Using two fiber-optic cables to track whales as they cruise the Arctic

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Fin whales are the second largest mammals on the planet. The development of a new technology that allows researchers to eavesdrop on the animals as they swim in the Arctic could one day help prevent ship strikes. Credit: NOAA Fisheries

Fiber-optic cables line the coasts of the continents and crisscross the

oceans, carrying signals that are the backbone of communication in the modern world. While their main job is telecommunications, researchers have been exploring ways to use this giant network to eavesdrop on everything from storms to earthquakes to whales.

Now, working with two nearly parallel fiber-optic telecommunications cables off the Norwegian arctic archipelago of Svalbard, researchers have been able to estimate the positions and tracks of eight fin whales along a section of the cable—for five hours.

"This work demonstrates how we were able to simultaneously locate and follow these whales over an 1800 km^2 area—with relatively low infrastructure investment," said Martin Landrø, head of the Center for Geophysical Forecasting at the Norwegian University of Science and Technology (NTNU) and one of the members of the team that did the work.

Transforming fiber cables into hydrophones

The system the researchers used for this work is called Distributed Acoustic Sensing, or DAS. DAS uses an instrument called an interrogator to send laser pulses into a fiber-optic system and records the returning light pulses, essentially turning the cables into a series of hydrophones.

Landrø and his colleagues first began to explore the ability of DAS to record underwater vibrations and sounds in the waters off Svalbard in June 2020, during the height of the COVID-19 pandemic. At that time, they collected 40 days of recordings and roughly 250 terabytes of data. From these data, researchers were able to identify more than 800 whale songs and calls.

The researchers have built on this early work to expand their ability to

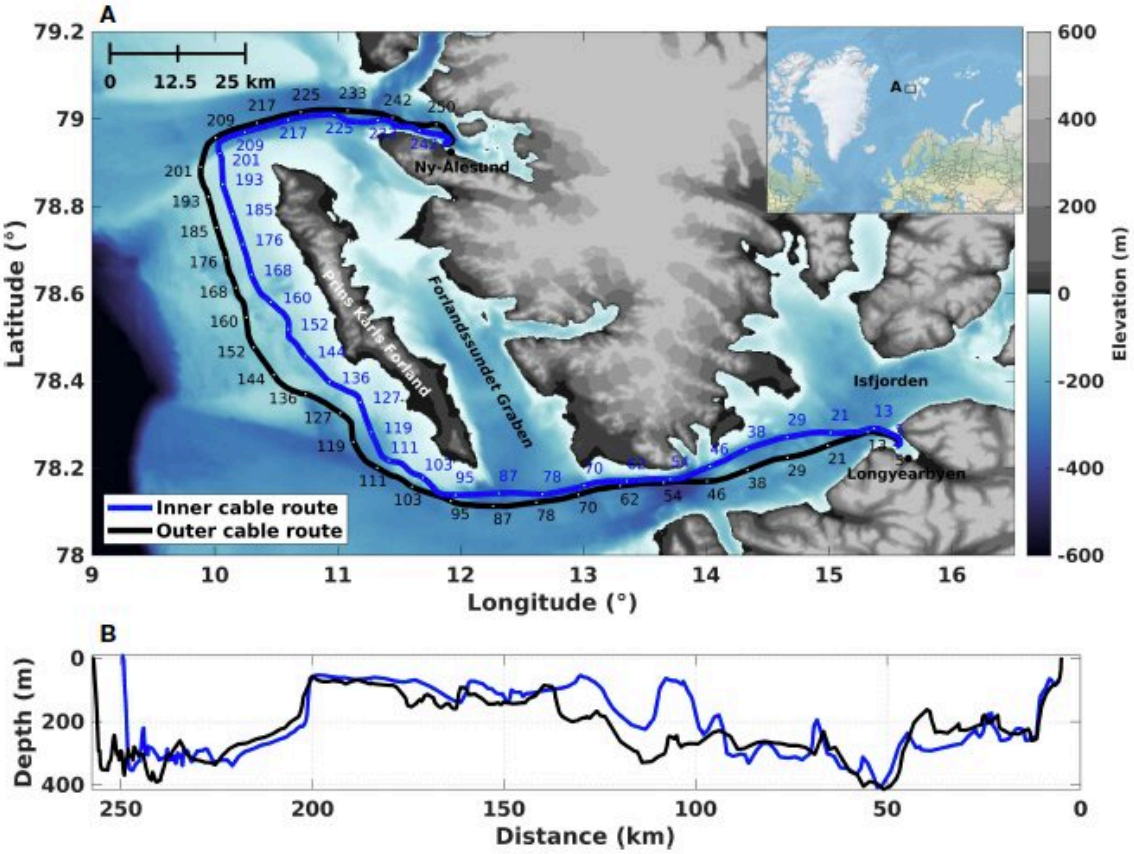
identify different whale species and to conduct real time recording from the fiber optic cables in Svalbard.

For this latest effort, published in *Frontiers of Marine Science*, the researchers had access to two, nearly parallel 250 km long fiber-optic cables that extend from Longyearbyen, the main settlement in Svalbard, to Ny-Ålesund, a research outpost to the northwest. The paired cables allowed the researchers to localize the whales with an accuracy of roughly 100 meters, within an area of roughly 1800 km^2.

"This shows that the two fiber cables are a very effective means of monitoring whales in the Arctic," Landrø said.

A melting Arctic

As a Norwegian territory in the high arctic, Svalbard offers Landrø and other researchers an important base from which to study this changing ecosystem.



This graphic show how researchers were able to simultaneously tracking multiple whales using fiber-optic cables in the Arctic, off the coast of Svalbard. The maps shows an overview of a 60 km long section of the cables, showing the positions and tracks of up to eight acoustically-detected whales, color-coded from dark to light over a 5.1-hour period. Credit: *Frontiers in Marine Science* (2023). DOI: 10.3389/fmars.2023.1130898

Recent research predicts that the Arctic could be ice free in the summer as early as 2035, which could increase shipping and cruise ship traffic across the top of the globe.

As one small example, as many as 35 cruise ships and additional smaller

expedition ships are expected to transport up to 75,000 people to Longyearbyen and surroundings in 2023, according to Visit Svalbard.

Could reduce ship strike risk

Whales are already changing the way they use the Arctic and Antarctic as feeding grounds, with some research showing that fin whales have begun spending time year-round in Arctic regions. That means increased ship traffic in these areas can also increase the likelihood of ship strikes. The use of the existing fiber-optic cable network and DAS could help reduce this possibility, the researchers said.

"The capabilities demonstrated here establish the potential for a near-real-time whale tracking capability that could be applied anywhere in the world where there are whales and fiber-optic cables," the researchers wrote. "Coupled with ship detection, using a similar approach ….a real-time collision avoidance system could be developed to reduce ship strikes."

More information: Robin André Rørstadbotnen et al, Simultaneous tracking of multiple whales using two fiber-optic cables in the Arctic, *Frontiers in Marine Science* (2023). DOI: 10.3389/fmars.2023.1130898

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