpoll Warbler	Landbirds	C	
<i>Seiurus noveboracensis</i>	Northern Waterthrush	Landbirds	C	
<i>Wilsonia pusilla</i>	Wilson's Warbler	Landbirds	B	
<i>Motacilla alba</i>	White Wagtail	Landbirds	C	
<i>Motacilla tschutschensis</i>	Eastern Yellow Wagtail	Landbirds	C	Yes
<i>Anthus rubescens</i>	American Pipit	Landbirds	B	Yes
<i>Cinclus mexicanus</i>	American Dipper	Landbirds	C	
<i>Poecile cincta</i>	Gray-headed Chickadee	Landbirds	C	
<i>Poecile hudsonica</i>	Boreal Chickadee	Landbirds	B,W	
<i>Phylloscopus borealis</i>	Arctic Warbler	Landbirds	C	
<i>Regulus calendula</i>	Ruby-crowned Kinglet	Landbirds	C	
<i>Myadestes townsendi</i>	Townsend's Solitaire	Landbirds	C	
<i>Catharus minimus</i>	Gray-cheeked Thrush	Landbirds	B	
<i>Catharus ustulatus</i>	Swainson's Thrush	Landbirds	C	

Table A1 continued

Scientific name	Common name	Bird group	Status	Priority
<i>Turdus migratorius</i>	American Robin	Landbirds	B	
<i>Ixoreus naevius</i>	Varied Thrush	Landbirds	B	
<i>Luscinia svecica</i>	Bluethroat	Landbirds	C	Yes
<i>Oenanthe oenanthe</i>	Northern Wheatear	Landbirds	B	

Appendix 2

General Methodology for Compiling the Six Standard Elements

Each strategy includes six required elements to conform to the national standard. An extensive manual (Kennedy et al. 2012) provides methods and other guidance for completing each element. The six elements provide an objective means of moving towards multi-species conservation efforts that are targeted to species and issues of highest priority. The six elements are:

- 1) identifying priority species – to focus conservation attention on species of conservation concern and those most representative of the region
- 2) attributing priority species to habitat classes – a tool for identifying habitats of conservation interest and a means of organizing and presenting information
- 3) setting population objectives for priority species – an assessment of current population status compared to the desired status, and a means of measuring conservation success
- 4) assessing and ranking threats – identifies the relative importance of issues affecting populations of priority species within the planning area as well as outside Canada (i.e., throughout their life cycle)
- 5) setting conservation objectives – outlines the overall conservation goals in response to identified threats and information needs; also a means of measuring accomplishments
- 6) proposing recommended actions – strategies to begin on-the-ground conservation to help achieve conservation objectives.

The first four elements apply to individual priority species, and together they comprise an assessment of the status of priority species and the threats they face. The last two elements integrate information across species to create a vision for conservation implementation both within Canada and in countries that host priority species during migration and the non-breeding season.

Element 1: Species Assessment to Identify Priority Species

The Bird Conservation Strategies identify “priority species” from all regularly occurring bird species in each subregion. The priority species approach allows management attention and limited resources to focus on those species with particular conservation importance, ecological significance and/or management need. The species assessment processes used are derived from standard assessment protocols developed by the four major bird conservation initiatives.¹

The species assessment process applies quantitative rule sets to biological data for factors such as:

- population size,
- breeding and non-breeding distribution,

¹ Partners in Flight (landbirds), Wings Over Water (waterbirds), Canadian Shorebird Conservation Plan (shorebirds), North American Waterfowl Management Plan (waterfowl).

- population trend,
- breeding and non-breeding threats, and
- regional density and abundance.

The assessment is applied to individual bird species and ranks each species in terms of its biological vulnerability and population status. The assessments can be used to assign sub-regional (i.e., provincial/territorial section of a BCR), regional (BCR) and continental conservation priorities among birds.

Element 2: Habitats Important to Priority Species

Identifying the broad habitat requirements for each priority species in the breeding and non-breeding season allows species with shared habitat-based conservation issues or actions to be grouped. If many priority species associated with the same habitat class face similar conservation issues, then conservation action in that habitat class may support populations of several priority species. In most cases, all habitat associations identified in the literature are listed for individual species. Habitat associations do not indicate relative use, suitability ratings or rankings, nor selection or avoidance; this could be a useful exercise to undertake in the future.

In order to link with other national and international land classification schemes and to capture the range of habitat types across Canada, habitat classes for all priority species are based, at the coarsest level, on the hierarchical approach of the international Land Cover Classification System (LCCS) developed by the United Nations Food and Agriculture Organization (FAO 2000). Some modifications were made to the LCCS scheme to reflect habitat types that are important to birds that are not included in the classification (e.g., marine habitats). Species often are assigned to more than one of these coarse habitat classes. To retain the link to regional spatial data (provincial forest inventories, etc.), or to group species into regionally relevant habitat classes, individual BCR strategies may identify finer-scale habitat classes. Finer-scale habitat attributes and the surrounding landscape context were also captured when possible to better guide the development of specific conservation objectives and actions. In this strategy, we note whether species occur in coastal or alpine areas. These designations were considered a finer-scale attribute of the LCCS habitat class (e.g., “coastal wetlands”), and are not treated as a separate habitat category.

Element 3: Population Objectives for Priority Species

A central component of effective conservation planning is setting clear objectives that can be measured and evaluated. Bird Conservation Strategies set objectives based upon the conservation philosophies of national and continental bird initiatives, including the North American Bird Conservation Initiative (NABCI), that support conserving the distribution, diversity and abundance of birds throughout their historical ranges. The baselines for population objectives used in this planning exercise (those existing during the late 1960s, 1970s and 1990s for eastern waterfowl) reflect population levels prior to widespread declines. Most of the four bird conservation initiatives under the umbrella of NABCI have adopted the same baselines at the continental and national scale (waterfowl, shorebirds and landbirds; national

and continental waterbird plans have not yet set population objectives). Some regions in the current planning effort have adjusted baselines to reflect the start of systematic monitoring. The ultimate measure of conservation success will be the extent to which population objectives have been reached. Progress towards population objectives will be regularly assessed as part of an adaptive management approach.

Population objectives for all bird groups are based on a quantitative or qualitative assessment of species' population trends. If the population trend for a species is unknown, the objective is usually "assess and maintain", and a monitoring objective is set. Harvested waterfowl and stewardship species that are already at desired population levels are given an objective of "maintain". For any species listed under the *Species at Risk Act* (SARA) or under provincial/territorial endangered species legislation, Bird Conservation Strategies defer to population objectives in available Recovery Strategies and Management Plans. If recovery documents are not available, objectives are set using the same approach as for other species within that bird group. Once recovery objectives are available, they will replace interim objectives.

Element 4: Threat Assessment for Priority Species

Bird population trends are driven by factors that affect reproduction and/or survival during any point in the annual cycle. Threats that can reduce survival include, for example, reduced food availability at migratory stopovers or exposure to toxic compounds. Examples of threats that can reduce reproductive success may include high levels of nest predation or reduced quality or quantity of breeding habitat.

The threats assessment exercise included three main steps:

1. Conducting a literature review to itemize past, current and future threats for each priority species and classifying the threats using a standardized classification scheme (Salafsky et al. 2008).
2. Ranking the magnitude of threats for priority species following a standardized protocol (Kennedy et al. 2012).
3. Preparing a set of threat profiles for the BCR subregion, for broad habitat categories.

Each threat was categorized following the IUCN-CMP threat classification scheme (Salafsky et al. 2008) with the addition of categories to capture species for which we lack information. Only threats stemming from human activity were included in the threats assessment because they can be mitigated; natural processes that prevent populations from expanding beyond a given level were considered and noted, but no actions beyond research and/or monitoring were developed. Threats were ranked by assessing the scope (the proportion of the species' range within the subregion that is affected by the threat) and severity (the relative impact that the threat poses to the viability of the species' populations) of the threat. The scores for scope and severity were combined to determine an overall magnitude low, medium, high or very high. These magnitudes were then rolled up by threat categories and sub-categories across habitat types (see Kennedy et al. 2012 for details on this process). The threats roll-up allows for comparison of the relative magnitude of the threats among threat categories and habitat types.

The scoring and ranking of threats not only helps to determine which threats contribute most to population declines in individual species, but also allows us to focus attention on the threats with the greatest effects on suites of species or in broad habitat classes.

Element 5: Conservation Objectives

Overall, conservation objectives represent the desired conditions within the subregion that will collectively contribute to achieving population objectives. Objectives may also outline the research or monitoring needed to improve the understanding of species declines and how to best take action.

Currently, most conservation objectives are measurable using qualitative categories (e.g., decrease, maintain, increase) that will allow an evaluation of implementation progress, but they are not linked quantitatively to population objectives. Implementation that incorporates an active adaptive management process is an underlying principle of this conservation effort and will allow for future evaluation of whether or not reaching conservation objectives contributed to achieving population objectives.

Whenever possible, conservation objectives benefit multiple species, and/or respond to more than one threat. However, where necessary, they focus on the specific requirements of a single species.

Conservation objectives generally fall into one of two broad categories:

- habitat objectives within the BCR subregion (the quantity, quality and configuration of priority habitats),
- non-habitat objectives within the BCR subregion (minimizing mortality by reducing predation, conducting education and outreach to reduce human disturbance, etc.)

Ideally, habitat objectives would reflect the type, amount and location of habitat necessary to support population levels of priority species outlined in the population objectives. Currently, there is a lack of data and tools at the BCR scale to develop these specific quantitative objectives. Threats-based objectives present the direction of change required to move toward the population objectives using the best available information and knowledge of ecosystem management strategies within broad habitat types.

Element 6: Recommended Actions

Recommended conservation actions are the strategies required to achieve conservation objectives. Recommended actions are usually made at the strategic level rather than being highly detailed and prescriptive. Actions were classified following the IUCN-CMP classification of conservation actions (Salafsky et al. 2008) with the addition of categories to address research and monitoring needs. When possible, more detailed recommendations can be included, for example if beneficial management practices, ecosystem plans or multiple recovery documents are available for a subregion. However, actions should be detailed enough to provide initial guidance for implementation.

The objectives for research, monitoring and widespread issues may not have actions associated with them. These issues are often so multi-faceted that actions are best designed in consultation with partners and subject-matter experts. Implementation teams will be better positioned to address these complex issues, drawing input from various stakeholders.

Recommended actions defer to or support those provided in recovery documents for species at risk at the federal, provincial or territorial level, but because these strategies are directed at multiple species, actions are usually more general than those developed for individual species. For more detailed recommendations for species at risk, readers should consult recovery documents.

www.ec.gc.ca

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