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ORIGINAL PAPER

Marine mammal and seabird summer distribution and abundance in the fjords of northeast Cumberland Sound of Baffin Island, Nunavut, Canada

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Abstract Critical baseline population knowledge is required to properly assess the status of marine mammal and bird populations in the Canadian Arctic and the effects of climate trends on them. To address this need for one significant Arctic region, a boat-based marine mammal and seabird transect survey was conducted in Cumberland Sound fjords during summer 2008. During 173 km effort (20 h), 959 birds were recorded representing at least nine species which were dominated by Common Eiders (*Somateria mollissima borealis*), Iceland or Glaucous Gulls (*Larus glaucoides* or *Larus hyperboreus*), and Black Guillemots (*Cepphus grylle*), in addition to less common birds including Red-throated and Common Loons (*Gavia stellata* and *Gavia immer*), Northern Fulmars (*Fulmarus glacialis*), and Great or Lesser Black-backed Gulls (*Larus marinus* or *Larus fuscus*). Of these, 480 birds were observed on the water in one event consisting of eiders and gulls which may have biased encounter rates. Of 101 marine mammal sightings, four species were represented: 73 harp seals (*Pagophilus groenlandicus*), 13 beluga whales (*Delphinapterus leucas*), nine bowhead whales (*Balaena mysticetus*), five ringed seals (*Pusa hispida*), and one unidentified pinniped. A pod of four killer whales (*Orcinus orca*) was observed off-effort in Pangnirtung Fjord during the survey period. This pilot study provided the first estimates of relative abundance for marine mammals and seabirds in the study area to aid in developing future surveys.

Keywords Survey · Distribution · Abundance · Marine mammals · Seabirds · Canadian Arctic

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Introduction

Recent marine mammal and seabird population data are poor or scarce for much of the Canadian Arctic, yet are of increasing interest for assessing potential impacts of a rapidly changing environment (Laidre et al. 2008). Loss of animal habitat, particularly resulting from a reduction in sea ice extent and duration, is forecasted to have large impacts on ice-associated animal populations in the Arctic (Moore and Huntington 2008) as well as increase potential threats from exploration and shipping in areas that have been previously inaccessible. Although surveys in remote regions can be costly and logistically challenging, baseline information on the distribution and abundance of Arctic populations is essential to identifying population changes and establishing proper conservation and management strategies.

Current information on abundance of marine mammal and seabird populations is deficient for Cumberland Sound of southeast Baffin Island (Fig. 1). Cumberland Sound is a biologically productive area that includes a polynya important to a variety of marine mammals and is recognized as a summer feeding area for many species (Stirling

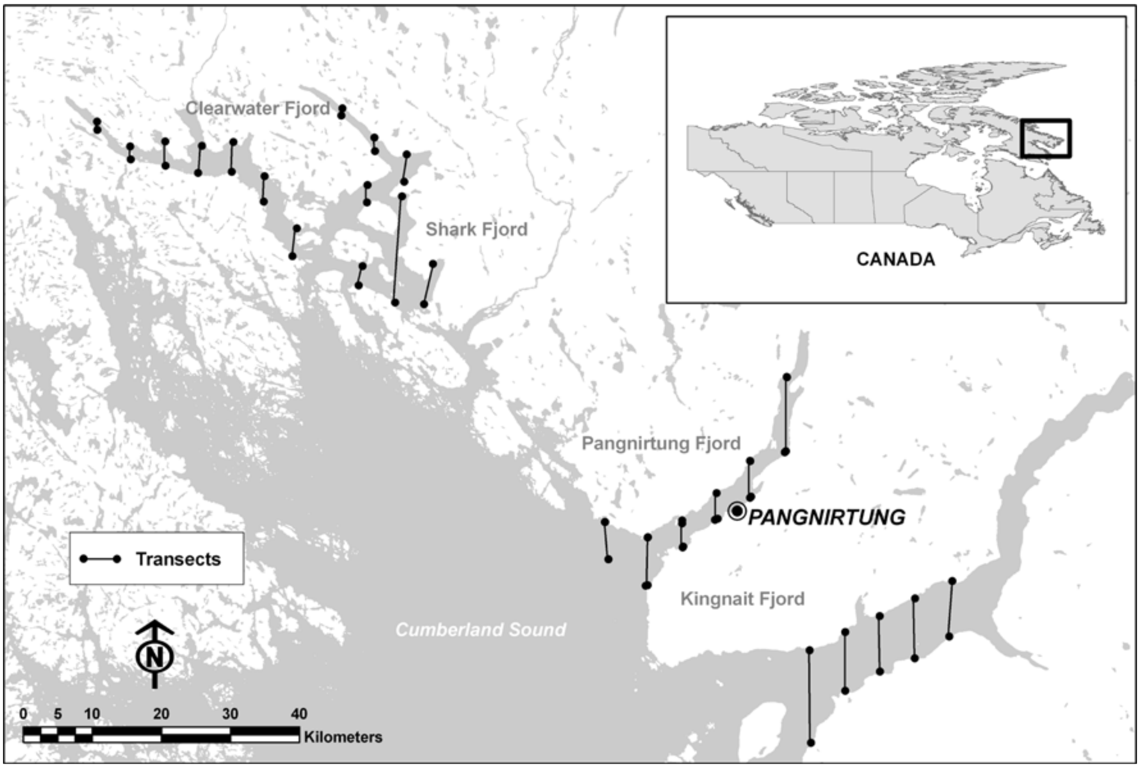

Fig. 1 Map showing locations of survey transect lines in northeast Cumberland Sound, located on Baffin Island in the Eastern Canadian Arctic. Survey effort totaling 173 km was completed in Clearwater, Shark, Pangnirtung (surveyed twice), and Kingnait Fjords taking place from July 29 to August 9, 2008

1997). Although sampling this area does not generally represent total stock sizes, sampling well-defined summering areas can aid in monitoring stock recovery while providing minimum population estimates and relative abundances between different regions (Cosens and Innes 2000).

Cumberland Sound is also recognized as one of the major former whaling grounds in the Eastern Canadian Arctic (Reeves et al. 1983). Although Inuit traditional knowledge studies suggest increasing numbers (Hay et al. 2000; DFO 2008), the beluga whales (*Delphinapterus leucas*) in Cumberland Sound are currently designated as threatened by COSEWIC (Richard and Stewart 2008) and bowhead whale (*Balaena mysticetus*) presence in the sound has yet to be quantified. Adequate data are necessary to set the quotas for subsistence hunting while allowing continued population recovery (Wade 1998), especially due to uncertainties arising from the effect of climate change on these ice-dependent animals and the arctic food web as a whole (Moore and Huntington 2008).

Inuit, who along with polar bears, rely on ringed seals (*Pusa hispida*) as a main staple to their diet, have reported decreasing numbers of ringed seals in recent years while the number of migratory harp seals (*Pagophilus groenlandicus*) inhabiting the waters has increased (Fisk, personal communication). Additionally, there have been increased sightings of killer whales (*Orcinus orca*) in Cumberland Sound and other adjacent areas of the Canadian Arctic, which may prey on all Arctic marine mammals, including bowhead whales (Higdon and Ferguson 2009).

Changes in sea ice have been reported in Pangnirtung, a fjordal community of about 1,325 inhabitants in northeast Cumberland Sound, since at least the year 2000 (Laidler 2006). The ice is reportedly thinner, freezing up slower and later, while breaking up faster and earlier. Marine mammal sensitivity to the loss of sea ice habitat will depend partially on current population sizes and distributions (Laidre et al. 2008) which will need to be monitored to identify species at risk and employ conservation strategies.

Cumberland Sound is also recognized as one of the key summer habitat sites for migratory birds in Nunavut (CWS 2006a) and is one of the regions that the Canadian Wildlife Service considers as top priority for bird population censusing. Surveys carried out in the western Cumberland Sound archipelago in the 1970s found thousands of Common Eiders (*Somateria mollissima borealis*) in the fjords and coastal areas in late summer of 1977, as well as over one thousand Black Guillemots (*Cepphus grylle)* (MacLaren Atlantic Inc. 1978; CWS 2006a). The islands here are thought to sustain the largest concentration of breeding Iceland Gulls (*Larus glaucoides*) in Canada. Over 200 colonies were surveyed in 1973 and 1985 to estimate 12,000 pairs, about 10% of which are probably Glaucous Gulls (*Larus hyperboreus*) (CWS 2006a). The bird populations in Cumberland Sound are believed to represent significant proportions of their totals and up to date surveys are needed.

To address the lack of current baseline data in Cumberland Sound, a marine mammal and seabird transect survey was carried out in the fjords of northeast Cumberland Sound during July and August 2008. The objectives of this study were (1) to make the first estimates of relative abundance for marine mammals and seabirds in the study area; (2) to assess their distribution; and (3) to establish preliminary data for future monitoring to develop survey methods and design appropriate to the study area. This study was also designed to test small boat surveys as a census technique in this area to provide reliable and cost-effective population information for marine wildlife which can eventually be conducted by northerners in the Canadian Arctic.

Methods and materials

Survey design

Survey transects in the fjords of northeast Cumberland Sound were designed for marine mammal surveys in coastal and inshore environments (Dawson et al. 2008). Surveying was conducted in Clearwater, Shark, Kingnait, and Pangnirtung Fjords for a total of 173 km (20 h) over 6 days between July 29 and August 9, 2008 (Fig. 1). A replicate survey of Pangnirtung Fjord was also completed, primarily due to limited accessibility to other areas of the sound as a result of ice conditions. When Pangnirtung Fjord was surveyed a second time an additional transect was added to increase effort. This line was included in reporting total sightings for the survey but was removed for the sake of comparing the results of the two replicates for their shared lines only. We used a systematic random sampling design with parallel line transects oriented north–south, running across the fjords at a spacing of 5 km.

Field methods

Over the course of the survey, three different boats were used, all of which were approximately 7 m in length. Survey transects were navigated and recorded with a GPS device and an average vessel speed of 15–17 km/h (8–9 knots) was maintained wherever possible, as recommended by Dawson et al. (2008). Three trained observers conducted the survey, accompanied by an Inuit guide. The tasks of marine mammal observer, seabird observer, and recorder were performed by the three participants and were rotated every line. Observers made initial observations by eye and used binoculars of 7–8× magnification to verify species and group size when necessary. Marine mammal and seabird species were identified to the lowest level of certainty (e.g., unidentified pinniped). A detailed manual of survey protocol was provided to the participants, and species identification and survey methods were practiced in the field prior to conducting the survey.

Seabird observation methods

Birds were recorded within an estimated 300-m-wide strip transect (CWS 2006b) in a 90° forward arc from bow to beam on the port side of the vessel. All birds, both on the water and flying were recorded continuously when in transect. Flying birds had to be within a 300-m radial sighting distance to the observer on the port side to be recorded as in transect. Birds on the water, however, were recorded as in transect if seen within 300-m perpendicular distance to the transect path on the port side even when greater than 300 m ahead to account for dive or flight responses as the boat approached. Birds following or circling the boat were recorded once as being associated with the vessel and then disregarded (CWS 2006b).

Marine mammal observation methods

As opposed to the strip transect methods employed for seabird observation, we carried out marine mammal surveys using distance sampling methodology (Buckland et al. 2001). The marine mammal observer searched the water by eye in the direction of travel from the boat out to as far as they could see. This field of view primarily consisted of 90° arcs left and right of the bow (Dawson et al. 2008).

Due to the small boat size, an elevated sighting platform was not feasible and thus sightings were made at approximately the observer's height above the water. As a result, the downward angle to sightings could not be measured and distance estimation by eye was required. Prior to conducting the survey and throughout the survey's course, time was dedicated to practicing distance estimation using a laser range finder (Bushnell, Cabela's VLR) to guess and check distance estimates to ice floes. The range finder, however, was not found useful for obtaining distance measurements during the survey due to the often brief appearance of marine mammals at the surface (most commonly seals) and the need to estimate distance rapidly. Marine mammals observed during transit between transect lines were noted, though distance data were excluded.

Data analysis

Although marine mammals were surveyed with distance methodology, there were not enough detections of the species involved to carry out distance analyses. Encounter rates were calculated for marine mammal and seabird species, by fjord and over total effort, using a simple ratio estimator of count to transect length (Williams et al. 2002):

$$\hat{E} = \frac{n}{L}$$

where $\hat{E}$ = individual encounter rate per km, n = number of individuals detected, L = length of transect.

The encounter rate variance estimated for each species within a fjord and overall was given by (Williams et al. 2002):

$$\widehat{\mathrm{var}}(\hat{E}) = \frac{s_n^2 + \hat{E}^2 s_L^2 - 2\hat{E}s_{nL}}{m}$$

where

s_n^2 = variance of species count across transects

s_L^2 = variance of transect lengths

s_{nL} = covariance between count and length

m = number of transects sampled within the fjord.

Standard deviation was given by:

$$\mathrm{SD} = \sqrt{\widehat{\mathrm{var}}}(\hat{E}_s).$$

Results

Pack ice in the sound extended to the mouth of the fjords being surveyed in most cases, however, about 87% of transects were conducted with a maximum ice concentration of less than 10%. Three of the 30 lines on the survey experienced a Beaufort sea state up to level 3, however, due to low overall survey effort these transects were still included in the analyses. Additionally, only 3 lines reported high glare conditions and visibility was always greater than 1 km.

Seabird observations

Along 173 km of transect, 959 birds were recorded, representing a minimum of nine species (Table 1). Eiders were the most numerous on the survey totaling 500 birds with an encounter rate of 2.9/km (Table 2). These individuals likely represented Common Eiders, as no King Eiders were positively identified. Furthermore, past surveys have shown a high concentration of Common Eiders only along the coasts and fjords of Cumberland Sound (MacLaren Atlantic Inc. 1978). Iceland or Glaucous Gulls, as they could not be reliably distinguished, were the next most common birds totaling 329 individuals with an encounter rate of 1.9/km. The gulls in our study area are more likely to be Iceland Gulls based on surveys of colonies in western Cumberland Sound in 1973 and 1985, where only 10% were estimated as Glaucous Gulls (CWS 2006a). The next most abundant were Black Guillemots (104 individuals) with an encounter rate of 0.60/km. All other species recorded numbered only eight birds or less (encounter rates 0.01–0.05/km) and were often found in only one general area (Table 2). Other species were identified within the study area in July, prior to the survey, and included a Long-tailed Jaeger (*Stercorarius longicaudus*), a Black-legged Kittiwake (*Rissa tridactyla*), Red-breasted Mergansers (*Mergus serrator*), and Long-tailed Ducks (*Clangula hyemalis*).

Common Eiders and Iceland and/or Glaucous Gulls were common throughout the study area. These species were most abundant in Kingnait Fjord where the highest number of seabirds was encountered. The largest number of Black Guillemots and loon species were found in Clearwater and Shark Fjords in northern Cumberland Sound. A large number of gulls were encountered on both surveys of Pangnirtung Fjord and many birds occupied coastal land and rock that were not included in the count. This fjord is also where the only on-effort sightings of Northern Fulmars (*Fulmarus glacialis*) and Great Black-backed Gulls (*Larus marinus*) or Lesser Black-backed Gulls (*Larus fuscus*) were made.

Marine mammal observations

A total of 101 marine mammals, representing four species, were recorded, including ringed seal, harp seal, beluga whale, and bowhead whale (Table 1). Harp seals were the most common marine mammal species comprising 72% of total individuals detected (or 57% of sighting events) in groups of up to 26 individuals, with an overall encounter rate of 0.42 individuals/km (Table 2) and on-effort sightings in every fjord except for Clearwater. A sighting of a herd of several hundred harp seals was made off-effort during the survey period. Beluga whales were the next most numerous species after harp seals although they made up only 13% of individuals, all of which were detected on one transect line in Clearwater Fjord. Off-effort beluga sightings were also made during transit in this fjord, as well as in the adjacent Shark Fjord region.

Harp seals were the only marine mammals detected in Pangnirtung Fjord, with seven individuals sighted on both replicate surveys in this location. Like harp seals, ringed seals also had a widespread distribution, being found in every region except for Pangnirtung Fjord. Despite their widespread distribution, however, there were a total of only five sightings of single individuals, resulting in an encounter rate of 0.03/km.

Table 1 Summary of on-effort seabird and marine mammal sightings in fjords of Cumberland Sound from July 29 to August 9 2008, given as the number of total individuals (I) and sighting events (E) seen per species in each fjord and overall

Species	Scientific name	Total		Clearwater Fjord		Shark Fjord Region		Pangnirtung Fjord (1)		Kingnait Fjord		Pangnirtung Fjord (2)	
		I	E	I	E	I	E	I	E	I	E	I	E
Seabirds													
Red-throated loon	*Gavia stellata*	3	2	3	2								
Common loon	*Gavia immer*	1	1			1	1						
Unknown loon	*Gavia* spp.	4	4			2	2			2	2		
Northern fulmar	*Fulmarus glacialis*	8	5					8	5				
Eider (mostly common)	*Somateria* spp. (*Somateria mollissima borealis*)	500	16	8	2	19	5	14	2	459	7		
Iceland or Glaucous gulls	*Larus glaucoides, Larus hyperboreus*	329	106	7	7	26	15	99	25	119	12	78	47
Great Black-backed gull	*Larus marinus*	1	1									1	1
Great or Lesser Black-backed gull	*Larus marinus* *Larus fuscus*	1	1									1	1
Black guillemot	*Cepphus grylle*	104	52	29	16	68	30			7	6		
Unknown bird		2	1							2	1		
Total		953	189	47	27	116	53	121	32	589	28	80	49
Marine mammals													
Bowhead whale	*Balaena mysticetus*	9	5							9	5		
Beluga whale	*Delphinapterus leucas*	13	4	13	4								
Ringed seal	*Pusa hispida*	5	5	1	1	3	3			1	1		
Harp seal	*Pagophilus groenlandicus*	73	20			44	4	7	6	10	3	12	7
Unidentified pinniped		1	1	1	1								
Total		101	35	15	6	47	7	7	6	20	9	12	7
Effort or L (km)=		173.1		23.6		34.6		31.0		47.9		36.0	

Pangnirtung Fjord was surveyed twice, the second time with an additional transect

Discussion

Seabird observations

The distribution and abundance of seabirds in the study area varied by species and by fjord. Over 97% of the total seabirds sighted were made up of only three species; Common Eiders (2.9/km), Iceland/Glaucous Gulls (1.9/km), and Black Guillemots (0.60/km). Although information on relative abundance is not available from surveys in the 1970s, these three species have been identified as being most abundant in the region (CWS 2006a), suggesting no major change in the presence of common seabird species in Cumberland Sound. The occurrence of bird species detected during this survey agrees with their expected summer ranges (Dunn and Alderfer 2006) except for that of Great and Lesser Black-backed Gulls for which sightings in the study area would be considered extralimital although other surveys have previously documented the presence of Great Black-backed Gulls the Canadian Arctic (CWS 2006a).

Although replicates of Pangnirtung Fjord varied in species composition, they did provide similar encounter rates for the abundant gulls with estimates of 3.2/km and 2.3/km, comparable even given the low effort (31 and 30.5 km, respectively) over which these replicates were obtained. These encounter rates exclude the additional transect from the second survey of Pangnirtung Fjord which is included in Table 1. The abundance of gulls in this fjord may be attributed to the town of Pangnirtung and its garbage dump that these species are known to frequent (Mallory et al. 2003) or could also relate to a high availability of suitable nesting sites.

Of all of the fjords surveyed, the greatest number of seabirds was in Kingnait Fjord. These detections were influenced by an encounter with approximately 400 eiders and 80 gulls in a mixed flock on the open water in a location our guide described as a known feeding area. The concentration of seabirds here may relate to an oceanographic feature such as an area of upwelling (Briggs et al. 1988). This event made up about half of the total number of seabirds detected on the entire survey. Had this group not

Table 2 Seabird and marine mammals encounter rate estimates ($\hat{E}_s$) with associated standard deviation (SD) by fjord and over total effort for sightings in fjords of Cumberland Sound from July 29 to August 9, 2008

Species	Overall		Clearwater Fjord		Shark Fjord Region		Pangnirtung Fjord (1)		Kingnait Fjord		Pangnirtung Fjord (2)	
	$\hat{E}_s$ (SD)	M (R)	$\hat{E}_s$ (SD)	M (R)	$\hat{E}_s$ (SD)	M (R)	$\hat{E}_s$ (SD)	M (R)	$\hat{E}_s$ (SD)	M (R)	$\hat{E}_s$ (SD)	M (R)
Seabirds												
Red-throated loon	0.017 (0.076)	0 (0–2)	0.13 (0.29)	0 (0–2)								
Common loon	0.006 (0.031)	0 (0–1)			0.029 (0.091)	0 (0–1)						
Unknown loon	0.023 (0.072)	0 (0–2)			0.058 (0.18)	0 (0–2)			0.042 (0.27)	0 (0–1)		
Northern fulmar	0.046 (0.27)	0 (0–8)					0.26 (1.6)	0 (0–8)				
Eider (mostly common)	2.9 (13)	0 (0–413)	0.34 (0.94)	0 (0–7)	0.55 (0.92)	2 (0–8)	0.45 (1.9)	0 (0–12)	9.6 (83)	6 (0–413)		
Iceland or Glaucous gulls	1.9 (3.3)	4 (0–82)	0.30 (0.29)	1 (0–2)	0.75 (0.77)	4 (0–10)	3.2 (14)	9 (3–69)	2.5 (16)	6 (1–82)	2.2 (2.2)	16 (3–19)
Great Black-backed gull	0.006 (0.034)	0 (0–1)									0.028 (0.17)	0 (0–1)
Great or lesser Black-backed gull	0.006 (0.034)	0 (0–1)									0.028 (0.18)	0 (0–1)
Black guillemot	0.60 (1.5)	0 (0–47)	1.2 (1.6)	5 (0–9)	2.0 (2.9)	0 (0–47)			0.15 (0.64)	1 (0–4)		
Unknown bird	0.012 (0.066)	0 (0–2)							0.042 (0.41)	0 (0–2)		
Marine mammals												
Bowhead whale	0.052 (0.19)	0 (0–6)							0.19 (0.88)	1 (0–6)		
Beluga whale	0.075 (0.44)	0 (0–13)	0.55 (1.8)	0 (0–13)								
Ringed seal	0.029 (0.10)	0 (0–3)	0.042 (0.14)	0 (0–1)	0.087 (0.27)	0 (0–3)			0.021 (0.21)	0 (0–1)		
Harp seal	0.42 (0.95)	0 (0–27)			1.3 (2.1)	0 (0–27)	0.23 (0.77)	1 (0–3)	0.21 (1.6)	1 (0–8)	0.33 (1.0)	1.5 (0–5)
Unidentified pinniped	0.006 (0.034)	0 (0–1)	0.042 (0.14)	0 (0–1)								
Transect length (km) Median and (Range)		4.4 (1.0–16.0)		3.8 (1.3–4.5)		2.9 (1.0–16.0)		5.3 (3.7–10.9)		9.0 (8.1–13.6)		5.4 (3.4–11.0)

Reported as $\hat{E}_s = n/L$, where $\hat{E}_s$ = encounter rate of individuals per km, n = number of individuals of seabird species detected, and L = total length of transect or length by fjord (km). Also provided are median values along with the range of values for the number of each species seen across transects in each respective fjord and overall. Median and range of transect lengths (km) in each fjord are also given been observed within the strip transect in Kingnait Fjord, gull species would have the greatest apparent density over the entire study area and that of eider species would be approximately equal to Black Guillemots. Because of the unusually high abundance of birds in this fjord, particularly eiders, species encounter rates over the entire study area may be skewed.

Besides one instance of a female eider, an association to the boat was reported only for the gull species present. For the 210 total flying gulls recorded, 8–11% showed some association to the platform. This range gives the minimum and maximum values due to ambiguity in the way association was recorded in some instances. This association affects gull detectability and may have resulted in a positive encounter rate bias due to vessel attraction, as well as potential double counting although care was taken to avoid this (Hyrenbach 2001).

Marine mammal observations

Within Cumberland Sound, beluga whales were last surveyed in 1999, bird surveys were conducted in the 1970s, and there have been only larger-scale regional Arctic studies for bowhead whales and ringed seals outside of the sound (DFO 2008; Kingsley 1998). Aerial surveys in 1999 estimated a population of 1960 beluga whales (SD = 250) (Baratin 2001; DFO 2005). This stock is considered to be a distinct population of beluga whales that does not range outside of Cumberland Sound (DFO 2002). Our detections of beluga whales in Clearwater Fjord agrees with their expected summer distribution, as they are known to migrate to Clearwater Fjord as the ice breaks up in June and July where they remain until the fall to feed and calve (Kilabuk 1998; Richard and Stewart 2008). Bowhead whales were recorded in Kingnait Fjord only, though they were also observed off-effort just outside the mouth of Pangnirtung Fjord.

Marine mammal species encounter rates varied within each fjord. Pangnirtung Fjord was the only fjord in which a single marine mammal species was observed on-effort, and there was good agreement here among the replicate effort with harp seal encounter rates of 0.23/km each time. Though the sample size is small, this does suggest repeatability even on a limited scale.

A pod of four killer whales were sighted off-effort in Pangnirtung Fjord the evening of August 5, the day the first survey of Pangnirtung Fjord was carried out. This may have negatively biased the presence and abundance of other marine mammal species here or in subsequent surveying if the killer whales were still in the area. In Kingnait Fjord 2 days later, two on-effort sightings were made of juvenile or sub-adult bowhead whales that were very close to the shore. Assuming that killer whales are potential marine mammal predators in the Canadian Arctic (Higdon 2007), this observation of prey species staying close to the shoreline was possibly to seek protection in shallow water with killer whales close by.

Although marine mammals were recorded using distance sampling methodology, data could not be analyzed with Distance because the number of sightings for any of the species present is much lower than the recommended 60–80 detections (Buckland et al. 2001). Multi-species marine mammal surveys often face difficulty in obtaining a sufficient number of sightings for all species. As such, future studies in the region may use a stratified survey design to obtain sufficient sighting events and minimize variance in abundance estimation for species with clumped distributions, such as bowhead or beluga whales, while subsequently recording all other species. If resources are available, this may be most reliably accomplished by aerial surveying due to the large effort necessary to obtain sufficient sightings within the sound as suggested by this survey, as well as to avoid potential constraints due to ice conditions. Resulting from their low encounter rate and dispersed distribution throughout the survey, ringed seal populations likely cannot be properly estimated with these methods during the open water season, and perhaps instead through aerial surveys of ringed seals hauled out on ice in the sound or counts of breathing holes and birth lairs (Krafft et al. 2006; Kingsley 1998).

Conducting surveys in remote locations such as the Canadian Arctic is challenging due to resource availability and environmental variation. Yet, if adequate survey effort can be completed, small boat surveys such as this can be used to obtain relatively low-cost and reliable abundance estimates when survey design is backed by preliminary data and is carried out with sound survey methods (Williams and Thomas 2009). Lack of a raised sighting platform does reduce effective strip width and forces observers to estimate distance by eye in most sightings for use in distance analyses. However, with adequate training observers have been shown to make unbiased estimates out to a distance of 450 m (Dawson et al. 2008) and observer bias can also be checked and calibrated. Also, a double observer approach can be adapted to estimate the detection probability, represented by the fraction of sightings missed.

This study is valuable as a multi-species pilot survey in this region of interest to establish an initial point for trend monitoring that can develop as new data are collected (Williams and Thomas 2009), especially as species continue to extend their ranges northward. This work provides future studies with expected marine mammal distributions and encounter rates in the area which can be used to estimate the required effort and enhance survey design (Buckland et al. 2001). With this information, small boat surveys could be adapted for implementation by northerners as an obtainable way to provide annual survey data necessary to assess trends in marine mammal abundance and distribution in various regions of the Canadian Arctic.

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