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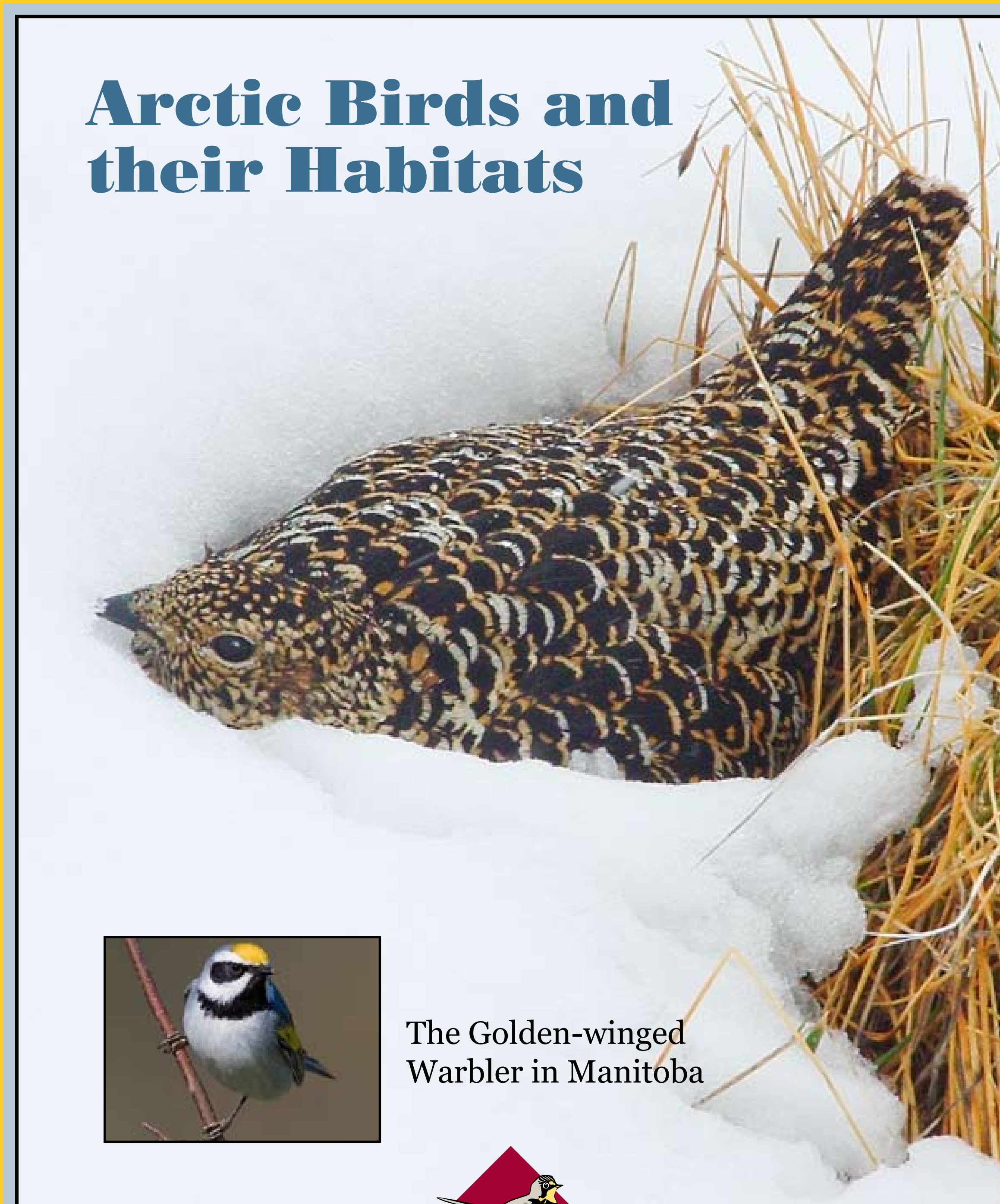

Arctic Birds and their Habitats

The Golden-winged Warbler in Manitoba

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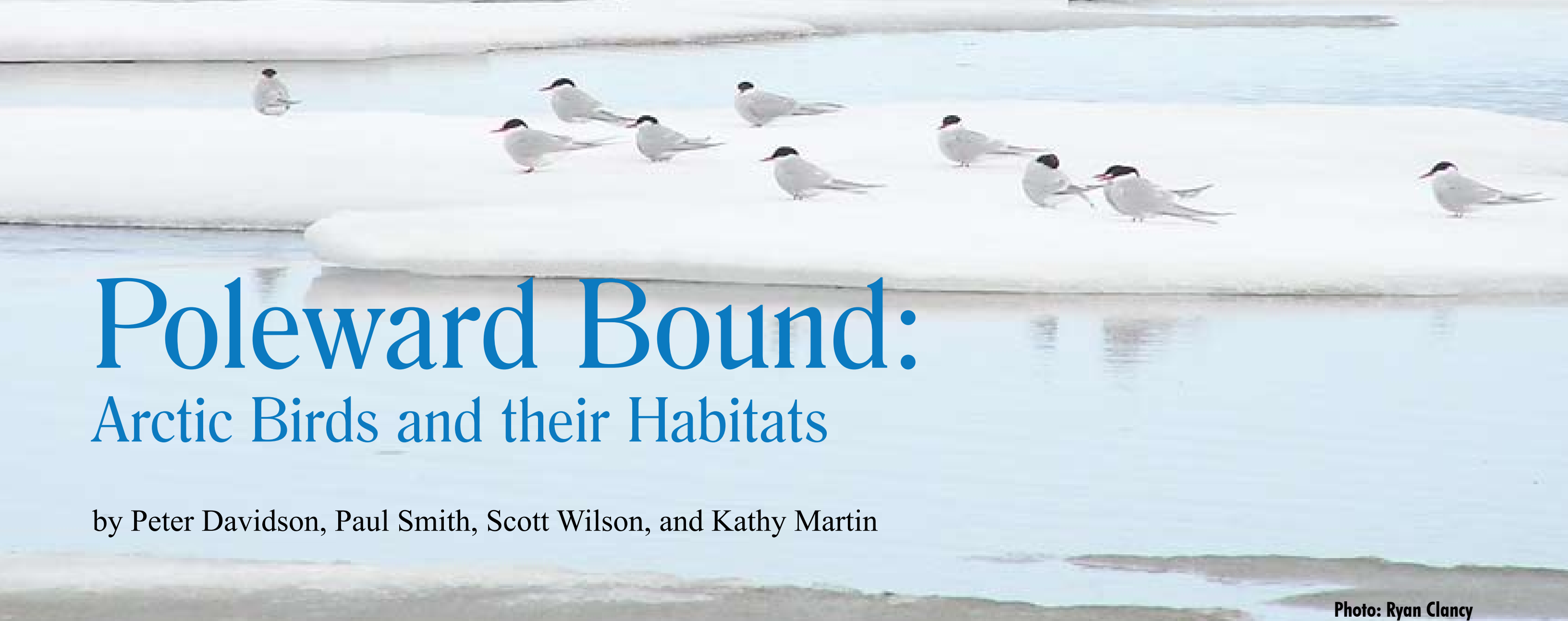

Poleward Bound:
Arctic Birds and their Habitats

by Peter Davidson, Paul Smith, Scott Wilson, and Kathy Martin

Photo: Ryan Clancy

For nine months of the year, the Arctic appears superficially dormant, with most terrestrial life covered in an insulating snow blanket, and most marine life under a sheet of ice. In May and June the melting snow and ice, under the near-continuous sunlight of the brief summer, provide the raw materials for one of the most rapid and productive annual blooms of life on the planet. Every summer, several hundred million birds are drawn from more southerly latitudes to exploit this food bonanza, before migrating south again to warmer regions, often over long distances.

Shorebirds breed on the treeless tundra plains, while seabirds breed along the coast, on rocky cliffs and islands, often maintaining a close association with ice. Some migrant songbirds nest on the tundra, including Horned Lark, Lapland Longspur, and Snow Bunting. A few other landbirds, including Willow and Rock ptarmigan, Gyrfalcon, and Common Raven, spend most or all of their annual cycle in arctic regions.

Over the past century, the Arctic and Antarctic have warmed more quickly than any other part of the planet, at almost twice the global average, which has major implications for birdlife. Current climate models predict that: i) the extent of summer sea ice, which has declined by 15-20% per decade over the past 30 years, will continue to reduce substantially; ii) the ice-free season will increase; and iii) the area of tundra could shrink by over 50% by 2100. There is regional variation within this general pattern. For example, while most of the western and central Arctic are warming, portions of the eastern Arctic have experienced a recent cooling trend, with delayed spring snow melt. A suite of recent and long-term studies, some of which are part of the current International Polar Year research effort, shed light on how these changes may affect arctic bird populations.

Thick-billed Murres/Guillemots de Brünnich Photo: Paul Smith

A Tale of Two Colonies

Many models predict that climate change will lead to a range contraction for arctic wildlife and plant species at lower latitudes, and expansion at higher latitudes. The Canadian Wildlife Service's Tony Gaston and colleagues have been studying seabirds in the eastern Arctic for the past three decades. Their research provides one of the only demonstrations of how this prediction might work, and highlights the different ways in which climate change is playing out across different parts of the Arctic. Since 1975, the team has monitored the reproductive success of colonies of Thick-billed Murres at two locations – on Coats Island in northern Hudson Bay, at the southern edge of the species' breeding range, and on Prince Leopold Island off the northern tip of Baffin Island, at the northern edge of its breeding range.

At Coats Island in the Low Arctic, two trends are apparent. Murres are laying eggs earlier in the season, coinciding with a long-term reduction in the extent of sea ice cover driven by warmer winter and spring temperatures. As well, in years of low ice cover, murres do not fare as well as they do in years of 'normal' ice cover, with adults weighing less and chicks growing more slowly, indicating that reduced ice cover has a negative effect on reproductive success.

On Prince Leopold Island in the High Arctic, there has been no trend in summer ice cover (although remote sensing suggests an increase in the open water period), and no detectable change in timing of breeding. In contrast to the Low Arctic, murre reproduction here is more successful


American Golden-Plover/Pluvier bronzé Photo: Ron Ridout

during years of early ice break-up and low summer ice cover, when murres are able to access open water close to the colony. In years of extensive summer ice cover, murres must commute up to 200 km to open water in late June.

Gaston's team documented a dietary switch in the Thick-billed Murre population on Coats Island during the mid-1990s, from Arctic cod – a species characteristic of High Arctic ecosystems, and the main prey of Thick-billed Murres on Prince Leopold Island – to smaller capelin and sandlance, the predominant schooling fishes in Atlantic Canada waters. Thick-billed Murres, which normally carry one fish at a time, may need to triple the number of trips from the colony to their feeding areas to nourish nestlings adequately with capelin.

Warming ocean conditions in the Low Arctic may eventually promote colonization of the area by Razorbill and Common Murre (species currently restricted to the North Atlantic), which may intensify competition for Thick-billed Murres. Furthermore, the advance in the peak abundance of mosquitoes in the Low Arctic since the mid-1980s has increased murre egg loss and adult mortality during hot days, further reducing breeding success.

Overall, a continuing warming trend with reduced summer ice cover, a fish-community shift toward smaller species, and potential increases in competition with other seabirds are likely to continue to reduce reproductive success of Thick-billed Murres on Coats Island. However, conditions for murre reproduction may improve for colonies farther north on Prince Leopold Island, if the summer ice-free period there increases. The net effect for the Thick-billed Murre will be a gradual decline in the Hudson Bay population and an increase in numbers at the High Arctic colonies.

Studies of other colonial seabirds – Northern Fulmar, Black-legged Kittiwake, and Glaucous Gull – on Prince Leopold Island suggest similar improved conditions for reproduction in northern portions of their ranges, at least in the short term, with a trend toward earlier ice break-up and longer ice-free summer periods. This gradual poleward shift in suitable breeding conditions could act as a buffer against climate change in the short term, but because the specific colony locations have evolved over millennia, these hardy arctic specialists may eventually find themselves in hot water.

The Transforming Tundra

In summer, a mosaic of lakes and ponds covers 20-50% of the tundra landscape. Shorebirds are one of the most abundant and diverse bird groups on the tundra, from the boldly coloured Red Phalarope and Ruddy Turnstone to the cryptic White-rumped Sandpiper and American Golden-Plover. At least 20 of Canada's 47 shorebird species are regular arctic breeders, and nine other species breed in the taiga shield and Hudson plains.

Arctic-breeding shorebirds are voracious insectivores. They have timed their breeding cycle to ensure that chicks have easy access to the immense summer burst of insect productivity. Less than six weeks after they hatch, the chicks must be developed enough to make the challenging migration south, which for many takes them to the beaches of Central and South America. Some travel as far south as Tierra Del Fuego, a distance of 14,000 km.

Since most shorebirds are long-lived, populations are vulnerable to changes in adult survival. And because they lay small clutches and raise only one brood per year, shorebird populations have a limited ability to bounce back from declines. Accelerated climate warming in the Arctic has both positive and negative potential implications for shorebirds. To maximize chick survival in the harsh arctic climate, eggs should hatch when the weather is most favourable for small chicks to maintain their body temperature, and when insect prey is most available.

As arctic summer weather becomes more variable, chicks may hatch before or after peak emergence of insects, with negative consequences for breeding success. However, predicted increases in summer air temperatures could also have positive effects on shorebird breeding success. In the Siberian Arctic, breeding seasons with warmer June and July temperatures have been linked to increased chick survival, and earlier breeding in warm years may increase opportunities to re-nest if first attempts fail.

The tundra is expected to retreat northward as climate warming proceeds. Shallow wetlands, which are the preferred nesting and feeding habitats of many shorebirds, are sensitive to changes in permafrost depth and precipitation. Warmer summer weather and a deepening active layer could lead to the drying of wetlands, with potentially negative effects on the abundance of invertebrates. Taller, denser vegetation is predicted to arrive from the south, with boreal forests expected to overwhelm dwarf shrub habitats along the tundra's southern edge. Some scenarios predict that all of Hudson Bay's coastal tundra could be replaced by boreal forest by 2100.

For shorebirds, this is just one piece in an increasingly uncertain puzzle. Across North America, shorebirds are in widespread decline. Of the 35 species for which reasonable survey data exist, 28 (80%) show negative trends, and 19 of them show statistically significant declines since the 1970s. A disproportionate number of declines have been noted for arctic breeders that migrate along North America's east coast. The globe-spanning migrations of arctic shorebirds make it difficult to identify the causes of declines. While most disturbance and habitat degradation is believed to be occurring at shorebird stopover and wintering sites in temperate and tropical regions, climate change on the breeding grounds could be playing an increasingly significant role.

Arctic Residents Respond Differently to Climate Variation

With their feathered feet, ability to burrow in snowdrifts for warmth, and habitat-coordinated plumage that changes from brown in summer to white in winter, ptarmigan are truly adapted for arctic conditions. Although they are permanent residents, ptarmigan populations in the High Arctic are partially migratory and may move hundreds of kilometres south during winter. Like other tundra species, ptarmigan are at risk from the loss of habitat following the northward advance of boreal forest. There is also concern over how their reproduction and survival might be affected by the rising temperatures and greater precipitation expected in many northern regions.

Scott Wilson's recent research in the Yukon Territory has found that co-occurring Rock and White-tailed ptarmigan respond differently to the severity of spring climate. The onset of breeding for both species is tied to spring temperature and the timing of snow melt, with breeding commencing earlier in warmer years. Although the two species breed at the same time, they differ in how much effort they put into reproduction in warm versus cold springs. Rock Ptarmigan clutches tend to be slightly larger than those of White-tailed Ptarmigan in warm springs, but considerably smaller in cold springs, and they are less likely to re-nest if their first nest is lost to predation.

These results suggest that while both species expend similar effort in warm springs, White-tailed Ptarmigan have a greater capacity to maintain that effort in cold, late springs. The mechanism behind this difference may be related to how susceptible the two species are to predators. Annual survival of Rock Ptarmigan in the Yukon is about 20% higher than White-tailed Ptarmigan, with most predation likely attributable to Golden Eagles and Gyrfalcons. Life-history theory suggests that when the probability of survival to the next breeding season is lower, females should put more effort into reproduction during the current year. Despite low survival rates, White-tailed Ptarmigan may be able

Gyrfalcon with ptarmigan/Faucon gerfaut avec lagopède Photo: Ron Ridout

to compensate by maintaining a relatively high level of breeding productivity, even during years when reproduction is otherwise difficult. Overall, these patterns may also show how interactions with other species, including predators, could affect how a particular species responds to climate change.

Arctic Songbird Survival Secrets

Because most arctic birds are ground nesters, they require snow-free areas to initiate egg-laying. As such, they must be capable of adjusting the onset of breeding to suit variable spring conditions. This is especially challenging for birds that weigh only 10 to 50 grams. Songbirds must survive and incubate during almost daily freezing temperatures, find shelter during multi-day spring storms, and evade a wide array of predators, including jaegers and Rough-legged Hawks.

Songbirds breed successfully in the Arctic by adopting a few simple behavioural and physiological rules that mitigate their cold and variable environments. They may choose nest sites that are protected from strong winds and snow and provide additional warmth from reflectance. White-crowned Sparrows nest on the ground in most years, but switch to nesting above ground in small shrubs during years of late snow fall. When conditions are very cold, incubating Horned Larks will take more frequent, but shorter, recesses to minimize the costs of re-warming their eggs. American Pipit females can avoid taking incubation breaks because their mates bring food to the nest. Other survival secrets involve altering behaviour in response to weather, avoiding stress responses when it is very cold, and when it is hot, taking a snow shower to cool off.

The hardiness of small songbirds in the Arctic can be amazing. At one site,

Horned Lark/Alouette hausse-col Photo: Harold Stiver

American Robins started laying eggs before ptarmigan, at a time when it was challenging to stay warm overnight in an arctic-rated sleeping bag!

Local Knowledge Tells

Canada has responsibilities to ensure the long-term sustainability and health of Canadian Arctic bird populations, both through international agreements like the UN Convention on Migratory Species, and from a cultural and economic standpoint, because arctic birds are part of the traditional diet of indigenous communities like the Inuit. First Nations communities contribute to our understanding of historical baseline conditions in the Arctic, and what changes to the polar environment will mean for birds. For example, scientists have learned much from the traditional ecological knowledge of the Inuit about Common Eiders wintering in polynyas (areas of permanent open water, surrounded by sea-ice) in southeastern Hudson Bay. Working more with northern communities and establishing long-term monitoring efforts like those on Coats and Prince Leopold islands will be essential in advancing our understanding of Arctic birds in their rapidly changing environments.

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Les oiseaux de l'Arctique et leurs habitats

Pendant neuf mois de l'année, l'Arctique semble dormant. Pour la plupart, les espèces végétales sont alors recouvertes d'un manteau de neige et de glace. En mai et juin, toutefois, alors que cette couverture fond et que l'ensoleillement est presque continu, on assiste à une croissance annuelle de la végétation des plus rapides et des plus productives sur la planète. Chaque été, avant leur migration vers le Sud, plusieurs centaines de millions d'oiseaux sont attirés par ce véritable festin dans ce lieu nordique.

Au cours du siècle dernier, les zones polaires se sont réchauffées plus rapidement que toute autre région dans le monde, l'augmentation de la température y correspondant à presque le double de la moyenne planétaire. Bien que les valeurs varient selon les zones arctiques, selon les modèles climatiques actuels, on prévoit que : i) l'étendue de la glace de mer, qui a diminué de 15 à 20 % par décennie au cours des 30 dernières années, continuera de régresser considérablement, ii) la durée de la saison des eaux libres augmentera et iii) la toundra perdra de 40 à 57 % de sa superficie. Diverses études portent sur la manière que ces changements sont susceptibles d'influer sur les populations d'oiseaux de l'Arctique.

D'après bon nombre, le changement climatique entraînera une réduction de l'aire de répartition des espèces fauniques et floristiques arctiques aux basses latitudes et un accroissement de cette aire aux altitudes élevées. Tony Gaston et ses collègues du Service canadien de la faune surveillent le succès de reproduction des Guillemots de Brünnich dans l'Est de l'Arctique depuis 1975, et les résultats obtenus pourraient appuyer cette prévision.

À la limite sud de l'aire de reproduction des Guillemots de Brünnich, sur l'île Coats, un hiver et un printemps plus chauds se sont traduits par une réduction à long-terme de l'étendue de la glace de mer. Les Guillemots de Brünnich y pondent leurs œufs plus tôt dans la saison, et le rétrécissement de la couverture de glace a des effets nuisibles sur leur reproduction. Cependant, sur l'île Prince Leopold, qui est située à la limite nord de l'aire de reproduction de l'espèce, la diminution de l'étendue du manteau glaciel est bénéfique pour l'espèce. Aucun changement décelable du moment de reproduction n'y est observé, quoique le taux de reproduction de l'espèce y soit plus élevé au cours des années où la débâcle a lieu tôt dans la saison et la couverture de glace est moins vaste en été, car les oiseaux ont alors accès aux eaux libres à proximité de la colonie.

Photo: Grant Gilchrist

Phalarope à bec large/Red Phalarope Photo: Rob Tizard

La population de Guillemots de Brünnich de l'île Coats est confrontée à des enjeux grandissants, tandis que sur l'île Leopold Island, les conditions de reproduction peuvent s'améliorer si la période des eaux libres estivale se prolonge. Cette situation provoquera une réduction progressive de la population dans la baie d'Hudson et une augmentation des effectifs dans l'Extrême Arctique. Les études des colonies de reproduction d'autres oiseaux de mer, notamment du Fulmar boréal, de la Mouette du Pacifique et du Goéland bourgmestre, sur l'île Prince Leopold Island révèlent, du moins à court terme, des améliorations similaires des conditions dans la partie septentrionale de leurs aires de reproduction.

Le réchauffement climatique accéléré dans l'Arctique pourrait avoir des incidences tant bénéfiques que nuisibles sur les oiseaux de rivage. À mesure que les variations climatiques estivales deviennent plus marquées, leurs œufs pourraient éclore après la période d'éclosion de pointe des insectes, ce qui aurait des conséquences néfastes sur les oisillons. Toutefois, les températures plus élevées de l'air en été pourraient favoriser la survie d'un plus grand nombre de petits et accroître les possibilités d'une deuxième nidification si la première tentative échoue.

On s'attend à ce que le réchauffement climatique modifie le paysage. Les limites de la toundra pourraient se déplacer vers le Nord et, d'après certains scénarios, la toundra côtière de la baie d'Hudson pourrait être entièrement remplacée par une forêt boréale d'ici 2010. Les habitats des populations d'oiseaux résidants comme le lagopède pourraient disparaître, et l'augmentation des températures et des précipitations dans les régions nordiques pourrait perturber la reproduction et la survie de ces espèces. Les interactions avec les autres espèces au sein de la communauté, comme les oiseaux prédateurs, pourraient influer sur la façon qu'une espèce particulière réagit au changement climatique.

Une collaboration accrue avec les collectivités du Nord et la mise en œuvre de programmes de surveillance à long terme comme ceux qui existent sur les îles Coats et Prince Leopold seront essentiels afin de faire progresser nos connaissances au sujet des oiseaux arctiques aux prises avec l'évolution rapide des milieux qu'ils fréquentent.