

# InfoNorth

## How Arctic Marine Birds Help Researchers Study a Changing North

by Jennifer F. Provencher

**T**HE ARCTIC REGION IS CURRENTLY UNDERGOING environmental change at an unprecedented rate (IPCC, 2007). Changing climatic conditions, a growing tourism industry, increasing levels of development and the associated marine shipping, and a growing human population are a few of the accumulating challenges the circumpolar Arctic is now facing (ACIA, 2004). The Canadian Arctic is no exception. Recent warming trends in Arctic Canada have led to reduced summer sea ice extent, as well as changes in snow line elevation and snowmelt (Wang and Overland, 2012; Miller et al., 2013). With the development of the tourism industry and the natural resource sector in northern Canada, ship traffic is predicted to increase, particularly around Baffin Island and the Northwest Passage (Smith and Stephenson, 2013; Dawson et al., 2014). In a time of rapid change, studies that examine how changes are affecting both the people and the environment are needed to develop evidence-based management and adaptation strategies (Armitage et al., 2011; Bring and Destouni, 2014).

With more than 36 000 islands and 162 000 km of coastline, the marine environment represents a large component of the Canadian Arctic. Although the magnitude of the northern marine environment makes it challenging to conduct research there, access can be enhanced through the involvement and participation of the many communities that are widely distributed throughout the region. An additional approach when working in this geographically large and diverse region is to examine “indicator species”: those that, in addition to being the focus of specific questions, also support a wider array of research objectives. As one example, marine birds are recognized as important global sentinels in marine ecology (Piatt et al., 2007), as well as in northern environments (Karnovsky et al., 2008).

By definition, marine birds spend most of the year at sea, typically dispersed across vast tracts of ocean, but each summer they must return to land to breed, often in large nesting colonies (Gaston, 2004). This annual pattern allows research programs to establish protocols that are repeatable from year to year and to support research questions that benefit from long-term data sets (Gaston et al., 2009). Given the number of birds nesting at colonies, seabirds also offer larger sample sizes than many other wildlife species studied: researchers can often monitor tens of thousands of individuals at one location (Piatt et al., 2007). It is important that marine birds are also among the few marine indicator species that regularly visit the terrestrial environment,

which makes them an accessible study group through which to address marine research questions (Piatt et al., 2007).

Marine birds also offer an opportunity to work closely with northern communities in collaborative ways. For example, many northern residents harvest marine birds for their eggs, feather down, and meat and thus are well positioned to provide meaningful input into research activities (Mallory et al., 2003, 2006a). Collaborations can include the incorporation of traditional and local knowledge into research objectives and findings (e.g., Mallory et al., 2003; Henri et al., 2010) and can support collections of samples for scientific analysis through community-based fieldwork (e.g., Jamieson et al., 2001; Provencher et al., 2013). The combination of local knowledge, community involvement, and scientific studies can also be used to help plan and develop wildlife conservation tools through a collaborative approach (Mallory et al., 2006a). Additionally, working with marine birds offers a diversity of educational opportunities that can increase understanding of northern research among students of all ages while addressing a wide range of research questions (Provencher et al., 2013).

### PARASITES IN MARINE BIRDS

Parasites are a common and important part of any ecosystem (Lafferty et al., 2008), and that of marine birds is no exception. In the North, where changing climatic conditions are causing warming temperatures in many areas, parasite life cycles and their possible impacts on wildlife are predicted to change in the coming decades (Brooks and Hoberg, 2007). In the western Canadian Arctic, warming temperatures may be benefiting existing and new parasites in the region to the detriment of their hosts (Kutz et al., 2004). Parasites alone can have an impact on species through changes in body condition, behaviour, and reproduction (Hudson, 1986; Saumier et al., 1991), but parasites can also interact with a variety of other wildlife stressors, including contaminants (Marcogliese and Pietrock, 2011). As part of my PhD research at Carleton University and in collaboration with Environment Canada and Hunter and Trapper Organizations (HTOs) in Cape Dorset, Coral Harbour, and Sanikiliauq, Nunavut, I have collected samples from more than 400 Common Eider (*Somateria mollissima*) and King Eider (*Somateria spectabilis*) ducks taken as part of a subsistence harvest. I conducted parasitological

examination of these tissues from 2011 through 2013, and analysis of the birds is currently underway. I am comparing the gastrointestinal (GI) helminths of the two eider species and within migratory and non-migratory subspecies of the Common Eider (*S.m. borealis* and *S.m. sedentaria*). These studies will provide a current assessment of GI parasites in northern eider species and may identify groups of birds that are susceptible to parasitism now or will be in the future. Both objectives are important in light of the changes in parasitism predicted in the region.

At East Bay Island, Nunavut, a large breeding colony of Common Eider ducks also serves as a rich research location to investigate the factors that affect marine bird reproduction. In 2013 and 2014, I undertook an experimental manipulation of eider ducks to assess whether the presence of GI parasites affected female reproductive effort. In each year of the experiment, more than 100 female eiders were given a commonly used anti-parasite treatment; I then monitored them through the breeding season to observe how parasite removal might affect reproductive success. Analysis of my findings is currently underway.

## CONTAMINANTS

Pollution is a challenge in the face of rapid growth and development, and marine birds have been important in tracking how pollution affects ecosystems (Rigét et al., 2011). Pollutants include both micro-contaminants (e.g., trace elements such as mercury (Hg) and persistent organic pollutants) and macro-contaminants (e.g., plastic and other large man-made pollutants). In the North, micro-contaminants are a growing concern because global atmospheric and oceanic processes can deposit large concentrations of micro-contaminants in regions where there is otherwise little pollution (Rigét et al., 2010, 2011). Understanding how micro-contaminants move through ecosystems and affect wildlife is important to understanding the implications of environmental pollution, and marine birds have served as an important group in this area of study (Rigét et al., 2010).

As part of my PhD research, I am examining Hg concentrations in Common and King Eider ducks. Through support from local HTOs in Cape Dorset, Coral Harbour, and Sanikiluaq, I am examining the same harvested birds used for parasitological assessment. Concurrent sampling of both Hg and parasites is a powerful approach in which I can simultaneously assess how interaction of these two factors may affect body condition and reproduction in eider ducks. Such an assessment is especially relevant given that both Hg and parasite levels are predicted to increase in the Arctic in the coming decades (Brooks and Hoberg, 2007; Marcogliese and Pietrock, 2011; Kirk et al., 2012; Provencher, 2013). In addition to studying how Hg and parasites may interact within eider hosts, I am also using Hg results from this study to assess any changes in eider duck tissue concentrations over time by comparing my samples with historical studies (Mallory et al., 2004).

Beyond my own research objectives, the ongoing sampling of marine bird tissue for contaminant analysis is also a critical component of future studies not yet started or even considered. The National Wildlife Specimen Bank at the National Wildlife Research Centre in Ottawa has been archiving and preserving tissues since the 1960s, and this collection allows for retroactive analyses of new and emerging contaminants of concern (Braune et al., 2010). Tissue samples of all of the birds studied for my PhD will be archived at the National Wildlife Specimen Bank, an openly accessible repository that can support future research projects both within and external to Environment Canada. The long-term cataloging and preservation of tissues at the National Wildlife Specimen Bank can enable researchers to track long-term trends in contaminants, and this research has informed global policy decisions such as the ban on particularly harmful chemical substances (Braune et al., 2010). For example, the analysis of marine bird tissues has contributed to understanding long-term trends in brominated flame retardants, DDT, and Hg in the Arctic (Gamberg et al., 2005; Braune et al., 2006), and these key pieces of evidence have helped inform policy and shape regulatory standards (AMAP, 2011).

## PLASTIC POLLUTION

Although the study of micro-contaminants such as mercury is the main focus of my PhD research, another emerging issue is macro-contaminants (especially plastic) that are affecting the global oceans (UNEP, 2014), including northern waters (Provencher et al., [2015]). Marine birds sampled as part of my PhD research for contaminant and parasite analyses have also contributed to studies examining plastic pollutants ingested by birds (Provencher et al., 2014). Monitoring plastic pollution in northern waters contributes to understanding the dynamics of plastic pollution in the marine environment. Both “user plastics” (e.g., plastics from consumer products such as bottle caps) and “industrial plastics” (i.e., plastic pellets used in industrial plastic making processes) have been found in Arctic marine birds (Fig. 1; Mallory et al., 2006b; Provencher et al., 2009). Since there are no sources of industrial plastics in the Canadian Arctic, this finding demonstrates that plastic pollution travels to the North passively on ocean currents (Mallory et al., 2006b). With no national strategy for assessing ingested plastics in marine birds, such opportunistic collections in partnership with local communities is currently the only widespread effort to assess how plastic pollution is occurring in marine wildlife in Arctic Canada (Provencher et al., [2015]).

## MONITORING WILDLIFE DISEASE

This practice of using birds to address multiple research objectives while minimizing handling and stress to wildlife is widely used by the northern marine bird research team.



FIG. 1. Ingested plastic debris found inside a Northern Fulmar in northern Canada.

Tracking emerging diseases has been part of the northern marine bird research program in the last decade (Descamps et al., 2012; Harms, 2012). One of the largest efforts in emerging disease research in marine birds has been the study of avian cholera among waterfowl (ducks and geese). Avian cholera is a bacterial disease with outbreaks that can cause significant mortality, particularly at stopover sites and breeding colonies where waterfowl species congregate (Samuel et al., 2007). Although avian cholera outbreaks in domestic birds have occurred in the temperate regions of the United States and Canada since the 1880s, the first report of avian cholera in wild waterfowl occurred in 1943–44 in Texas (Samuel et al., 2007). Since that time, avian cholera has been detected in many other regions, including Hudson Bay and northern Quebec, where it was found in breeding Common Eider ducks in 2005 (Buttler et al., 2011; Harms, 2012). Since the detection of avian cholera in the eastern Canadian Arctic, surveys of Common Eider colonies have been conducted in collaboration with local communities to discover how widespread the disease is in the region and what the impacts may be on eider duck colonies (Fig. 2; S. Iverson pers. comm. 2014). This effort has included performing avian cholera tests on all the birds handled at East Bay and collected by hunters for my PhD research in an effort to identify potential pathways and reservoirs of the disease among wild birds.



FIG. 2. The northern marine bird research team works with a hunter in Cape Dorset, Nunavut, to survey local eider colonies.

#### IDENTIFYING “ECOSYSTEM HOTSPOTS”

Identifying important wildlife habitat is a critical step in the conservation and management of species. The miniaturization of wildlife tracking technologies offers growing opportunities to better study marine bird movement and migration in the Arctic. There are ongoing efforts to study the areas important to marine birds throughout their annual cycle and how these areas overlap with shipping routes, resource extraction, and other developments. Through work at bird colonies, including East Bay Island, the northern marine bird research team has now been able to track hundreds of individual birds from almost a dozen species across all three of Canada’s oceans (Fig. 3). Although in-depth analysis and continued tracking of many species are still underway, the initial data suggest that marine birds breeding in the Canadian Arctic are using northern waterways such as Hudson Strait and Lancaster Sound extensively, but that they also travel widely outside this region each year. In addition, year-round tracking shows that many seabirds leave the Arctic later in the fall and return earlier in the spring than once thought. This

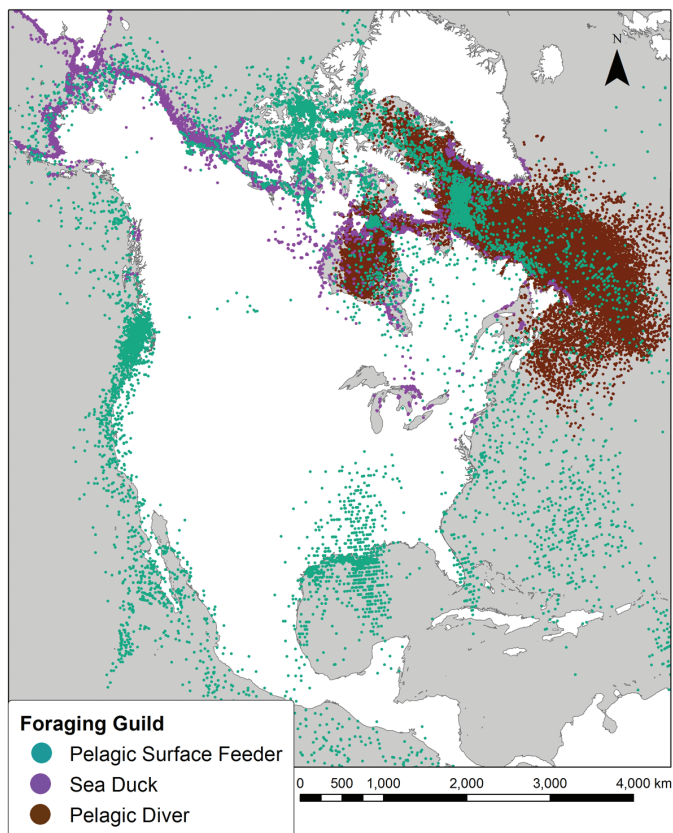


FIG. 3. Tracking data collected between 1994 and 2014 from marine birds nesting in the Canadian Arctic. Map prepared by Travis White.

is a new finding because it is difficult for both Northerners and researchers alike to reach and monitor offshore marine environments during periods of sea ice formation (fall) and breakup (spring). These tracking data allow researchers to identify not only areas important to wildlife, but also areas where wildlife habitat and industrial development may co-occur.

#### IDENTIFYING CHANGES IN NORTHERN FOOD WEBS

Lastly, Arctic marine birds are helping researchers to detect large-scale changes that are taking place in northern Canada as a result of changing climatic conditions. Thick-billed Murres (*Uria lomvia*) in the eastern Canadian Arctic are a widely distributed and harvested species. Thick-billed Murres gather in large numbers each summer to breed on steep cliffs in Nunavut and Nunavik, where they feed on fish and zooplankton in the waters surrounding the colonies. Studies that have examined the diet of Thick-billed Murres have been ongoing in Canada since the 1970s, and recent work has shown that changing climatic conditions are affecting the forage fish species in the region (Gaston et al., 2003). Declining levels of summer sea ice are linked with a decline in ice-associated Arctic cod (*Boreogadus saida*) and an increase in the warmer water

capelin (*Mallotus villosus*) in the diet of the murres in the low Arctic region, where summer sea ice has declined the most (Provencher et al., 2012).

The impacts of changes in sea ice cover are not limited to the marine environment. Declining levels of sea ice also affect the rate at which polar bears (*Ursus maritimus*) depredate nests of marine birds (Iverson et al., 2014). Polar bears typically use the sea ice as a hunting platform and move onto land only when the sea ice disappears with warming summer temperatures. As the extent of summer sea ice declines in some areas (e.g., the Hudson Bay/Strait region), the ice-free season becomes longer and so does the time that polar bears are forced to inhabit land. This decline in sea ice cover in the low Arctic has coincided with increased bear activity along coastlines and depredation of nests on marine bird colonies (Smith et al., 2010; Iverson et al., 2014). Such changes in ecosystem dynamics may have consequences for both the prey and the predator.

While marine birds are the focal wildlife for my own PhD research specifically, and of our northern research group in general, the scientific objectives include a much broader array of topics. Marine bird research continues to inform policy at regional, national, and international levels (e.g., AMAP, 2011). Collaborative community research efforts and education opportunities related to marine bird research continue to provide insight and capacity building with our northern partners (Mallory et al., 2006a; Provencher et al., 2013). Marine birds also offer long-term data sets that are helping us to understand how changing conditions may be affecting wildlife throughout the region (Provencher et al., 2012; Iverson et al., 2014). Through my own PhD research and as a member of the northern marine bird research team, I strive to carry on this collaborative approach to northern research, always keeping in mind that those who study birds in the North are more than just bird biologists.

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