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Aerial survey of sea ducks and whales in winter in eastern Canadian Arctic

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Abstract

In February of 2010, we conducted an exploratory aerial survey for sea ducks in the eastern Canadian Arctic along coastal waters of Ungava Bay, Hudson Strait, Frobisher Bay, and Labrador. Small numbers of eiders and long-tailed ducks were detected on the east and west coasts of Ungava Bay, Québec, Resolution Island, Nunavut and Labrador. A large concentration (~35 000 birds) of king and common eiders were detected in the waters around the Button Islands, Nunavut. We also report on incidental observations of beluga and bowhead whales and other species of wildlife observed on the survey.

Key words: eastern Canadian Arctic, Button Islands, wintering, king and common eider, long-tailed duck, bowhead whale

Résumé

En février 2010, nous avons effectué un relevé aérien exploratoire de canards de mer dans l'est de l'Arctique canadien, le long de sections de la baie d'Ungava, de l'est du détroit d'Hudson, de la côte sud de la baie de Frobisher et de la côte du Labrador. De petits nombres d'eiders et de Hareldes kakawis ont été détectés sur les côtes est et ouest de la baie d'Ungava, autour de l'île Resolution et sur la côte du Labrador. Un très grand groupe (~35 000 oiseaux) d'Eiders à tête grise et d'Eiders à duvet a été détecté dans les eaux entourant les îles Button, Nunavut. Nous rapportons également des observations fortuites de bélugas, de baleines boréales et d'autres espèces fauniques. [*Ceci est une traduction fournie par l'auteur du résumé en anglais.*]

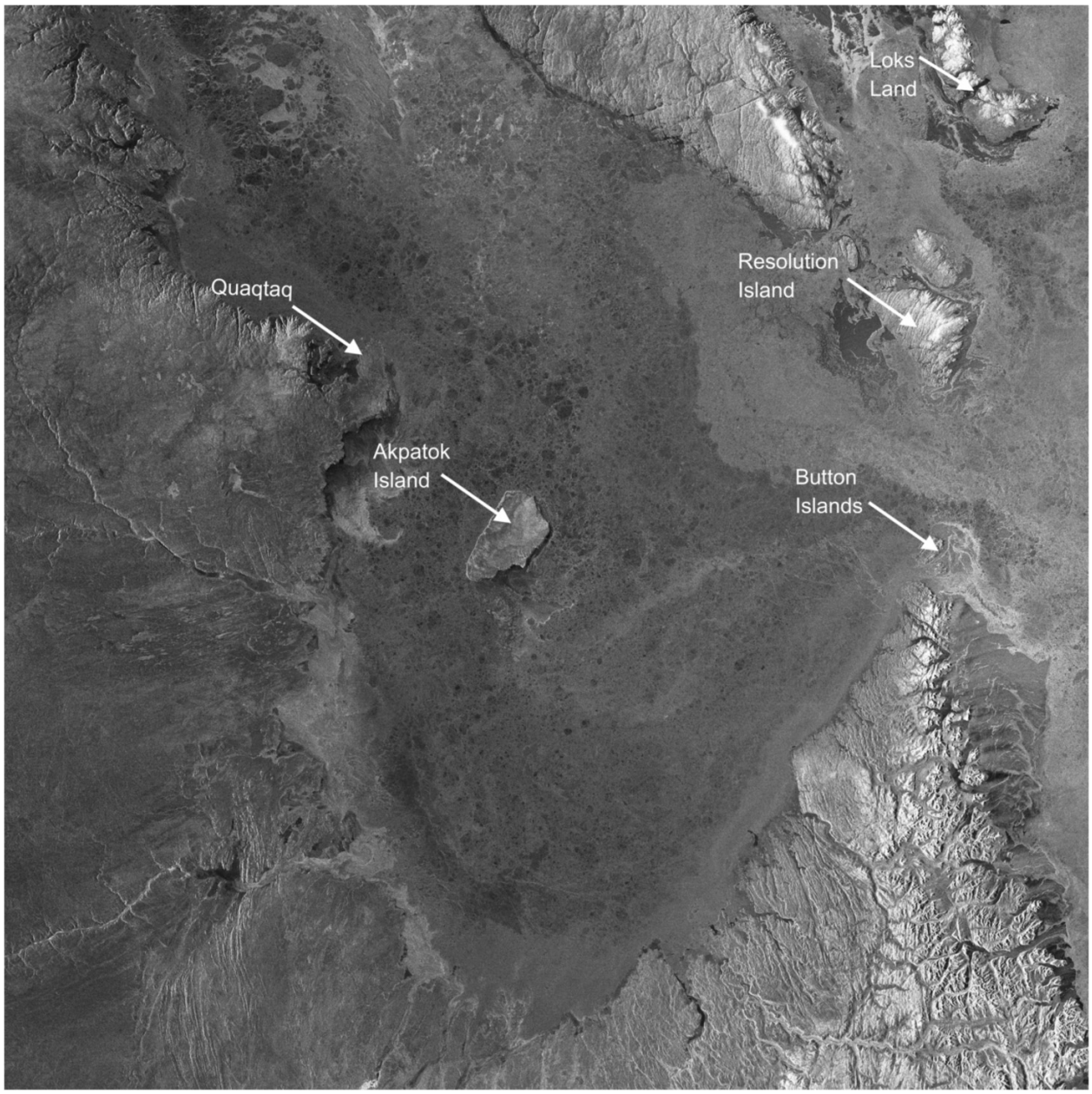
Mots-clés : Partie est de l'Arctique canadien, îles Button, hivernage, eider à tête grise et à duvet, harlede kakawi, baleine boréale

Introduction

Longer ice-free seasons in polar waters of the Canadian Arctic have resulted in longer shipping seasons and increases in shipping traffic for transportation of goods, mineral extraction, commercial fishing, and recreational cruise ships. It is thus important to identify key wildlife habitats to mitigate potential environmental impacts. The Canadian Arctic is vast and remote, and distributions for many species of birds are poorly described, particularly in winter (see Richards and Gaston 2018). Areas of persistent open water in Arctic oceans occur in polynyas, along some flow edges, and within some areas of brash or land fast ice where tides, winds and land features maintain open water. These areas can be important feeding areas for marine wildlife (Stirling 1980; Stirling 1997; Peterson et al. 1999; Gilchrist and Robertson 2000). Information on sea ducks wintering in the eastern Canadian Arctic is limited. Inuit knowledge (Prach et al. 1981; Nakashima 1986; Reed and Erskine 1986; Nakashima and Murry 1988) and one ground-based field project (Gilchrist and Robertson 2000) have documented the use of small recurring polynyas by common eiders (*Somateria mollissima*) and long-tailed ducks (*Clangula hyemali*) in Hudson Bay. Inuit from Ungava Bay, Nunavut have reported eiders using the area around Killiniq Island, Nunavut in early spring (Prach et al. 1981; Nakashima 1986). Inuit that wintered in Okak Bay, Newfoundland & Labrador, reported that they occasionally hunted eiders (Brie-Bennett 1977), and they also reported flocks of eiders in winter off Hopedale, Newfoundland & Labrador (W. Barbour pers. comm. and J. Flowers pers. comm.). Satellite telemetry studies have documented potential wintering sites for king eiders (*Somateria spectabilis*) in eastern Hudson Strait (Mosbech et al. 2006*a*) and for common eiders on the Labrador coast (Mosbech et al. 2006*b*; G. Gilchrist unpublished data).

In this article, we report observations of common and king eiders, long-tailed ducks, beluga (*Delphinapterus leucas*) and bowhead (*Balaena mysticetus*) whales, and other wildlife

Fig. 1. RADARSAT-2 image of eastern Hudson Strait and Ungava Bay, Canada, taken on 10 February 2010. Courtesy of the Canadian Ice Service.



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encountered on an exploratory survey of Ungava Bay, eastern Hudson Strait, Frobisher Bay, and the coast of Labrador flown in February 2010.

Materials and methods

We identified possible wintering sites from several sources. Information from the literature was limited to Inuit Knowledge studies (Brice-Bennett 1977; Nakashima 1986). Discussions with Inuit from Nunavik (northern Québec) and Nunatsiavut (northern Newfoundland & Labrador) identified several locations along the west coast of Ungava Bay where small numbers of common and king eiders wintered and a few sites near Nain, Newfoundland & Labrador. Helicopter pilots have been reported seeing eiders wintering in open water near Loks Land (62.5°N, −64.9°W) in eastern Frobisher Bay, Nunavut (J. Innis pers. comm.). Winter locations from satellite telemetry studies of king eiders (Mosbech et al. 2006*a*), common eiders (Mosbech et al. 2006*b*), and snowy owls (*Bubo scandiacus*) (Therrien et al. 2011) were also sources of potential wintering sites. We also examined RADARSAT-2 images of Ungava Bay, Frobisher Bay, and the coast of Labrador taken in February 2008 and 2009 to identify any areas of shallow open water that may provide winter sea duck habitat. Prior to the survey, these locations were updated using RADARSAT-2 images acquired for Frobisher and Cumberland Sound on 31 January 2010, Ungava Bay and Hudson Strait on 4 February

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2010 (Fig. 1), and several images of the coast of Labrador on 8 February 2010.

The survey was conducted from a DHC-6 Twin-Otter with three observers from 22 to 24 February 2010. The aircraft was equipped with two bubble windows in the forward passenger compartment and a large bubble window that replaced the rear emergency exit. The flight track of the aircraft and coordinates of all observations were recorded using two software applications that geo-tag voice recordings: USFWS GPS Voice Recording Software (Version 6.1; Hodges and Thorpe 2002) and PC Mapper Airborne Inventory (Version 3.0, Corvallis Microtechnology Inc., Oregon, USA). The survey was conducted at an altitude of 425–550 m ASL and an air speed of ~250 kph to detect areas of open water; most areas of open water were overflown at ~150 m ASL and an air speed of ~180 kph to search for birds and were visually scanned using Canon 10 × 30 image stabilized binoculars to locate and identify birds. We assumed the species composition of brown eiders (females and first year males) was the same as for the males and partitioned the number of brown birds into king and common eiders based on the species ratio for males in each flock. Flocks were photographed using a Canon EOS 5D Mark II camera fitted with a Canon EF 75–300 mm at an altitude of ~150 m ASL.

The flight tracks were sampled at 1 s intervals and each point along the track was assigned a count of 0 and the flight track was appended to the observations. Species distribution maps were made by summing the counts by half-degree blocks. The track count was included in the summaries to identify areas that were searched but had no detections. The counts are uncorrected for detection and observer error in flock size estimation.

Results and discussion

Weather and ice conditions, and extent of coverage

Except where noted, winds were light, the sky was clear, and we had excellent viewing conditions. On 22 February 2010, we departed Kuujjuaq, Nunavik, on a flight plan up the eastern side of Ungava Bay, around the Button Islands (60.6°N, −64.6°W), and across Hudson Strait to Resolution Island (61.5°N, −65°W), then along the south coast of Baffin Island, ending in Iqaluit. The inner area of Ungava Bay was covered with extensive areas of compact pack ice, with a few areas of close pack ice and open water. There was a wide band of fast ice that extended from the shoreline for a kilometer or more seaward of the outer islands; there were a few small polynyas located between islands within the fast ice. Strong northeasterly winds prevailed the week prior to the survey resulting in extensive areas of open water beyond the fast ice along the northeastern tip of Ungava Bay. We also covered the east coast of Akpatok Island (60.4°N, −68.2°W) and along the west coast of Ungava Bay from Aupaluk, Nunavik, to Kuujjuaq. These areas had extensive coverage of close pack ice.

On 23 February 2010, we departed from Iqaluit on a flight plan following target areas of open water sites in Frobisher Bay to Loks Land, then across Hudson Strait via Resolution Island to the Button Islands and down along the coast of Labrador to Nain, Newfoundland & Labrador. There were large areas of open water within Frobisher Bay, but most of these areas were in waters too deep to support sea ducks.

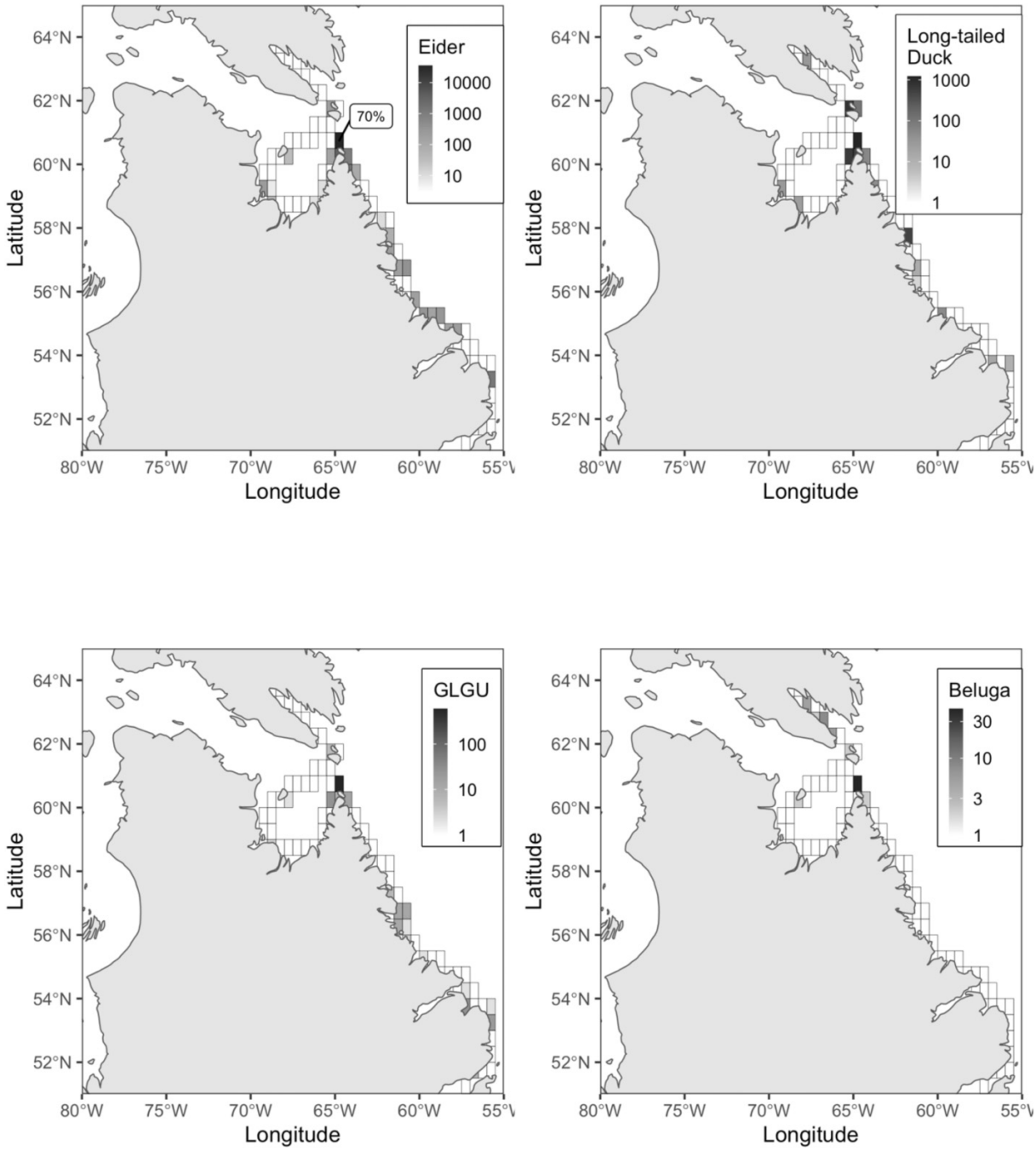
On 24 February 2010, we departed Nain and covered most of the Labrador coast south to Blanc-Sablon, Québec. The temperature was unusually warm (+5 °C), which resulted in thin layer of low cloud and fog over open water in light onshore winds, which affected visibility between Voisey's Bay (56.2°N, −61.5°W) and Makkovik, Newfoundland & Labrador; low cloud restricted visibility in some areas between Table Bay (53.6°N, −56.4°W) and Henley Harbour (52.0°N, −55.8°W); otherwise, viewing conditions were good. There was a thin band of close pack ice along the outer islands along the entire coast of Labrador. However, there were extensive areas of open water within the large archipelagos between Nain and Makkovik, loose brash ice in the areas near Smokey (54.5°N, −57.2°W), and some open water along the southern shore of Groswater Bay, Newfoundland & Labrador. The dense narrow band of close pack ice covered most of the coastline between Cartwright, Newfoundland & Labrador to Henley Harbour (52.0°N, −55.9°W); however, the Gannet Islands (53.9°N, −56.5°W) were beyond the outer ice edge and in open water.

Species distributions and abundances

We recorded *nine species of aquatic birds*: common eider, king eider, long-tailed duck, northern fulmar (*Fulmarus glacialis*), ivory gull (*Pagophila eburnean*), herring gull (*Larus argentatus*), great black-backed gull (*Larus marinus*), and glaucous gull (*Larus hyperboreus*). Eider and long-tailed ducks were detected in most areas with shallow open water (Fig. 2). Eiders were the most abundant birds but were restricted to two or three sites (Fig. 2*a*). We recorded a total of 45 200 eiders (14 849 common eiders, 24 666 king eiders, and 5685 eider spp.). The majority were located around the Button Islands (~35 000 eiders) and Killiniq Island (~4400 eiders; Fig. 3). There was a high degree of segregation between flocks of king and common eiders. Of the three flocks photographed (Table 1), one (6000) was dominated by king eiders and the two others by common eiders (Table 1). Many of the eiders seen in Ungava Bay and in Labrador were in small groups dominated by brown eiders (females and first-year males) and most males in these flocks were common eiders.

Long-tailed ducks were the second most abundant bird observed (4140). They did not occur in large aggregations but were the most common bird encountered and were often associated with large flocks of eiders. They were widely distributed, and small numbers were observed in most areas of shallow open water. Most long-tailed ducks were observed around the Button and Killiniq Islands, with smaller concentrations found along the edge of the land fast ice on the northeastern side of Ungava Bay, the north side of Resolution Island, and around Okak Island (57.6°N, −61.6°W; Fig. 2*b*). Long-tailed ducks were likely much more numerous as they spend significant portion of daylight hours under water while foraging (Goudie and Ankney 1986), have more cryptic plumage than eiders, and occur in small groups that could easily have been missed. This was evident from one of our

Fig. 2. Distributions of the most abundant wildlife species detected on the survey: eiders (*a*), long-tailed ducks (*b*), glaucous gulls (GLGU) (*c*), and beluga whales (*d*) detected during an exploratory survey of Ungava Bay, Frobisher Bay, and the coast of Labrador, 22–24 February 2010. Almost all detections of eiders were common eiders except at the northern tip of Québec-Labrador, where 70% were identified as king eiders. Maps were created in R/RStudio (Version 2023.12.0 + 369), using *rnaturalearth* base maps, as well as package *sf*.

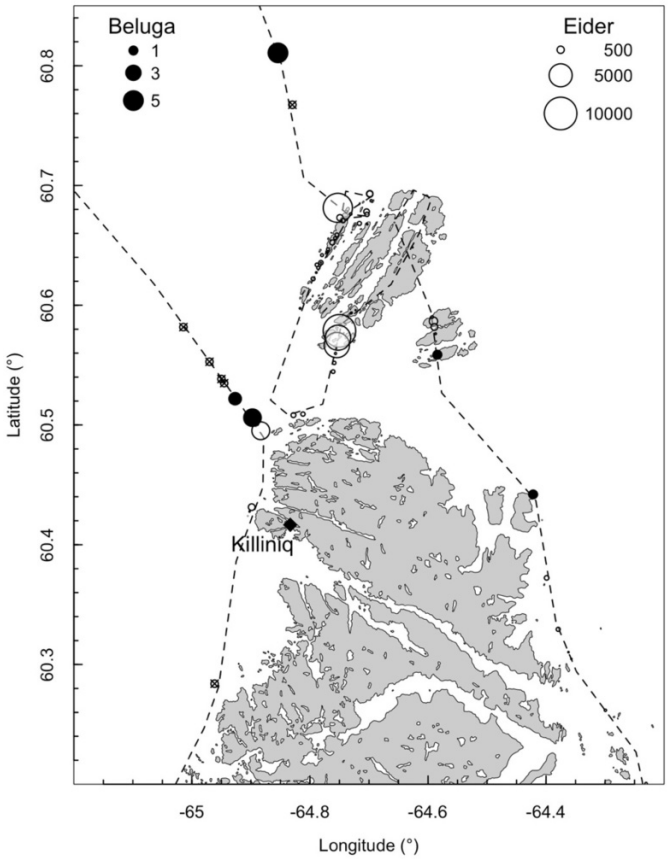


photos where 88 long-tailed ducks were counted, although we did not visually detect any long-tailed ducks in this flock (Table 1).

Gulls were detected throughout the area surveyed and were often associated with concentrations of eiders. Glaucous gulls were the most abundant gull species (765) with the main concentrations occurring along the north side of Resolution Island, around the Button and Killiniq Islands, and along the entire coast of Labrador (Fig. 2*c*). One large flock of ~150 ivory gulls was detected along the edge of the land fast ice along the northeastern side of Ungava Bay. This flock was located just outside of the western boundary of the ivory gull wintering range estimated by Spencer et al. (2016). Great black-backed and herring gulls were uncommon with only a single great black-backed gull recorded north of Cartwright, and two herring gulls recorded near Pinware, Newfoundland

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Fig. 3. Distribution of eiders (70% king and 30% common eiders; ○), beluga whales (●), and locations of bowhead whales (⊕) detected around Killiniq Island and the Button Islands, located at the northern tip of Québec-Labrador, on 22 and 24 February 2010. For eiders and beluga whales, the size of the symbol is proportional to the number of individuals, while the bowhead sightings were detections of single individuals. The flight track of the aircraft is identified with a dashed line. Maps were created in R/RStudio (Version 2023.12.0 + 369) as well as package *sf* using 025A07, 025A108, and 025A10 topographic maps using NAD83 projection and UTM coordinate system. Maps were freely available at https://ftp.maps.canada.ca/pub/nrcan_rncan/vector/index/html/geospatial_product_index_en.html#link.



& Labrador. However, there were many unidentified "greywing" gulls (245), which likely consisted of herring and glaucous, and possibly iceland gulls (*Larus glaucoides*). We also encountered a flock of 20 northern fulmars around the Button Islands.

Observations of whales were incidental. We detected 72 beluga and nine bowhead whales along the entire flight track. Beluga whales appeared to be common thought-out Frobisher Bay. Most beluga whales were detected in the area around, and to the north of, the Button Islands (Figs. 2*d* and 3), which is a wintering area previously identified by Inuit from Nunavik (Nunavik Marine Regional Wildlife Board 2020). They appeared to be less common in Ungava Bay, where only two were observed in areas of open water along the southeast side of Akpatok Island; however, much of the bay was covered in extensive areas of close pack ice which would have affected our ability to detect them if they were there.

We observed nine bowhead whales (three singles and three in groups of two), all of which occurred around the Button Islands and along the northeastern tip of Ungava Bay (Fig. 3). However, much of the open water habitat used by bowhead whales was not searched. Little information exists on winter distribution of bowhead whales in Hudson Strait. Most information on their winter distribution comes from satellite telemetry studies (Dueck et al. 2006) and two winter surveys (Koski et al. 2006; Elliot et al. 2013), which suggested that bowhead whales were primarily found in the central and western portion of Hudson Strait in winter.

Conclusion

Winter distributions of waterfowl and most wildlife are poorly described in the Canadian Arctic, and most information on winter habitat use come from a few satellite tracking studies (see Petersen et al. 1999; Dueck et al. 2006; Mosbech et al. 2006*a*, 2006*b*; Spencer et al. 2016). We searched about 3150 km of Arctic and sub-Arctic waters focusing on areas of shallow open water, and observations of wildlife were rare. The small groups of eiders that were observed in Ungava Bay, Frobisher Bay, and along the Labrador coast appeared to be comprised mainly juvenile birds; they occurred in small unpredictable areas of open water, suggesting they may have made poor decisions in selecting their wintering site. The only large concentrations of wintering waterfowl occurred around the Button Islands and along the western side of Killiniq Island. Based on experience surveying for eiders in Hudson Bay (Gilchrist and Robertson 2000; Gilchrist et al. 2006; S. Gilliland and H.G. Gilchrist unpublished data), large concentrations of eiders have only been found wintering at the northern and southern tips of the Belcher Islands, Nunavut, and around the Sleeper (57.5°W, −79.8°N) and Marcopeet Islands (57.7°W, −79.7°N). All these sites share unique geographical features in combination with wind and strong tidal currents that maintain large predictable areas of shallow open water required by waterfowl to survive Arctic winters. The Button Islands were particularly important for king eiders and may be the most important wintering site for this species in eastern Canada (S. Gilliland unpublished data; C. Lepage unpublished data). The area also appears to be important for wintering common eiders, several species of gulls as well as beluga and bowhead whales. Based on the results of this survey, the site was identified as a key site for sea ducks in North America (Bowman et al. 2022); indeed, given the site use by marine mammals, it should be considered as a marine key site (Mallory et al. 2018). Given the importance of the area around Killiniq and the Button Islands for wintering eiders, we recommend surveys be repeated periodically, to evaluate changes in eider distribution with changing sea ice conditions. We also identified a potential wintering site at Loks Land in Frobisher Bay, which we were unable to survey, and we recommend this site be assessed for use

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Table 1. Estimates of size and species composition of three flocks of common and king eiders photographed in the Button Islands, Nunavut, Canada, with associated visual estimates.

Image				Visual					
Male				Male					
KIEI*	COEI*	Brown†	LTDU*	KIEI	COEI	Brown	LTDU	Species‡	Image/visual
3480	290	2115	0	3000	+§	3000	0	8%	0.98
0	273	543	0	–	–	–	0	100%	–
20	2392	1017	88	0	1200	1800	0	99%	1.17

*Species: king eider (KIEI), common eider (COEI), long-tailed duck (LTDU).
†Female and first year male eiders.
‡Proportion of males in photos that were common eiders.
§Noted as present in the flock.

by wintering eiders. All raw observation data and track files that document the flight track of the plane are available at https://doi.org/10.5061/dryad.34tmpg4wh.

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Data availability

All raw observation data and track files that document the flight track of the plane are available at https://doi.org/10.5061/dryad.34tmpg4wh.

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Visualization: SGG
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Competing interests

The authors declare there are no competing interests.

References

Bowman, T.D., Churchill, J.L., Lepage, C., Badzinski, S.S., Gilliland, S.G., McLellan, N.R., and Silverman, E. 2022. Atlas of sea duck key habitats in North America. Sea Duck Joint Venture. March 2022. Available from https://seaduckjv.org/science-resources/sea-duck-key-habitat-sites-atlas/.

Brice-Bennett, C. 1977. Our footprints are everywhere: inuit land use and occupancy in Labrador. Labrador Inuit Association, Nain.

Corvallis Microtechonology. PC Mapper Airborne Inventory. [computer software]. Available from http://www.cmtinc.com.

Dueck, L.P., Hiede-Jorgensen, M.P., Jensen, M.V., and Postma, L.D. 2006. Update on investigations of bowhead whale (*Balaena mysticetus*) movements in the eastern Arctic, 2003–2005, based on satellite-linked telemetry. Canadian Science Advisory Secretariat Research Document 2006/050. 27pp.

Elliott, R.E., Moulton, V.D., Raborn, S.W., and Davis, R.A. 2013. Hudson Strait marine mammal aerial surveys, 10 March–2 April 2012. LGL Limited report for Baffinland Iron Mines Corporation. 107pp.

Gilchrist, H., and Robertson, G. 2000. Observations of marine birds wintering at polynyas and ice edges in the Belcher Islands, Northwest Territories. Arctic, **53**(1): 61–68. doi:10.14430/arctic835.

Gilchrist, H.G., Heath, J.P., Arragutainaq, L., Gilliland, S., Allard, K., and Mallory, M. 2006. Combining science and local knowledge to study common eider ducks wintering in Hudson Bay, *In* Climate change:

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linking traditional and scientific knowledge. *Edited by* J. Oakes and R. Riewe University of Manitoba Aboriginal Issues Press. pp. 185–201.
Goudie, R.I., and Ankney, C.D. 1986. Body size, activity budgets, and diets of sea ducks wintering in Newfoundland. Ecology, **67**(6): 475–1482. doi:10.2307/1939078.
Hodges, J., and Thorpe, P.P. 2002. Voice/GPS survey program manual for the breeding population and production surveys. Unpublished Report.
Koski, W.R., Heide-Jørgensen, M.P., and Laidre, K.L. 2006. Winter abundance of bowhead whales, *Balaena mysticetus*, in the Hudson Strait, March 1981. Journal of Cetacean Research and Management, **8**: 139–144.
Mallory, M.L., Gaston, A.J., Provencher, J.F., Wong, S.N.P., Anderson, C., Elliott, K.H., et al. 2018. Identifying key marine habitat sites for seabirds and sea ducks in the Canadian Arctic. Environmental Reviews, **27**(2): 215–240. doi:10.1139/er-2018-0067.
Mosbech, A., Dano, R.S., Merkel, F., Sonne, C., Gilchrist, G., and Flagstad, A. 2006a. Use of satellite telemetry to locate key habitats for king eiders *Somateria spectabilis* in West Greenland, *In* Waterbirds around the world. *Edited by* G.C. Boere, C.A. Galbraith and D.A. Stroud. The Stationery Office, Edinburgh, UK. pp. 769–776.
Mosbech, A., Gilchrist, G., Merkel, F., Sonne, C., Flagstad, A., and Nyegaard, H. 2006b. Year-round movements of Northern common eiders *Somateria mollissima borealis* breeding in Arctic Canada and West Greenland followed by satellite telemetry. Ardea, **94**(3): 651–665.
Nakashima, D.J. 1986. Inuit knowledge of the ecology of the common eider in northern Quebec, *In* Eider ducks in Canada. *Edited by* A. Reed. Canadian Wildlife Service Occasional Paper No. 47. Ottawa. pp. 102–113.
Nakashima, D.J., and Murray, D.J. 1988. The common eider (*Somateria mollissima sedentaria*) of eastern Hudson Bay: a survey of nest colonies and Inuit ecological knowledge. Environmental Studies Research Funds Report No. **102**. Ottawa.
Nunavik Marine Regional Wildlife Board (NMRWB). 2020. Inuit knowledge of beluga of Southern Ungava Bay and the Marralik (Mucalic) and Ungunniavik (Whale) River Estuaries. Project conducted and report prepared for the NMRWB by Durkalec, A., Basterfield, M., Jean-Gagnon, F., Kasudluak, P., and Breton-Honeyman, K, 66 pp.
Petersen, M.R., Larned, W.W., and Douglas, D.C. 1999. At-sea distribution of Spectacled Eiders: a 120-year-old mystery solved. Auk, **116**: 1009–1020. doi:10.2307/4089681.
Prach, R.W., Boyd, H., and Cooch, F.G. 1981. Polynyas and sea ducks. *In* Polynyas in the Canadian Arctic. *Edited by* I. Stirling and H. Cleator Canadian Wildlife Service Occasional Paper No. 45, Ottawa. pp. 67–70.
Reed, A., and Erskine, A.J. 1986. Populations of the common eider in Eastern North America. In: Eider Ducks in Canada. *Edited by* A. Reed, Populations of the common eider in Eastern North America. pp. 156–162. Canadian Wildlife Service Report Series No. 47.
Richards, J., and Gaston, A. 2018. Birds of Nunavut. Vol. **1**. UBC Press, Vancouver, British Columbia, Canada. pp. 820.
Spencer, N.C., Gilchrist, H.G., Strøm, H., Allard, K.A., and Mallory, M.L. 2016. Key winter habitat of the ivory gull *Pagophila eburnea* in the Canadian Arctic. Endangered Species Research, **31**: 33–45. doi:10.3354/esr00747.
Stirling, I. 1980. The biological importance of polynyas in the Canadian Arctic. Arctic, **33**(2): 303–315. doi:10.14430/arctic2563.
Stirling, I. 1997. The importance of polynyas, ice edges, and leads to marine mammals and birds. Journal of Marine Systems, **10**: 9–21. doi:10.1016/S0924-7963(96)00054-1.
Therrien, J.-F., Gauthier, G., and Bêty, J. 2011. An avian terrestrial predator of the Arctic relies on the marine ecosystem during winter. Journal of Avian Biology, **42**(4): 363–369. doi:10.1111/j.1600-048X.2011.05330.x.

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