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Olokhaktomiut Hunters and Trappers Committee (OHTC), Lea, E.V., Akhiatak, J., Goose, A., Harwood, L.A., Joss, A., Kanayok, B., Kitekudlak, J., Kudlak, A., Kudlak, G., Kuptana, D., Matari, K.G.A., Melling, H., Memorana, R., and Wright, H.

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Olokhaktomiut Hunters and Trappers Committee (OHTC)[1], Lea, E.V.[2], Akhiatak, J.[1], Goose, A.[1], Harwood, L.A.[3], Joss, A.[1], Kanayok, B[1]., Kitekudlak, J.[1], Kudlak, A.[1], Kudlak, G.[1], Kuptana, D.[1], Matari, K.G.A.[2], Melling, H.[4], Memorana, R.[1] and Wright, H.[1]

Canada-Inuvialuit Fisheries Joint Management Committee
76 Mackenzie Road
P.O. Box 2120
Inuvik, NT, Canada
X0E 0T0

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[1] Olokhaktomiut Hunters and Trappers Committee, PO Box 161, Ulukhaktok, NT, X0E 0S0
[2] Fisheries and Oceans Canada, PO Box 1871, Inuvik, NT, X0E 0T0
[3] Fisheries Joint Management Committee, PO Box 2120, Inuvik, NT X0E 0T0
[4] Fisheries and Oceans Canada, Freshwater Institute, 9860 West Saanich Road, Victoria, BC, V8L 4B2

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**Correspondence: OHTC (ohtc2015@outlook.com) and Ellen Lea (Ellen.Lea@dfo-mpo.gc.ca)*

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ABSTRACT

Bowhead whales (*Balaena mysticetus*) are an ice-adapted baleen whale capable of navigating through areas of relatively heavy sea ice. Most bowhead whales of the Bering-Chukchi-Beaufort (BCB) population undertake seasonal migrations between wintering areas in the Bering Sea and summer feeding habitats in the Canadian Beaufort Sea and Amundsen Gulf. Residents of the coastal community of Ulukhaktok, NT, in eastern Amundsen Gulf rely extensively on sea ice during winter for traveling and harvesting. While travelling on the sea ice near the community between January and March 2019, multiple individuals independently observed bowhead whales in the Prince Albert Sound region of eastern Amundsen Gulf, representing the first known sightings of bowhead whales overwintering in this area. Ten Olokhaktomiut Knowledge Holders were interviewed to document these sightings within the context of known seasonal use of bowhead whales in the area over time, their observations of winter 2018–2019 ice conditions, and environmental changes detected over time. These observations and Traditional Knowledge add to multiple lines of evidence that have revealed both variability and shifts in the timing, locations, and extent of BCB bowhead whale migrations, with several linkages to shifting biological and physical characteristics of their habitats due to climate change.

INTRODUCTION

The bowhead whale (*Balaena mysticetus*) is a highly ice-adapted baleen whale that occupies Arctic waters year-round. Bowheads are capable of navigating through areas of relatively heavy sea ice during spring (Zeh *et al.* 1993, Quakenbush *et al.* 2012), including easily fracturing 18 cm ice to breathe; Inupiat hunters have witnessed bowheads breaking ice approximately 2 ft (60 cm) thick (George *et al.* 1989). Climate change in Arctic waters has been rapid, with extensive changes to the biological and physical characteristics of bowhead whale habitats, including appreciable reductions in pan-Arctic multi-year-sea-ice extent and thickness (Moore and Laidre 2006, Druckenmiller *et al.* 2018), particularly in the Beaufort Sea (Kwok and Cunningham 2010). Here the composition of pack ice in the Beaufort gyre, once dominated by thick and old multi-year ice had shifted by 2007 to a more varied mix of thinner younger old ice and seasonal sea ice (Moore *et al.* 2022). Associated changes in the biological and physical characteristics of the bowhead whale's habitat in the Beaufort Sea have been extensive, including widespread reductions in sea-ice cover during late spring, summer, and early fall (Moore and Laidre 2006, Druckenmiller *et al.* 2018). While the climate-driven decline in multi-year sea ice extent at a pan-Arctic scale has been minimal since 2007 (Stern 2025), it is expected to resume in future years.

Up until observations reported in this paper, bowhead whales of the Bering-Chukchi-Beaufort (BCB) population were thought to migrate annually between wintering areas in the Bering Sea, and summer feeding habitats in the Canadian Beaufort Sea and Amundsen Gulf (Citta *et al.* 2015, Harwood *et al.* 2017). Most whales have left Canadian waters by early-October, returning to overwintering habitats in the Bering Sea (Moore and Reeves 1993). While the majority of

BCB bowhead whales follow these seasonal patterns, satellite telemetry has revealed some degree of individual variability in the timing, locations, and extent of seasonal migrations, coupled with emerging evidence of stock and range expansion, earlier arrivals to summering habitats, and later departures (*e.g.*, Harwood *et al.* 2010, 2017, Olnes *et al.* 2020, Citta *et al.* 2021, Kuletz *et al.* 2024, Young *et al.* 2024).

Traditional Knowledge (TK) is crucial for understanding the biology, behaviour (migration, feeding, mating), health, and conservation of wildlife populations. TK can provide insights that may be missed by science, and together both ways of knowing can be complementary to build a more comprehensive understanding in the context of research, monitoring, and management (Alexander *et al.* 2011, Ban *et al.* 2018, Thompson *et al.* 2020). It is also important to integrate ecological observations shared by TK holders with available scientific knowledge to inform management and mitigation aimed at addressing impacts of the changing climate, shipping, and other anthropogenic stressors. Extensive and dedicated TK studies have been conducted on the Eastern Canada-Western Greenland (EC-WG) bowhead whale population (*e.g.*, Hay *et al.* 2000) and on BCB bowheads in several villages in Alaska (Noongwook *et al.* 2007, Huntington and Quakenbush 2009a, 2009b, Quakenbush and Huntington 2010), but until now, little has been compiled explicitly for the BCB bowhead population within the Inuvialuit Settlement Region (ISR).

Residents of Ulukhaktok, located on the shores of eastern Amundsen Gulf in the ISR, Northwest Territories, Canada, rely extensively on the sea ice during winter, for both traveling and harvesting (Pearce *et al.* 2010, OHTC *et al.* 2016). While traveling on the sea ice near the community between January and March 2019, multiple individuals independently observed bowhead whales. These are the first known sightings of bowhead whales in the Prince Albert Sound region of eastern Amundsen Gulf in these winter months. The objective of this report is to compile and publish these winter observations of bowhead whales and related Olokhaktomiut Knowledge on seasonal bowhead whale distribution and associated environmental conditions, in winter 2018–2019 and over time.

METHODS – DOCUMENTATION OF OLOKHAKTOMIUT KNOWLEDGE AND OBSERVATIONS

Upon hearing news of these novel observations, staff in the Fisheries and Oceans Canada (DFO) Inuvik office reached out to the Olokhaktomiut Hunters and Trappers Committee (OHTC) to learn more and determine if there was interest in working together to document these sightings. DFO worked with the OHTC to identify individuals who had observed bowheads during winter (November-March, in 2018–2019 or in an earlier year), extensive experience travelling on the sea ice during the winter months, and/or extensive knowledge of community observations over time. Posters were also displayed around the community for those who wanted to participate in a drop-in session. Semi-structured interviews were conducted with ten Olokhaktomiut Knowledge

Holders[1] in May 2019 with the support of guiding questions, printed maps, and a voice recorder. Knowledge Holders consisted of eight Elders (>60 years of age) and two youth (<30 years of age). DFO researchers followed up with these Knowledge Holders in February 2024 to verify responses and confirm that everyone was comfortable with publishing the results presented in this report.

Interview responses were summarized into three categories: 1) direct observations of bowhead whales during winter; 2) knowledge of historical winter observations of bowhead whales in the area; and 3) winter 2018–2019 ice conditions and changes observed in the environment over time. Interview responses were summarized as direct quotes whenever possible (text presented in italics and quotations) or otherwise paraphrased. Notes and references made on printed maps were compiled into a single image representing these observations.

RESULTS – OLOKHAKTOMIUT KNOWLEDGE AND OBSERVATIONS

Direct observations of bowhead whales during winter

Multiple accounts of bowhead whales observed during winter between January and March 2019 were reported by residents of Ulukhaktok, NT, seen within 50 km of the community in the western Prince Albert Sound region of eastern Amundsen Gulf (Table 1, Figure 1). A total of five Knowledge Holders independently reported direct sightings of bowhead whales between January and March 2019, between one and four whales at a time, with most observations noted in late-January and early-February. Four out of the five were polar bear and seal hunting near the floe edge at the time, while the fifth was travelling and observing in the area. The bowhead whales were observed at the surface, with some Knowledge Holders suggesting that they were possibly feeding and/or resting. Although most reported that it was difficult to confidently assess the size of the whales, three individuals thought that they were adult whales given their size, body condition, white patches, and the height of their blow (30–50 ft). All five individuals reported that the bowheads were observed in an area of open water, within a 100–200 ft lead near Holman Island, in addition to extensive young ice extending eastward far into Prince Albert Sound. One individual was able to capture a photo of the open water area near Holman Island the day of his sighting; unfortunately, due to the cold air temperatures at the time his phone battery died before he could take a photograph of the bowhead whale that was observed nearby (Figure 2).

"I was closest to the island, Holman Island… maybe 15–20 minutes after I was there, Adam came down because he was going to wash his bear skin. So we washed his bear skin first and we started standing around waiting for seals and singing drum dance tunes. Of course when you sing the seals come around. A couple seals came around but we thought they were too big so we never shot at them. And then when we were looking around for seals a bowhead came up… that was so puzzling to see a bowhead in February!"–JA

[1] All Knowledge Holders have been recognized as co-authors on this report.

Table 1. Summary of reported winter bowhead whale observations in the vicinity of Ulukhaktok, NT, between January and March 2019.

Initials	Age Category	Number of whales observed	Date	Activity	Location	Behaviour of whales observed	Other observations	Water and Ice conditions
BK	Youth	3	End of January 2019	polar bear hunting near the floe edge	within 50 km SE of Ulukhaktok	observed at surface, a couple of them going up and down, looked like they might have been travelling east	seemed large; blow spray went up about 50 ft.	more open water relative to other years; a lot of northeast wind breaking shelf off and ice is thinner than usual
JK	Youth	>3	January-March 2019	polar bear hunting near the floe edge	within 50 km SE of Ulukhaktok	not sure	*NA*	open water and thick ice
RM	Elder	>6	initially in February 2019 (n=4), March (n=2), and April (n=6)	travelling, observing	within 20 km of Ulukhaktok	mostly at the surface; could see their breathing	too far away to assess their size	open water, a lot of young ice and pieces of ice at the surface
JA	Elder	1	February 5, 2019	polar bear and seal hunting near the floe edge	near Holman Island (within 20 km of town)	at the surface; appeared to be feeding	big white patches; good condition; blow about 30–40 ft in the air	open water; nearly 100-200 ft lead near the island from the wind moving the ice around; young ice extended far out.
AK	Elder	1	February 5, 2019	polar bear and seal hunting near the floe edge	near Holman Island (within 20 km of town)	resting at surface, likely from feeding; did not fluke up when it dove under.	appeared to be an adult given its size	open water and young ice

Figure 1. Map of reported observations of bowhead whales between January and March 2019 and ice conditions in the Ulukhaktok area, in the Prince Albert Sound area of eastern Amundsen Gulf. Initials represent observations reported by specific Knowledge Holders.

Figure 2. Hunting at the floe edge on February 5, 2019. Cold temperatures caused the hunter's phone battery to die before he could take a photograph of the bowhead whale that was observed nearby shortly after (photo credit: J. Akhiatak).

Knowledge of historical observations of bowhead whales during winter

All ten Knowledge Holders reported that they had not observed bowhead whales during winter previously and that they were also not aware of any past winter observations in the community (Table 2). Many expressed their surprise that bowhead whales were observed during winter given that they typically do not arrive until spring (April or May, but more typically into June and throughout the summer).

"This is the first time I have heard of anyone seeing bowheads in the winter time. The earliest I have seen whales, which were beluga, is end of May."–AK

"*For this bowhead, I'm telling you I was surprised to see it out there! It really amazed me. After talking to [a few] Elders... they smiled at me and said 'first time I hear of that too'*."–JA

"To have somebody sight a bowhead in the mid of winter [is] a shock. Out of normal to have bowheads sighted in our area where were supposed to have lots of ice."–AG

Winter 2018-2019 ice conditions and changes observed in the environment over time

All ten Knowledge Holders reported that the ice conditions were exceptionally low the winter of 2018–2019 and they have never seen that much open water and thin ice close to the community during winter (Table 3). Many attributed the open water conditions to the warmer air temperatures and high winds that persisted throughout the winter. All Knowledge Holders spoke about how much the winter ice conditions in the area have changed over time, and many spoke of the impact that these shifting conditions have had on the community's hunting and travelling. Knowledge Holders also reported changes in the timing and occurrence of other wildlife species such as birds, insects, and ducks being observed in the area.

"It was one of the years where we had the least amount of ice. Some years the ice would blow in and then it would – if we're lucky – it would form again and we can travel on it. But this year it would form, blow away, form, blow away, never really get a chance to stay connected to the thicker ice that's left out there. And even that ice is not very thick compared to other years. The one good thing about it is whales get to feed. The thing that a lot of us are worried about is how the seals are. That's one of the biggest concerns. This year has been the lowest amount of seals in this area. Last spring, this year. Last summer through this year and that has been the lowest… it's one of the most widespread open water seasons we've had I think ever."–AK

"Strange world. Some stuff happened that you rarely see in the past. This past winter there were a few other things kind of thought were strange that I've never seen throughout my lifetime in winter. Some rivers in the middle of the winter. Really puzzling. I had to really teach the young people I was traveling with how to be careful out there. Even though we were on land, some of these rivers were still open in November. That was really strange." –JA

"Yes. The dead of winter in 2019. It's alarming to hear… with cycles for seasons, you know, and when about the change is going to happen. Today, it just happens really early, way too early or way too late. The fall can't freeze for a long time. People have to travel by the land to get to their hunting ground in the southern part. The northern part you have the land, but to get that way you have to go a certain long leg route and then by the ocean in Safety Channel to travel on good ice. It's really changing fast!" –AG

Table 2. Summary of responses related to past observations of bowhead whales during winter directly by the interviewees as well as their knowledge of historical sightings by the community of Ulukhaktok.

Initials	Age Category	Have you observed bowheads during winter before?	Have you heard of bowheads being observed during winter before?	Other observations specific to bowheads
JA	Elder	No	No	*"For this bowhead, I'm telling you I was surprised to see it out there! It really amazed me. After talking to [a few] Elders... they smiled at me and said 'first time I hear of that too'."*
AG	Elder	No	No	*"To have somebody sight a bowhead in the mid of winter [is] a shock. out of normal to have bowheads sighted in our area where were supposed to have lots of ice."*
AJ	Elder	No	No	Past observations of bowheads mostly in June-August.
AK	Elder	No	No	*"This is the first time I have heard of anyone seeing bowheads in the winter time. The earliest I have seen whales, which were beluga, is end of May."*
BK	Youth	No	No	*"First time I've seen them in the winter time; usually see them more in the spring/summer and fall."*
DK	Elder	No	No	*"This is the first time. The open water has been open all winter. Even in Sachs Harbour they say that it has been open all winter. I don't think a bowhead would have a hard time to go through the young ice, it's open all winter. The young ice doesn't get thick and doesn't freeze anymore."* He also reported the earliest he has seen bowheads was in April when the ice was breaking up early many years ago, but otherwise only during late-spring and summer.
GK	Elder	No	No	*"That was pretty odd to see; usually they are around Alaska that time of year in January."*
JK	Youth	No	No	NA
RM	Elder	No	No	The earliest he has observed bowheads was in spring when the ice starting breaking up.
HW	Elder	No	No	*"[A bowhead sighting during winter] was very unique. That was the only time I ever heard, but this year has probably the most open water since 1969 or 1970. I don't know if it's ever been like this. The old old people who are long gone now told me way way back it used to be very cold. They were very good observers."*

Table 3. Olokhaktomiut accounts of ice conditions the winter of 2018–2019 and changes observed in the environment over time in the area. Table continued on next page.

Initials	Age category	Ice conditions that winter relative to other years	Changes observed in the environment over time
JA	Elder	open water; nearly 100–200 ft lead near the island from the wind moving the ice around; young ice extended far out. Ice wasn't as thick this winter at floe edge. Slush, water on top of ice from wind and waves. *"The ice is no good this year, [with] so much wind it never really got a chance to freeze good this past winter. Once in a while, there's young people this time of the year who start going bear hunting. I always know information from when people are going, so I always tell them right away to be careful on the ice. We were actually testing out the ice once, with a couple of Elders when we were waiting for seals and few young guys starting coming around. We start talking with them and said "you can't just fly around anymore, you have to be careful"."*	*"Strange world. Some stuff happens [now] that you rarely see in the past. This past winter there were a few other things kind of thought were strange that I've never seen throughout my lifetime in winter. Some rivers open in the middle of the winter; really puzzling. I had to really teach the young people I was traveling with how to be careful out there. Even though we were on land, some of these rivers were still open in November. That was really strange... Too warm this winter, and with wind didn't allow things to freeze up. Slowly I am believing in global warming....All [of this knowledge is] brought forward from the Elders who are still trying to pass along to the young ones."*
AG	Elder	*"The ocean keeps breaking up. It freezes and whatever east winds really break up our ocean. The concern is if west winds happen we're going to get more broken ice closer to the shores."*	*"Ice doesn't get thick anymore. I was just saying it must be really confusing for even sea mammals and land mammals. Birds for that matter! We're getting different bird sightings. New species. New insects."*
AJ	Elder	*"This winter all winter the ice was moving, lots of open water. It didn't freeze up."*	*"35 years we used to go way out [to Paulatuk, NT] with dog team in the winter… not anymore."*
AK	Elder	*"It was one of the years when we had the least amount of ice. Some years the ice would blow in and then, if we're lucky, it would form again and we could travel on it. But this year it would form, blow away, form, blow away and never really got a chance to stay connected to the thicker ice that's left out there. And even that ice is not very thick compared to other years."*	*"From the amount of wind that happens, it does not get a chance to form the way it used to. The wind is the biggest factor in our ice change here. It doesn't stay calm enough for the ice to form to what it used to be. It would form and blow away. Finally, eventually at least probably a month later than what it used to be it would finally start forming. Most times it's rough nowadays. When I was growing up and when my kids were 5 and 7 years old, I used to be able to go on it with snowmobile and drive straight out to anywhere I wanted to go without any worries of running into open water or being blown away. Now we have to be so careful where we travel at all times. Even out at the open water we have to watch when we're getting close to the open water we have to watch where the other cracks are because one year we almost drifted away while sitting at the open water. The open water is one of the reasons why the whales didn't leave. Ducks are staying too."*

Initials	Age category	Ice conditions that winter relative to other years	Changes observed in the environment over time
BK	Youth	*"There was a lot of north wind so I'm guessing it was blowing the ice out into the open. The ice shelf is breaking off and there wasn't much for thick ice around. Compared to other years it was fairly less ice than usual in that area. A little bit thinner than usual."*	A lot less ice and warmer over time.
DK	Elder	*"This winter it's been open all year round. There is a lot of open water all the way across here to Cape Parry….. This winter this part [near Ulukhaktok] never froze. Safety Channel, PAS, Prince of Wales Strait they would freeze but this part stayed open all winter... it is going to be hard for us if it doesn't freeze anymore."* David noted it was the first time he had seen ice conditions like that during winter and a lot of east wind over this winter.	*"[The ice is much] different, it doesn't get thick anymore. When you use your chisel, it's really soft and it doesn't get hard anymore."*
GK	Elder	*"We had broken ice, young ice and open water right through the whole winter. Right down from here to around across Prince Albert Sound, Cape Parry, around to the mainland and east and then north you can tell it was all broken up young ice."*	*"I remember back in the old days when my Dad used to go out, used to talk about going straight out from here until you can't see the land anymore; that is where the big polar bears came out."*
JK	Youth	Thick landfast ice to hunt from with open water lead.	
RM	Elder	Lots of young ice and open water.	*"Since climate change...it has been getting warmer and warmer slowly, the open water is starting to stay here longer… starting to get thinner ice."*
HW	Elder	*"They could have [spent all winter there]. There was never any fully formed ice that was stable… The ice doesn't get thick [anymore]…that is definitely true that the surface water is noticeably warmer. Anyone who used a fish net can tell you that."*	*"The warmer water has implications on making ice.... And that has implications on how fast the ice melts and more importantly how fast the ice goes from currents. We almost lost people here and I think it's probable that we will lose people, driving on the ice where they've always driven before, that they know should be good but it isn't. We can hope nothing happens. That's the difference in the water and in the ocean and the ice. There's more algae growing everywhere down in the inter-tidal. You didn't have to be as careful as you are now. There's a lot of sediment coming down the rivers. You can see that because the permafrost is melting and is washing sediment down."*

DISCUSSION

To our knowledge, these accounts from residents of Ulukhaktok represent the first observations of bowhead whales overwintering in eastern Amundsen Gulf. Although bowheads had not been observed nearby during winter previously, Ulukhaktok residents are accustomed to observing bowhead whales in the area during spring and summer, especially during summers in recent years that had earlier break-up dates. For example, a group of approximately six or seven groups of whales were observed feeding directly in front of the community for about three weeks in July 2024 (Pat Klengenberg, Ulukhaktok, pers. comm.). Ice in the area persisted later in 2025 with a later break-up date and no bowheads were observed. It was noted that this winter (2025–2026) the ice has been very solid with no open water observed (Joshua Oliktoak, Ulukhaktok, pers. comm).

The Knowledge Holders interviewed here possess decades and likely centuries of cumulated knowledge held and passed down in this area. This report not only documents Olokhaktomiut winter observations of bowhead whales, but also puts these observations into context of long-term Olokhaktomiut Knowledge of bowhead whales and ice conditions in a changing Arctic. This was a series of novel sightings, in a year with an unusual persistence of thin ice along the western shore of Victoria Island (see Appendix A for further details), accompanied by many other observations of changes in the environment and the timing and occurrence of other species observed in the area. While ice conditions can be highly variable among years, Olokhaktomiut reported that the winter of 2018–2019 was among the lowest that they had observed in the area to date. Additionally, Knowledge Holders noted the importance of wind speed and direction as a key driver of sea ice thickness and extent in the area.

The presence of bowheads in the area during winter 2018–2019 was also detected through a network of passive acoustic recorders deployed in eastern Amundsen Gulf by Insley *et al.* (2021). It is possible that bowhead whales have overwintered in other areas of Amundsen Gulf previously and were undetected if they were outside the proximity of community hunting and travelling areas. In light of changing sea ice conditions and the substantial time Inuvialuit harvesters spend on the ice during winter, the frequency of reported bowhead whale observations during this season may increase. Future work could explore possible reasons why bowhead whales overwintered in Amundsen Gulf 2018–2019, or in any other years going forward, and explore bowhead whale's ability to survive potentially wintertime ice conditions prevalent on Canada's polar continental shelf. Inuit Knowledge Holders from Nunavut have reported that "sea ice does not seem to be a significant problem for the bowhead whale" although they tend to "avoid areas where ice cover is very extensive or apparently continuous", with infrequent reports of bowheads found dead due to ice entrapments[2] (Hay *et al.* 2000).

Multiple lines of evidence, now including the Olokhaktomiut Knowledge shared and reported in this study, indicate that both the timing and spatial extent of BCB bowhead migrations have been

[2] Based on their observations of the Eastern Canada-Western Greenland population of bowhead whales.

undergoing detectable change over the past two decades. While most of the population has historically overwintered in the western Bering Sea (Citta *et al.* 2012), satellite telemetry since 2007 suggests they may have shifted their wintering habitats further north into the Chukchi Sea in recent years, corresponding with reductions in ice conditions in the Bering Sea (Citta *et al.* 2023). Traditional Knowledge of Yupik whalers from St. Lawrence Island, Alaska, located in the north Bering Sea, have also reported changes in bowhead whale migration timing and distribution that are likely attributed to changing environmental factors, as well as increases in the number of whales observed in the area over time (Noongwook *et al.* 2006). Aerial surveys spanning several decades in the Alaskan Beaufort Sea have demonstrated that bowheads are using shallow shelf habitats earlier in the summer than previously observed (Clarke *et al.* 2018). In Canada, aerial surveys conducted in the offshore southeastern Beaufort Sea have also shown that bowhead whales are arriving and aggregating earlier in the summer and leaving later in the fall (Harwood *et al.* 2010). Passive acoustic data have revealed that bowhead migration patterns are shifting both temporally and spatially in the western Beaufort Sea and Chukchi Plateau (Szesciorka and Stafford 2023, Szesciorka *et al.* 2024). In parallel, several Nunavut communities have also observed changes in the number and occurrence of EC-WG bowhead whales observed in their respective areas over time, likely reflecting an increasing population size as well as potential shifts in the distribution of bowhead whales (Hay *et al.* 2000).

The drivers and implications of these shifts in a changing climate remain poorly understood. Bowhead whale foraging behaviour, characterized by year-round feeding across a broad geographic range, suggests a higher degree of adaptability thereby making them more resilient to the impacts of climate change compared to closely related cetacean species (Fortune *et al.* 2023). While not detected in adult bowheads, the body condition of subadult BCB bowhead whales has shown a positive correlation with reductions in sea ice (George *et al.* 2015, Harwood *et al.* 2015). In addition, the BCB bowhead population size has been increasing since the 1970s and may be at carrying capacity (Young *et al.* 2023). While bowhead migration patterns are known to be driven by patterns in food availability (Citta *et al.* 2015, 2021), the changes in sea ice conditions influence these patterns, with ice retreat perhaps leading to increased ocean productivity within the Pacific Arctic in recent years (Moore 2016). On the other hand, reductions in sea ice may also be mediating other growing threats to bowhead whales, such as increased disturbance and displacement due to marine shipping (Halliday *et al.* 2022, Martin *et al.* 2023).

Further explorations into how bowheads are using winter habitats in eastern Amundsen Gulf and the surrounding area, and the environmental factors that may be influencing this, warrant ongoing prioritization during a time of rapid change. Further efforts to work with ISR communities to document their historical and contemporary knowledge and observations of bowhead whales would help to provide further insights into bowhead whale seasonal migrations and distributions while in Canadian waters over time. For example, harvesters out of Sachs Harbour, NT, in the eastern Beaufort Sea have reported observing bowhead whales while hunting with dog teams in the 1940s (Gerald Inglangasuk, Inuvik, pers. comm.). Inuit across the

Arctic are intimately tied to the sea ice, using it as a main platform for hunting and travelling in coastal areas and while applying their knowledge, observational skills, and risk assessment of all ice conditions they encounter (George *et al.* 2004, Beaulieu *et al.* 2023). While technology continues to advance to better understand Arctic species and their habitats, it is crucial to continue working with Inuit communities to document and mobilize their knowledge of local conditions and observations, which are typically more representative of broader time and spatial coverage than scientific approaches (Moller *et al.*, 2004, Moore and Hauser 2019). Ongoing collection of Traditional Knowledge and observations, in conjunction with scientific research and environmental monitoring, is essential to understanding BCB bowhead whales and the ecological variables driving their habitat use.

KNOWLEDGE ACCESS, OWNERSHIP, AND CONTROL

All Knowledge Holders have provided their consent for sharing their knowledge in this report, have verified their responses in advance of publication, and have been recognized as coauthors of this report. Original interview recordings and transcriptions have been archived at the OHTC and DFO. Requests to access to these files must be submitted in writing to the OHTC for consideration and approval.

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APPENDIX A – EXAMINATION OF SEA ICE CONDITIONS OF EASTERN AMUNDSEN GULF WINTER 2018–2019

Images acquired by sensors on Earth satellites and the ice charts prepared from them are the only sources of frequent and systematically collected information about the varying ice cover of Amundsen Gulf during the last 45 years. The charts prepared by the Canadian Ice Service (CIS) are a convenient source of insight into year-round sea-ice conditions in Canadian Arctic, especially when seeking information about decades long past. The charts have been based on information from a variety of sources – visual observations from ships and aircraft, radar on aircraft, imaging scanners on satellites, radar on satellites – that have been interpreted by experts in ice analysis. Wintertime charts at monthly intervals are available from 1980, at bi-weekly intervals from 2006 and consistently at weekly intervals from 2011.

Data extracted from CIS ice charts reveal that ice conditions averaged across eastern Amundsen Gulf were not unusually light during the 2018–2019 winter relative to other winters since 1999–2000 (Figure A1). This figure displays weekly values of the fraction of the sea surface covered by ice less than 30 cm thick – open water, new ice and young ice – during this 26-year period. Although it remains unclear what maximum ice thickness is manageable for bowhead whales to break through for breathing without great difficulty, 30 cm was used as the threshold for the purposes of this analysis. This differs from the Knowledge Holders' reports ("ice conditions were exceptionally low the winter of 2018–2019 and they have never seen that much open water and thin ice close to the community during winter") due to differences in geographic scale between the ice conditions encountered by hunters within a few kilometers of shore and those across the Gulf in general. This underscores the importance of considering multiple sources of information on both local and regional scales when trying to understand ice conditions and their relevance to wildlife and local communities.

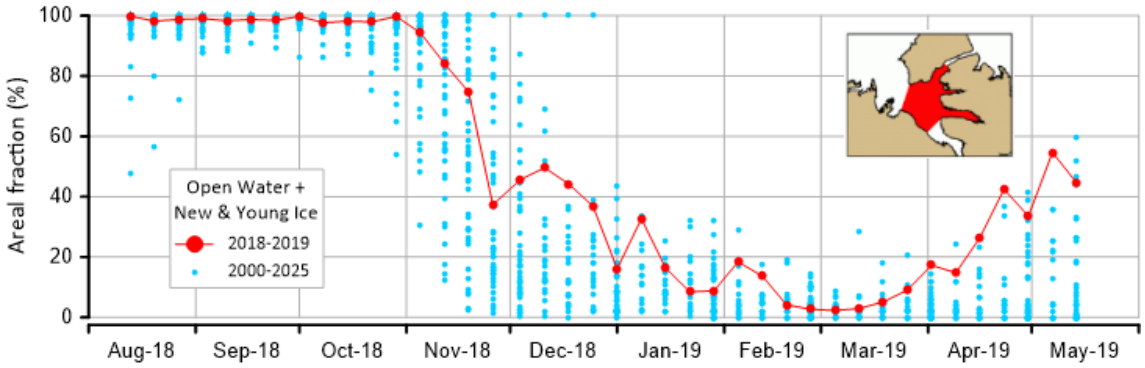

Figure A1. The areal fraction of ice thinner than 30 cm in eastern Amundsen Gulf (area shown in inset map), for the 2018–19 winter in red and for all other winters since that of 1999–2000 in blue.