Martin MJ, Halliday WD, Storrie L, Citta JJ, Dawson J, Hussey NE, Juanes F, Loseto LL, MacPhee S, Moore L, Nicoll A, Moore L, O'Corry-Crowe G, Insley SJ (2023) Exposure and behavioral responses of tagged beluga whales (*Delphinapterus leucas*) to ships in the Pacific Arctic. *Marine Mammal Science* 39: 387-421.

What is the research about?

- Belugas in the Pacific Arctic migrate through United States, Canadian, and Russian waters, passing through areas with high levels of vessel traffic and potentially are exposed each year to a high number of acoustic disturbance events.
- Literature has shown that belugas can be disturbed by vessel-related noise and temporarily displaced. A few studies have examined the impacts of underwater noise on the behavior of wild belugas, and in some cases noise from outboard motors, icebreakers, tugs, barges, seismic air guns, and drilling evoked an avoidance/startle (i.e., flee) response at varying noise levels.
- The encounters presented here provide detailed evidence about how belugas may respond to vessel noise.

What we did:

- The current study reports location data from satellite-linked time and depth tags attached to nine male Eastern Beaufort Sea (EBS) belugas in conjunction with vessel location data, and summarizes the number of vessels encountered by tagged individuals. We examined data on beluga horizontal surface movements, and where possible, dive behavior including identified dive types associated with certain functional behaviors (e.g., foraging, travel, and recovery) to characterize potential behavioral responses to vessels.
- We used whale and vessel locations and a sound propagation model to estimate the level of vessel noise the whales would have experienced.

What we found:

- We investigated individual tagged beluga whale behavioral responses to vessel approaches within 50 km (23 encounters) and found belugas' swim speed increased with closer vessel approaches, showing possible changes in swim speed up to 79 km away. Changes in beluga horizontal swimming and diving movements were observed when some vessels passed within 50 km and indicated a disruption of whale behavior.
- These findings corroborate previous studies that have shown behavioral responses of belugas to vessels at distances far beyond visual range, implying belugas react to "quiet" vessel noise near ambient levels.

Our recommendations:

- Future analysis using tag technology that contains 3-dimensional movement and acoustic recorders would provide the opportunity to examine changes in the acoustic behavior of belugas, identify the acoustic signature, received level and exact time when vessel noise is received at the whale, and ultimately allow a more in-depth examination of belugas' behavioral response to the type and level of vessel noise and other sounds.

Why is the research relevant to the Inuvialuit people?

- Beluga whales are of cultural and ecological importance and are an important focus of Inuvialuit subsistence hunting.
- It is important to understand how increasing vessel presence could negatively affect the behavior and population status of belugas and therefore have an impact on the Inuvialuit people who rely on them.

Was the community involved?

- Yes. The Eastern Beaufort Sea beluga tagging program was conducted in partnership with the Inuvialuit Game Council and Fisheries Joint Management Committee, along with the Inuvialuit members of the Tagging Advisory Group. Special thanks to members of the 2018 field crew for their work in data collection, advice on project delivery, and discussions on beluga ecology: John Noksana Sr., Joseph Felix Jr., James Pokiak and Mikkel Panaktalok (Tuktoyaktuk), Lawrence Kaglik and Linley Day (Inuvik), Dennis Arey and Dwayne Benoit (Aklavik), and Patrick Akhiatak (Ulukhaktok). Thank you to Emily Way-Nee (Joint Secretariat), Jimmy Kalinek (Only Way Outfitting), Charles Pokiak for key logistical support, and for the letters of support from Inuvialuit Hunters and Trappers Committees and the Inuvialuit Game Council.