WWF GLOBAL ARCTIC PROGRAMME

THE CIRCLE

MAGAZINE

2.2024

MAKING WAVES

Getting it right for Arctic whales

The Circle 2.2024

MAKING WAVES: GETTING IT RIGHT FOR ARCTIC WHALES

COVER: A bowhead whale surfaces in the Bering Land Bridge National Preserve.
Photo credit: Kate Stafford, CC BY-SA 2.0

THIS PAGE: A trio of beluga whales in an ice hole far from open water in the Canadian High Arctic.
Photo credit: © naturepl.com / Sue Flood / WWF

Publisher:
WWF Global Arctic Programme
Ulriksdals Slott,
170 81 Solna Sweden

arcticwwf.org

ISSN 2074-076X = The Circle

Date of publication:
July 2024

Editor-in-chief:
Andrea Norgren,
andrea.norgren@wwf.se

Managing editors:
Sarah MacFadyen,
sarah@sarahmacfadyen.com
Patti Ryan,
patti@southsidecommunications.ca

Web and social media:
Ashley Perl,
ashley.perl@wwf.se

Design and production:
Film & Form/Ketill Berger,
ketill.berger@filmform.no

The Circle is published quarterly by the WWF Global Arctic Programme. To keep up with news about WWF and the Arctic, subscribe to our newsletter.

Whales in a changing Arctic: A call for action

THE THREE whales that are endemic to the Arctic—bowhead whales, white whales (or belugas) and narwhal—have, over evolutionary time, become high-latitude specialists that live in close association with sea ice. Thus, it is no surprise that climate change is a cause for concern for their well-being.

The Arctic is warming four times faster than the global average. Air and water temperatures are increasing, glaciers are melting and retracting onto land, and sea ice is declining rapidly. Current trends suggest that an ice-free Arctic (in summer) is possible before 2050. What will the consequences be for ice-dependent whales?

The short answer is that the consequences are likely to be many—and most will not be good. Climate change is causing both direct and indirect deterioration of ice-whale habitats. These whales depend on vast areas of sea ice for protection from storms and predators.

In the past, the sea ice edges that sweep north in the spring over shallow Arctic seas induced upwelling (the movement of nutrients from deeper waters to the surface), boosting the growth of plants and algae and, in turn, making food more available and easier for whales to find. These areas were also free from competition with other species that cannot cope with ice cover, and the sea ice curbed the whales' contact with southerly species that are more exposed to diseases. The presence of Arctic sea ice across vast areas for thousands of years also limited a host of human activities that readily take place in open oceans.

A bowhead whale lifts its fluke out of the water at the sea ice floe edge in the Last Ice Area, Pond Inlet, Nunavut, Canada.

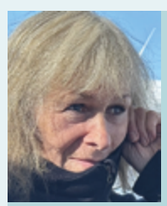
Photo credit: © WWF / Clive Tesar

Climate change is generating new challenges for Arctic-endemic whales, including risks associated with ocean noise, oil spills, pollutants and ship strikes.

But climate change is removing many of these protections, generating new challenges for Arctic-endemic whales, including risks associated with ocean noise, oil spills, pollutants, and ship strikes in an Arctic with more ship traffic. Competition for food—with both human fisheries and southerly species moving North—and declines in the availability of traditional Arctic prey species are adding to the risks.

This issue of *The Circle* addresses some of these challenges for Arctic-endemic cetaceans (along with harvest issues in Greenland) and proposes new monitoring methods and conservation actions to help mitigate the negative impacts on these whales.

We should not give up trying to slow climate change. But in the meantime, directed action to ensure that Arctic-endemic whales remain part of our future is essential. Arctic nations need to hunt responsibly and sustainably, leave enough fish and other forms of sea life to sustain Arctic species, and learn more about the ecological needs of, and key threats to, each of the three Arctic whale species so that we can take appropriate steps to protect their habitats. ●



KIT M. KOVACS is a marine mammal ecologist who has worked with ice-associated species in polar regions for many decades. She is the marine mammal network leader for the Arctic Council's Conservation of Arctic Flora and Fauna working group.

A "DANGEROUS PRECEDENT"

WWF sues Norway over deep-sea mining plan

IN JANUARY, NORWAY approved a plan to open a large part of its seabed to mining exploration despite the uncertain environmental impacts. Now, WWF–Norway is suing the Norwegian government.

WWF says the decision breaches Norwegian law, goes against the advice of the government's own scientific advisors, and violates several laws relating to adequate and inclusive environmental impact assessment. The proposed mining area, located in the Barents and Greenland seas, spans more than 280,000 square kilometres. It is a largely unexplored biological treasure that is home to unique forms of marine life and important marine mammal and seabed populations.

"It will set a dangerous precedent if we allow the government to ignore its own rules, override all environmental advice, and manage our common natural resources blindly," says Karoline Andaur, CEO of WWF–Norway. "The deep-sea mining ambitions of the Norwegian government represent one of the most substantial interventions ever proposed by Norway to its natural environment—and it could alter an area the size of Italy."

Deep-sea mining extracts metals and minerals from the seabed. Norway's government has said these are needed to support the transition to green energy. However, Andaur says top scientists have debunked these claims and characterized them as misleading.

MARINE CONSERVATION

New Inuit Protected Area in Canada

CANADA MAY BE getting a new marine conservation area.

In March, the Canadian government and Government of Nunatsiavut (an autonomous Inuit region within the Province of Newfoundland and Labrador) announced that a feasibility study had recommended protecting almost 17,000 square kilometres of the Labrador Sea near the shores of the province's Torngat Mountains. Known for their rugged terrain, deep fjords and significant cultural importance to Inuit, the mountains are considered one of the most remote and pristine wilderness areas in North America.

Torngat Mountains, Labrador, Canada.

Photo Credit: © Sara Falconer / WWF-Canada

The proposed Inuit Protected Area is home to polar bears, whales and dolphins, seals, breeding and migrating seabirds, waterfowl and a variety of fish species. If established, the area will conserve a portion of the Labrador Shelf Marine Region and protect the fjords that extend into Torngat Mountains National Park. There are no settlements within the park's borders today, but many Inuit trace their roots back to these lands and waters.

Next steps will involve ongoing consultations with rights holders, partners, stakeholders, industry and communities to negotiate elements like a final boundary and co-management structure.

FORCES AND COUNTERFORCES

Diminishing polar ice changing the Earth's rotation

A NEW STUDY has found that the melting of polar ice caused by climate change is slowing the Earth's rotation—and could affect how we keep time. Because global warming is melting ice at both poles, it is changing where the Earth's mass is concentrated: less solid ice at the poles means more mass around the equator. This affects the planet's angular velocity, causing it to spin more slowly.

According to the study, published in the journal *Nature*, this dynamic is counteracting an opposing trend that has actually seen the Earth spin faster in recent decades. Scientists had predicted that to deal with this acceleration, clocks worldwide would need to subtract a single "negative leap second" as early as 2026. (Doing so would result in a minute being only 59 seconds long.)

Coordinated Universal Time (UTC) is used to regulate clocks and time around the world and is calculated by the Earth's rotation. Since the 1970s, timekeepers have added about 27 leap seconds to the global clock—but never before has a second been subtracted. According to the study, computers may not need to subtract a negative leap second until 2029 now that polar ice melt is slowing the Earth's rotation. Because this has never happened before, it is unclear whether the world's interconnected computers will stay synchronized when it does.

This ski hut was part of Bolivia's Chacaltaya Ski Resort, once the world's highest ski resort at 5,400 metres above sea level. There is no snow here anymore.

Photo credit: Sally Rangecroft (distributed via imaggeo.egu.eu) (CC BY 3.0)

LAW OF THE SEA RULING

A breakthrough for collective climate and ocean action

IN LATE MAY, the International Tribunal for the Law of the Sea, a global maritime court, found that greenhouse gas emissions constitute marine pollution under the UN Convention on the Law of the Sea. The court's ruling—which stated that countries must go beyond the requirements of the 2015 Paris Agreement to protect the marine environment—is only an advisory opinion, but still provides a precedent that could shape future climate cases.

The tribunal established that to protect and preserve oceans from the impacts of climate change, countries have a duty to take all measures to prevent, reduce and control pollution of the marine environment from greenhouse gas emissions in line with the best available science.

The future of small island states and coastal communities—which are among the most vulnerable to the immediate impacts of climate change and ocean acidification—depends on decisive global action to reduce emissions and conserve the marine environment. But the benefits of tackling the climate and nature crises will be felt by all countries and communities, including in Arctic regions, where wildlife, ecosystems and people are already significantly affected.

WWF submitted an expert opinion to the court arguing that reducing emissions and protecting oceans should be a top priority.

Three whale species

GETTING TO KNOW THE ARCTIC'S WHALES

When Arctic sea ice breaks up in spring, whales that winter in more southern areas—such as humpbacks, minkes and fins—migrate north to spend their summers there. Only three species call the Arctic home year-round: belugas, narwhals and bowhead whales. These whales have evolved to take advantage of sea ice and thrive in the Arctic's frigid waters. But warming temperatures over the past decades have led to rapid sea ice declines and longer periods of open water in summer across much of the Arctic. These changes are bringing threats like oil and gas exploration and increased shipping.

Climate change is also altering the whales' migratory patterns and the ecosystems they have depended on for thousands of years. By better understanding belugas, narwhals and bowheads—and how their behaviours are changing—we can work together to protect these Arctic species.

A bowhead whale swims just beneath the surface of the Arctic Ocean.

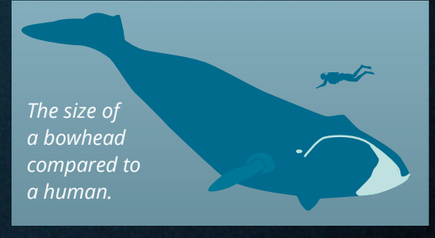
BOWHEAD WHALES: GIANTS OF THE ARCTIC

■ Bowhead whales, sometimes called Greenland whales, are found on both the Atlantic and Pacific sides of the Arctic. Their migrations are influenced by the melting and freezing of ice. These "giants of the Arctic" can reach more than 19 metres in length, and their large, reinforced skulls and powerful bodies enable them to break through sea ice up to 20 centimetres thick. As with narwhals and beluga whales, bowhead whales don't have dorsal fins. This is thought to help them minimize the heat loss that could come from a protruding fin. But perhaps more importantly, it helps the whales manoeuvre in waters covered by heavy sea ice.

Believed to be among the longest-lived mammals on Earth, bowhead whales can live for up to 200 years. They filter their food through baleen, special bristle-like structures in their mouths, opening their jaws and straining plankton from the surface, water column or close to the sea floor.

Heavily hunted by commercial whalers until the last century, bowhead whales across much of the Arctic are now recovering. Over the last 40 years, their conservation status has been gradually downlisted from "endangered." They are currently listed as "least concern" on the International Union for Conservation of Nature (IUCN) Red List, although two populations have been extremely slow to recover.

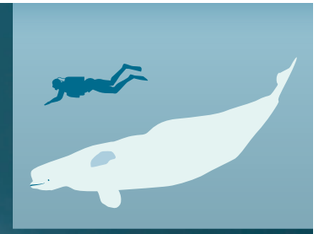
But with climate change, bowhead whales now face new threats. Since they swim slowly, often near the water's surface, they are at risk of being struck by ships. They also "sing" at a similar sound frequency to that of the underwater noise produced by ships, which could disrupt their ability to use sound to communicate.



The size of a bowhead compared to a human.

Photo credit: © naturepl.com / Martha Holmes / WWF

A beluga whale in Norway.



The size of a beluga compared to a human.

BELUGA WHALES: CANARIES OF THE SEA

Belugas, or white whales, live primarily in areas with sea ice. They are extremely sociable mammals that typically live, hunt and migrate in small pods of two to 10 whales, though they may form herds of up to 2,000 individuals in summering areas. Many populations migrate between summer and winter habitats. In summer, belugas are also found near river mouths and may even venture upriver in search of food. They feed on a variety of fish species, such as salmon, herring, shrimp, Arctic cod, flounder, crabs and molluscs.

Their name comes from the Russian word "bielo," meaning white. But these whales are actually dark grey at birth and lighten in colour during their juvenile years. Female belugas are completely white by about age 14, while males can take another six years to achieve the trademark colour. They have a bulbous forehead, called a "melon," that is capable of changing shape and is believed to play an important role in belugas' ability to send and interpret sound underwater. Often called the "canary of the sea," belugas are highly vocal and produce a series of chirps, clicks, whistles and squeals to convey important information to each other.

Beluga whales typically live as long as 80 years. But as climate change reduces the amount of sea ice in the Arctic, sightings of orcas in beluga whale habitats have increased. Orcas are a major predator of all three Arctic whale species, including belugas. Belugas also face threats from underwater noise produced by shipping, oil and gas development, and heavy metal and organic pollutants.

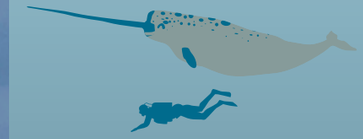
Narwhals with their tusks emerging out of the water surface near Baffin Island, Nunavut, Canada.

NARWHAL: UNICORNS OF THE SEA

Narwhals live in the Arctic waters of Canada, Greenland, Norway and Russia. During the winter months, most of the world's narwhals congregate in the icy areas between eastern Canada and western Greenland in Baffin Bay and the Davis Strait. Narwhals, like bowheads and belugas, will surface to breathe in "leads"—or cracks in sea ice—as well as breathing holes. They feed mainly on Greenland halibut along with other fish, squid and shrimp.

Nicknamed the "unicorn of the sea," the narwhal is well-known for its long ivory tusk. This spiralled tusk—which is actually an enlarged left tooth—can reach up to 2.5 metres in length and has millions of nerve endings, which are thought to help the narwhal locate food.

Of the three Arctic whales, scientists believe narwhals are the most sensitive to climate change because of their reliance on sea ice and specialized feeding. As the Arctic warms and sea ice disappears, narwhals face pressures similar to those of the other two Arctic species, such as changes to prey, predators and sea ice habitat as well as underwater noise pollution from increased industrial activities, especially shipping. Narwhals are listed as a species of "least concern" on the IUCN Red List, but some Greenlandic populations have declined in recent years. In fact, in Southeast Greenland, scientific assessments put narwhals at high risk of local extinction.



The size of a narwhal compared to a human.

Now is the time to recognize migratory corridors as essential components of ocean connectivity and marine species conservation, and to include these in ocean protection measures.

Protecting lifelines

MIGRATING WHALES NEED SPECIALLY MANAGED BLUE CORRIDORS

Often when people think about the mass migration of animals, they picture herds of wildebeest galloping across the Serengeti plains or flocks of geese flying south for the winter. But as **MELANIE LANCASTER** explains, vast underwater migrations also take place in the Earth's oceans—and these migratory routes need to be safeguarded to protect marine species like whales.

Beluga whale pod migrating through sea ice, Arctic Canada.

Photo credit: © naturepl.com / Doug Allan / WWF

MANY CETACEANS—from diminutive dolphins to massive blue whales—swim astonishing distances seasonally to take advantage of sheltered bays, food hotspots, and other areas that offer the conditions they need to survive. The underwater migration routes they use, known as blue corridors, can span thousands of kilometres, often crossing national borders and extending into the high seas.

For species that live within the boundaries of a single country, the responsibility for their conservation ultimately belongs to that country's government. For far-ranging whales, including those that migrate from the tropics to the Arctic, conservation is more complicated—yet no less essential.

Across the globe, whales face a multitude of threats during their migrations. The top three are shipping, fishing and climate change. Depending on their routes, whales risk entanglement in fishing nets and lines, collisions with ships, distress, disorientation and displacement from underwater noise pollution, shifts in and loss of prey, and increasing predation risk due to the effects of the climate crisis. Protecting some of their habitats through marine protected areas and other measures is a good start. But it is not a complete solution.

Networks of protected and conserved areas—which incorporate elements of ecological connectivity, such as migratory corridors—are necessary to maintain ocean health and function. Although widely promoted by scientists and now finally getting some traction among policy-makers, in practice, migratory corridors for whales have never been integrated into the systematic design and implementation of such ocean networks. Instead, whales are left to "swim the gauntlet" of threats during their migrations twice a year—a conservation strategy that is far from effective.

Blue corridors are conduits for thousands of whales finding their way from the tropics to the Arctic's icy cold, food-rich waters every summer.

A grey whale mother and calf migrate along the central California coast from their wintering grounds in Mexico to their summer feeding grounds in the Arctic.

Photo credit: NOAA Fisheries West Coast via Flickr.com. CC BY-NC-ND 2.0

A TRIPLE WHAMMY OF THREATS

Holding the champion position for the longest migration of all mammals on the planet, the North Pacific grey whale swims 11,000 kilometres every spring from the warm equatorial waters of Mexico to the icy Arctic Ocean. These whales face a multitude of threats during their migrations.

Leaving the sheltered lagoons of Mexico, the whales, including females with young calves, travel north along the US west coast. Stopping over to feed off the coast of Oregon, they are stressed by underwater noise from ship traffic. They then continue up Canada's coastline into Alaska and swim through the Bering Sea, known as America's "fish basket" because it supplies almost half the seafood consumed in the US. Here, some whales become entangled in fishing gear. Upon finally reaching Arctic waters, it seems they have, in recent years, been greeted by a lack of food: Arctic marine heatwaves and other climate change–related effects are thought to have diminished grey whale prey.

This loss of food at the end of a long migration was believed to be a primary cause of an unusual mortality event declared by the US government from 2018 to 2021, during which time more than 500 malnourished grey whales washed up along the coasts of their blue corridors. The size of the grey whale population dropped by half, from around 28,000 to 14,000.

Yet the Arctic Ocean is a summer feeding destination for almost a quarter of the world's whales. Blue corridors are conduits for thousands of whales finding their way from the tropics to the Arctic's icy cold, food-rich waters every summer. In addition, three whale species—narwhal, beluga and bowhead whales—live there year-round.

CONSERVATION STRATEGIES

As climate change heats up Arctic waters and industrialization creeps northward, whales—like the North Pacific grey whale—need space to adapt to new conditions. They cannot be fenced in by shipping lanes and fishing trawlers. They need adequate protective measures that include migratory corridors as critical habitats.

For the three Arctic whale species, dynamic and flexible measures to safeguard them on their migrations are especially important. We still have large gaps in our knowledge of when and where these populations migrate. Because they hug the sea ice during their migrations, reductions in ice thickness and extent across the Arctic directly affect their migratory behaviours. Considering that Arctic shipping volumes have doubled over the last 10 years while both commercially important fish stocks and fishing fleets have pushed deeper into Arctic waters, now is the time to recognize migratory corridors as essential components of ocean connectivity and marine species conservation, and to include these in ocean protection measures.

This is not just an Arctic opportunity, but a global one. Under the United Nations Global Biodiversity Framework, 196 nations around the world have already committed to protecting and conserving at least 30 per cent of the world's oceans—and ensuring sustainable use of the remaining 70 per cent—by 2030. This is a heavy lift for governments, the private sector and civil society, but it's an essential one. At the 16th meeting of the Conference of the Parties to the Convention on Biological Diversity in October 2024, we will have the first chance to see whether national commitments towards this target, including by Arctic states, measure up to the task.

I've been lucky to see the blows of humpback whales off the coast of southeastern Australia as the whales migrated from Antarctica to give birth in calm tropical waters. Across the country, there is great excitement each year as we welcome the whales back. We must not let whales and other migratory ocean species, like turtles and sharks, become the tragedy of the commons because their lives span multiple political boundaries. We must take collective responsibility to protect these species by ensuring that our oceans remain connected. ●

MELANIE LANCASTER is a senior specialist, Arctic species with the WWF Global Arctic Programme. Together with WWF staff across the Arctic, she supports the conservation of Arctic species, including narwhals, beluga and bowhead whales.

Bowheads at risk

AS VESSELS FIND NEW ROUTES, BOWHEAD WHALES FACE NEW THREATS

Changes to habitat use, coupled with increasing vessel traffic, could put whales more directly in the path of vessels.

Three bowhead whales breathing near ice.

Photo credit: Kate Stafford

The climate crisis is upending a unique and complex ecosystem that has existed in the Arctic for millennia. The loss of sea ice means more vessels can pass through the Bering Strait, bringing more ocean noise and pollution and driving up the risk of catastrophic oil spills and deadly ship strikes. **ANGELA SZESCIORKA** asks: What will this mean for bowhead whales—an ecologically and culturally important species—and the Indigenous communities that rely on them?

THE EXCITEMENT IS palpable as the telltale signs of spring mark Earth's reawakening from the cold, dark winter. Nowhere is this more evident than in the Bering Strait, the sole marine gateway between the Pacific and Arctic oceans. Daylight lengthens rapidly and snowpack begins to melt, triggering photosynthesis. Marine phytoplankton blooms follow the retreating ice edge from the Bering Sea into the Chukchi and Beaufort seas. This area becomes one of the world's most biologically productive ecosystems, attracting millions of birds and hundreds of thousands of marine mammals eager to feed on a buffet of plankton, clams and fish.

By April, the largest population of bowhead whales—the Bering-Chukchi-Beaufort population—is following narrow cracks in the ice to make their way from their winter grounds in the northwestern Bering Sea through Bering Strait into the Chukchi Sea and finally to their summer feeding grounds in the Canadian Beaufort Sea. These whales are uniquely adapted to Arctic conditions, with large heads that can crack through the ice to breathe and a thick blubber layer to keep them warm. They navigate the frigid, ice-filled waters with ease.

ANCIENT SINGERS CONTRIBUTE TO RESEARCH

Bowhead whales can live for 200 years, so it is possible that some individuals have been making the same journey every year for two centuries. The journey is accompanied by an ever-changing soundtrack, as males sing elaborate songs on their way to and from their winter grounds. The songs are so unique and complex that scientists have dubbed bowhead whales the jazz singers of the sea.

To take advantage of this near-constant singing, scientists deploy hydrophones (underwater microphones) that sit on the ocean floor, passively recording sounds day and night over many years to provide clues about bowhead whale movements and how their behaviours are changing over time.

Changes to bowhead migration patterns have long been documented by Indigenous Knowledge holders. More recently, evidence from satellite tagging data has complemented this knowledge. With just over 10 years of data from passive acoustic monitoring, scientists are observing changes: some whales are spending winters in the southern Chukchi Sea instead of migrating further south to the northwestern Bering Sea. Others are spending more time at their feeding grounds in the Canadian Beaufort Sea and expanding their summer range into the Chukchi Sea.

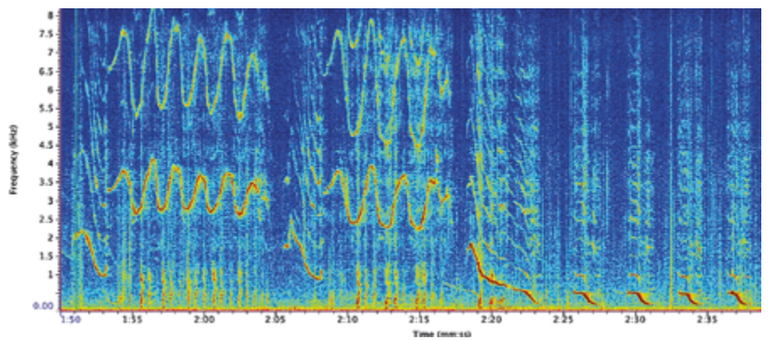
These shifts accompany changes to the ecosystem that has been home to these whales for thousands of years.

Rapidly increasing air temperatures and decreasing sea ice—harbingers of a "new Arctic"—are concerning to the Siberian Yupik, Central Yupik, Chukchi and Iñupiaq residents in the Arctic who depend on the seasonal migration of marine mammals for subsistence. Villages dotting the coastlines of Russia and Alaska closely track bowhead whale spring migration in the Bering Strait and spring and fall migration in northwest Alaska, where Indigenous People have harvested bowhead whales for millennia.

MORE VESSELS EYEING ARCTIC SEA ROUTES

The loss of sea ice is also bringing another change to the Arctic: increased vessel traffic. Ships are now finding open water in areas that were once unnavigable for much of the year due to heavy ice. A number of developments are propelling these vessels to seek new routes. For example, the Panama Canal has experienced drought exacerbated by climate change. Multiple ships have run aground in the Suez Canal, blocking all shipping activity, and pirates are deterring transits through the Red Sea. Compared to the longer alternative route around the Cape of Good Hope off southern Africa, the Northwest Passage and the Northern and Transpolar Sea Routes are beginning to look more profitable.

In the Chukchi-Bering Sea region, the number of vessels transiting through the Bering Strait annually increased by more than 55 per cent from 2014 to 2022. Many of these were oil tank- ➤



A spectrogram (visual representation of sound) of bowhead whale song recorded in the Bering Strait. Time (mm:ss) is displayed on the x-axis, and frequency (Hz) is displayed on the y-axis.

ers, some of which recently transited the Northern Sea Route along the Russian coast without the aid of an icebreaker—an achievement that was once an impossibility. In addition to oil and gas development, rare mineral mining, commercial fishing, and vessel-based tourism are also on the rise in the region, which will mean even more vessel traffic passing through the Bering Strait gateway and bowhead whale habitat.

A study about 10 years ago found that only two per cent of subsistence-harvested Bering-Chukchi-Beaufort whales had vessel strike scars. But the true number of deaths due to ship strikes is unknown due to the difficulty of monitoring evidence of strikes or recovering whales in remote areas—and an unknown fraction of carcasses strand or remain floating. Scientists know from ship-strike research in other regions that changes to habitat use, coupled with increasing vessel traffic, could put whales more directly in the path of vessels. Increasing ship traffic will also increase ocean noise, and an oil spill in this remote region could cause catastrophic ecological damage.

In the face of these rapid and concerning changes, the scarcity of formal shipping lanes or vessel speed limits can make the Arctic feel like the Wild West. Given the environmental, societal and economic importance of the Arctic, we need proactive, preventative measures to protect this complex ecosystem, which supports fisheries, migratory birds and mammals, and Indigenous communities whose identity, culture and survival are strongly tied to the Arctic. ●

ANGELA SZESCIORKA is a marine mammal ecologist who uses passive acoustic monitoring and tagging to examine the movements of baleen whales and the threats they face in climate- and human-impacted ecosystems.

Bioacoustics

USING FIBRE OPTICS TO LISTEN IN ON WHALES

In the remote Arctic, the ability to repurpose infrastructure has become a boon for scientists. Emerging fibre optic sensing technology uses existing telecommunications equipment to eavesdrop on whale sounds so researchers can monitor baleen whales on an ecologically significant scale. As **KYRIN POLLOCK** and **LÉA BOUFFAUT** tell us, this technique is poised to be a game-changer in conservation.

BENEATH THE WATER'S surface, there is a conductor-less symphony in the depths of the Arctic Ocean. Marine mammals bellow and sing, deep-sea vents provide bass, invertebrates use steady snaps to warn off predators, and cracking sea ice sends gongs reverberating through the waves. But this oceanic orchestra is quickly transforming as the climate warms and human activity increases. To study these changes, scientists are tuning into marine sounds. An emerging technology using fibre optic cables is a promising method to study baleen whales and their ecosystem at the habitat scale, from fjords or bays to entire migration routes. This technology may provide unique perspectives into Arctic dynamics and prove vital for conservation.

> In 2022, scientists found that baleen whales could be monitored using a technology known as distributed acoustic sensing.

Retreating sea ice is exposing previously inaccessible Arctic areas to shipping routes and marine tourism. At the same time, global energy pressures make the rich and largely untapped Arctic an alluring prospect for oil and gas exploitation. Beyond human industrial intrusion, the Arctic is seeing transient baleen whale populations spend more time at higher latitudes, including humpback, blue and fin whales that have historically visited the region in the short summer months to feed in the ice-free, nutrient-rich waters. The bowhead, a year-round resident of the Arctic, relies on the unique soundscape to navigate, communicate and feed. While this species increasingly contends with competition from transient boreal whales, they all face physical threats from industrial shipping and associated noise pollution across the Arctic.

USING ACOUSTIC DATA TO SUPPORT CONSERVATION

Collecting data on baleen whales in the Arctic is challenging, but there have been notable local successes. For example, a collaboration between Iñupiat, researchers and the US government has yielded a reliable census of the Bering-Chukchi-Beaufort bowhead whale population. The visual and acoustic data collected helped to establish subsistence hunting quotas and enact required protections. After this collaboration began in the 1970s, the Bering-Chukchi-Beaufort bowhead population began to rebound, reaching more than 16,000 individuals by 2011 (the most recent survey) from fewer than 5,000 when the study began. This outcome also protects Iñupiat food sustainability and cultural sovereignty. Successes like these make compelling cases for using acoustics at scale.

> Acoustics has proven to be an effective mode of research because baleen whales are chatty.

Acoustics has proven to be an effective mode of research because baleen whales are chatty: they make frequent identifiable vocalizations that can be heard tens of kilometres away underwater. Acoustic data can serve a dual purpose, providing baseline information that will help us understand changes over time in whale movements and habitat use for marine management while also acting as a method for near-real-time monitoring to mitigate potential anthropogenic threats.

However, there are some drawbacks to the technologies currently used in acoustic monitoring. Researchers typically monitor sound using autonomous archival hydrophones (underwater microphones), but the data these collect are accessible only after scientists have retrieved the instruments. In addition, deployments of these devices are associated with high operational costs, such as for fuel, boat rental, crew, and the potential risk of instrument failure or loss of the equipment at sea. An alternative is near-real-time recording platforms, but these also pose operational hurdles, such as the need to source low-power data processing for autonomous mobile platforms (such as gliders) and high infrastructural costs for fixed installations (e.g., cabled hydrophones). Overall, these methods are also challenged by the spatial scale associated with the conservation of large migratory species.

MAKING USE OF FIBRE OPTIC CABLES

In 2022, scientists found that baleen whales could be monitored using a technology known as distributed acoustic sensing (DAS). DAS uses telecommunication fibre optic cables that are already present in the ocean to provide internet access around the globe. This approach works by connecting an instrument, known as an interrogator, to a fibre on land. The interrogator enables real-time, continuous monitoring—creating thousands of virtual acoustic sensors uniformly spread across the length of the fibre optic cable—without disrupting data transfers.

This means that researchers can monitor whales from the comfort of land, without needing to go to sea. Observations can be made from up to 170 kilometres from shore at a resolution as fine as a metre. Leveraging the opportunities created by submarine cable landings across the Arctic to create several DAS arrays could support coastal monitoring along migration corridors, contributing to both baseline science and real-time risk mitigation.

While there are still challenges to overcome with DAS, such as processing massive datasets and understanding responses, the potential benefits are intriguing. The concept of a mobile marine protected area—an ocean sanctuary with shifting boundaries protecting species as they follow ocean features that can change rapidly due to the climate crisis—was introduced as early as 2000, but at the time, the technology to implement it was in its infancy. DAS is a step towards making such dynamic habitat protection measures a reality. It can also be complemented by other acoustic technologies to provide additional coverage in coastal and offshore areas that are under-served by fibres or out of the recording range for DAS, reducing the overall burden of Arctic acoustic data collection.

Bowheads' lifespans can extend more than seven human generations, meaning that individuals from a single generation are experiencing an outsized shift in the dynamics of their habitat in response to changing sea ice conditions, which are reflected as increased competition from boreal species and intensification of human industrial activities. A better understanding of their ecology combined with migration monitoring in a rapidly changing environment is crucial to their conservation. Listening in can help preserve the sounds of life in all its forms. ●

KYRIN POLLOCK is a climate and environment consultant with a focus on Arctic conservation and science storytelling.

LÉA BOUFFAUT is a researcher specializing in marine conservation bioacoustics with a focus on baleen whales and technology.

Both work with the K. Lisa Yang Center for Conservation Bioacoustics at the Cornell Lab of Ornithology, Cornell University, US.

Taking stock

THE FUTURE OF GREENLAND'S NARWHALS

There are an estimated 110,000 narwhals in the world today. Found only in the Arctic—in the eastern Canadian Arctic, West and East Greenland, Svalbard, and the western Russian Arctic—these whales can live for more than 100 years and are highly specialized to live in the Arctic's icy waters. As a result, they are considered more sensitive to climate change than any other Arctic marine mammal.

DEPENDING ON WHERE they live, narwhals are affected by changing climate conditions, industrial development (such as shipping and oil and gas exploration and development), and Indigenous and traditional hunting. Shifts in their physical environments may include sea ice and water temperature changes as well as alterations in aspects of their biological environments, such as the type and quantity of prey and predators.

UNDERSTANDING HOW NARWHALS ARE DOING

Narwhals inhabit both the east and west coasts of Greenland. While east and west don't mix, some narwhals from West Greenland do swim across Baffin Bay to eastern Canada. This makes it complicated for researchers to track how populations are faring. But there are some key differences in the numbers and population trends of narwhals in different parts of Greenland.

According to scientific assessments, one West Greenland stock is possibly stable, although another is decreasing in number. Throughout Southeast Greenland, narwhal numbers are declining. In Northeast Greenland, where most of their habitat is protected by the world's largest national park—a vast area of 1 million square kilometres—at least 2,000 narwhals are found.

All decisions about how narwhals in Greenland are managed are made by the Greenland government, or Naalakkersuisut. The government has a responsibility to conserve narwhals, including through international agreements on populations shared with Canada. The government makes decisions based on scientific advice, hunter knowledge, community consultations, and the goals outlined in international agreements. There is currently considerable debate among scientists, scientific committees, hunters, conservationists and managers about how the decisions the Greenland government is making about narwhal population management will affect their future.

Map: Ketil Berger, ketil.berger@flinnform.no © WWF

HUNTERS' OBSERVATIONS OF NARWHALS IN NORTHWEST GREENLAND

Narwhals have always been culturally significant to Greenlandic people. Every summer in Northwest Greenland, large pods of narwhals arrive and spend the warmest months in Inglefield Bredning (Fjord). Inuit hunters from Qaanaaq, a community located at the northern entrance of the fjord, harvest them for their tusks, meat and skin. The animals provide a critical source of food in remote communities.

In recent years, many hunters have witnessed changes in the narwhals that spend their summers along the coast of Northwest Greenland. Qumagaapik Kvist is one of them. In the decade since the young hunter from Qaanaaq started harvesting narwhals, he's noticed changes in both their physical condition and number. He and other hunters from the area say that narwhal numbers are increasing, but the animals are much thinner than in the past.

"Many have little fat or blubber because they don't have enough to eat," ➤

Close-up of a Northwest Greenland narwhal with its tusk emerging from the water.

There are some key differences in the numbers and population trends of narwhals in different parts of Greenland.

Photo credit: © naturepl.com / Bryan and Cherry Alexander / WWF

An Inuit narwhal hunter throwing a harpoon from his kayak, Qaanaaq, Greenland.

The Greenland government has resisted the call to implement a zero hunting quota, saying that hunters' knowledge of the number of narwhals differs from the science.

Photo credit: © Staffan Widstrand / WWF

says Kvist. "I hear that, and I can also see it."

Management of narwhal hunting in West Greenland came under a quota system in 2004 after international concern about declining stocks and scientific findings that harvest levels were not sustainable. But hunters in the region question whether the quotas reflect what they are witnessing firsthand. They argue that quotas aren't needed if traditional hunting methods are used.

"Our tradition is kayak and harpoon," says Rasmus Daorana, a resident of Qaanaaq and hunter for many years. "We can't hunt when the sea is frozen or when the wind blows. Nature is our boss, and it gives us limits. This means a quota is not necessary."

Daorana also says that local rules for narwhal hunting were in place before the quotas came in. "There were areas where you could only row your boat without using a motor, and hunters were not allowed to wait [for the narwhals] in their boats—most of us waited on land. Now all of that is gone."

Adolf Simigaq, who's been a hunter in Northwest Greenland for more than 20 years, believes quotas are the reason hunters are seeing thinner narwhals.

"When there are too many narwhals, there is not enough food for all of them," he says. "It is dangerous that the government is making the quotas smaller."

Once they leave Inglefield Bredning at the end of summer, narwhals migrate to the North Water Polynya, or Pikialasorsuaq, for winter. Straddling Canadian and Greenlandic waters, it is the Arctic's largest polynya and one of its most biologically productive places. Narwhals that spend summers in the Canadian high Arctic also use the polynya. Some of the Qaanaaq hunters suspect there is another reason why they might be seeing more narwhals in Northwest Greenland.

"Canadian narwhals are coming from the polynya and mixing with ours," says Kvist. Daorana notes the same, and describes them as having a different body colour and length as well as different behaviours from the narwhal in their local stock.

The Qaanaaq hunters note other changes, too. Kvist says less sea ice and warmer temperatures are attracting more cruise ships and larger boats to the fjord where he lives. This is scaring off the narwhals, which are extremely sensitive to underwater noise—an observation that has been made both by hunters and scientists.

And it isn't just ships that are appearing. Orcas are starting to arrive every year, causing the narwhals to move into the shallower waters of the fjord, where they are easier to catch.

"That's good for hunters," says Kvist. "But the orcas are catching more narwhals than I am. And sometimes they just kill without eating."

SCIENTIFIC ADVICE ON NARWHALS IN SOUTHEAST GREENLAND

On the other side of this vast country live the Southeast Greenland narwhals. Recent counts, including from a 2022 survey planned and executed by scientists and hunters together, indicate that the situation for narwhals in this area is dire.

"We have a population that has declined from more than 1,700 to only a few hundred since 1960," explains Mads Peter Heide-Jørgensen, a professor at the Greenland Institute of Natural Resources and a member of the Northern Atlantic Marine Mammal Commission's (NAMMCO) working group on narwhals in East Greenland. "In one area of Southeast Greenland, we weren't able to detect any animals at all during the past two aerial surveys. They're at high risk if hunting continues at any level."

Narwhals in Southeast Greenland do not venture outside Greenlandic waters and are the sole responsibility of the government to manage. They are hunted by residents of two communities—Ittoqqortoormiit and Tasiilaq—under a quota system set by the government.

Scientists like Heide-Jørgensen point to dwindling numbers in this area as a clear alarm bell that more regulation is needed. For the past several years, NAMMCO has recommended a moratorium on narwhal hunting in the three Southeast Greenland management units. But the Greenland government has resisted the call to implement a zero hunting quota, saying that hunters' knowledge of the number of narwhals differs from the science. It argues that a ban on hunting will threaten food security and prevent traditional hunting techniques and culture from being passed down in Indigenous communities.

It might also come down to economics. For many Greenlandic communities, selling narwhal products is economically important. The government banned the export of narwhal tusks in 2006 because unsustainable hunting levels meant trade could have a detrimental impact on narwhals. But there's a thriving commercial domestic trade in narwhal skin, known as mattak. The high prices paid for mattak create a strong incentive to continue narwhal hunting. But it's also part of local peoples' cultural identity, considered a healthy "soul" food that provides important vitamins. Mattak is a delicacy served at special occasions, such as weddings, baptisms, communions and other festivities.

Undoubtedly, narwhals face a range of pressures, especially in Southeast Greenland, where sea temperatures are rising, sea ice is retreating, and ship traffic is on the rise. But a concern shared by many scientists, including Heide-Jørgensen, is that continuing to remove narwhals from this tiny population through hunting will have a much more immediate and permanent impact.

"In Southeast Greenland, a [hunting] ban is the only way to protect the stock if you want to have narwhals in the future," he says.

Finding ways to conserve narwhal populations for future generations while meeting the needs of Greenlanders today is a complex task facing Greenland's government, and it will entail bringing together multiple knowledge systems to inform decisions. But maintaining abundant populations of narwhals throughout Greenland is essential for a healthy, balanced ecosystem, healthy people and lasting cultural identity—something everyone can agree on. ●

Co-producing knowledge

LISTENING FOR BELUGAS IN ALASKA'S YUKON RIVER

Beluga conservation efforts depend on an accurate understanding of whales. Indigenous hunters also need to know how these whales are faring in order to determine a sustainable harvest level. As **ELISABETH KRUGER** explains, that's why WWF–US is bringing together western science and Indigenous Knowledge to answer questions that are important to all who care about belugas, such as: How many belugas are there, and how are they adapting to changes in their ecosystem?

Scientists have been trying to detect belugas in the fast-flowing, shallow and muddy Yukon River.

The pilot project clearly demonstrated that using hydrophones to detect belugas in the Yukon River works—and it's an approach that is both cost-effective and non-invasive.

Photo credit: © Elisabeth Kruger / WWF-US

IT IS ESTIMATED that the eastern Bering Sea off the coast of Alaska is home to more than 12,000 beluga whales. But this number includes only those whales that are spotted in the ocean. It doesn't take into account the belugas that might be swimming in the Yukon or Kuskokwim rivers.

Indigenous hunters in the region have long known that beluga whales often migrate upstream in search of food. But tracking the whales in rivers is often challenging. First, belugas are notoriously elusive—and finding a non-invasive method to detect belugas that spend time in rivers is difficult. Often, scientists depend on aerial surveys to come up with beluga estimates. But this entails planes flying over waterways, which many community members worry will scare away birds and animals that Indigenous communities depend on for subsistence hunting.

That's how the idea of using hydrophones to "listen" for belugas came about.

SEARCHING FOR BELUGAS IN THE YUKON'S MUDDY WATERS

In summer 2023, we began supporting a beluga monitoring pilot project—at the request of a representative from the Alaska Beluga Whale Committee (ABWC)—to try to determine whether belugas were using the river at the same time that scientists were counting them in their ocean habitat. To do this, we partnered with Manuel Castellote at the University of Washington and NOAA Fisheries. Castellote worked with ABWC representative and Yup'ik hunter Marvin Okitkun to choose two sites on each side of the Lower Yukon River. The team then set up two stations at each site with underwater microphones, or hydrophones, placing them on the bottom of the river to continuously record the sounds of the river.

From June to September, Okitkun, along with another Indigenous hunter, Brandon Kameroff, periodically checked on the equipment at the two sites, removing debris and entangled plant material from the lines anchoring the hydrophones. They also collected the memory cards from the hydrophones at the end of the season. These were sent to Castellote to see if any beluga sounds had been detected and analyze the data.

Although a similar technique has ➤

Photo credit: © Elisabeth Kruger / WWF-US

Marvin Okitkun is one of two Yu'pik hunters who are working with WWF to monitor hydrophones in Alaska's Yukon River.

Photo credit: © Elisabeth Kruger / WWF-US

Photo credit: © Elisabeth Kruger / WWF-US

Dana Okitkun, 14, helps his father, Marvin, monitor the hydrophones placed at one of the sites along the Yukon River.

Researchers are trying to find out how Yukon River belugas are responding to changes in their ecosystem.

Photo credit: © David Merron / WWF-US

been used before to monitor belugas in the Eklutna River in Cook Inlet, one of the unknowns when we launched the project was whether this type of equipment would even work in the Yukon River. The Yukon is a shallow, wide, fast-flowing river with an extremely silty bottom. One of the big questions was whether beluga sounds could be detected once the hydrophones were sitting on the river's muddy bottom.

USING LESSON LEARNED TO SUPPORT CONSERVATION

Over the four-month period, the pilot project clearly demonstrated that using hydrophones to detect belugas in the Yukon River works—and it's an approach that is both cost-effective and non-invasive. That's good news for scientists and hunters trying to ensure that belugas continue to thrive in the future.

But this pilot project is just the beginning. As in the rest of the Arctic, climate change is altering the ecosystem in this region, and we hope that the lessons learned from this pilot will inform the ongoing monitoring of beluga habitat use in the Yukon Delta.

The data collected by the hydrophones could provide vital information to help answer critical questions about the beluga population in the region, such as: How are belugas responding as the ecosystem changes? Is their habitat use shifting? Are they spending more time in the Yukon or travelling further upriver?

Ultimately, combining acoustic monitoring in the Yukon River with aerial surveys will result in a better understanding of belugas—and will support better management and conservation of this population. Although belugas were once abundant throughout Alaska's waters, the Cook Inlet beluga stock has dwindled to a fraction of its historic estimated size of about 1,300 despite decades of conservation efforts. The goal of WWF-supported projects like this one is to make sure Alaska's other beluga stocks don't suffer the same decline. ●

ELISABETH KRUGER is the WWF-US manager for Arctic wildlife. She works at the forefront of Arctic conservation, mitigating threats to the wildlife of coastal Alaska.

Ships 1, whales 0

WHAT'S NEXT FOR THE MARY RIVER MINE?

The Mary River iron mine is the biggest industrial development project and largest private-sector employer in the Canadian Arctic. Located in the northern interior of Baffin Island, Nunavut, and owned by Baffinland, it contributes nearly a quarter of the territory's GDP. Since extraction began in 2015, the mine has sparked similarly outsized controversy due to its harmful impacts on the environment and wildlife—and as **SAM DAVIN** explains, its latest plans may affect the whales and other marine mammals of Steensby Inlet.

IN 2022, ALIGNING itself with science and Inuit organizations, the Government of Canada rejected Baffinland's proposal to double production at its iron mine. Following that failed bid, which would have increased shipping through a marine protected area, the company is now seeking to leverage a 12-year-old project certificate to triple its annual ore production to 18 million tonnes using a different shipping route.

This latest expansion would entail the construction of the first railway in the Canadian Arctic as well as a deep-water port at Steensby Inlet, which extends north from Foxe Basin into central Baffin Island. The railway would run through the critical habitat of a heavily depleted caribou population that has only recently begun to show signs of recovery. The expansion would also triple vessel traffic—from an annual maximum of 84 bulk carrier transits to a maximum of 242—and support year-round shipping by icebreaking, further threatening ice-dependent wildlife and accelerating sea ice loss.

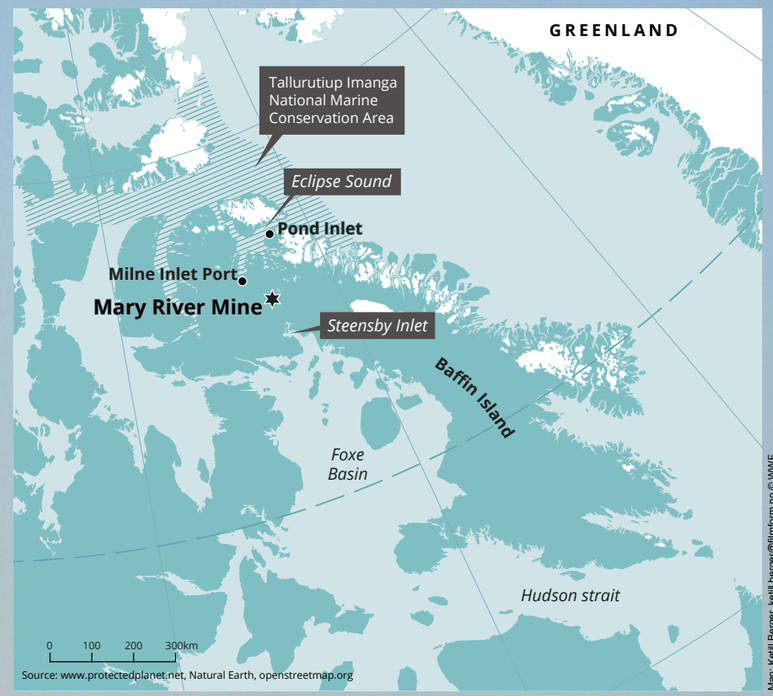
HOW WE GOT HERE

On August 8, 2015, the bulk carrier *Federal Tiber* departed Milne Port carrying 53,000 tonnes of iron ore destined for Europe. This voyage marked the beginning of ore shipments from the Mary River Mine. By 2019, ships travelling to and from the mine had increased traffic in Milne Inlet by 583 per cent.

Baffinland is currently approved to produce 6 million tonnes of ore in 2024, supported by up to 84 bulk carrier round-trip voyages during the ice-free season. As in previous years, these ships access Milne Port through Eclipse Sound, which is part of the Tallurutiup Imanga National Marine Conservation Area.

This 108,000 square kilometre zone, Canada's largest marine protected area, is home to 60 per cent of the world's narwhals as well as bowhead and beluga whales, walrus and polar bears. Baffinland's summer shipping operations coincide with the annual narwhal migration from Baffin Bay to the inlets and fjords of Baffin Island.

For the predominantly Inuit community of Pond Inlet on Eclipse Sound, the increased ship traffic is a grave and ongoing concern. Hunters have reported fewer narwhals, seals, seabirds and Arctic char in waters where they have traditionally been harvested. ➤



For the predominantly Inuit community of Pond Inlet on Eclipse Sound, the increased ship traffic is a grave and ongoing concern. Hunters have reported fewer narwhals, seals, seabirds and Arctic char in waters where they have traditionally been harvested.

Carriers anchored in Eclipse Sound.

Photo credit: © Erin Keenan/WWF-Canada

The Mary River Mountain is being levelled so crews can remove the iron ore.

Photo credit: The Cosmonaut, CC BY-SA 2.5 CA, via Wikimedia Commons

Displacement of these species, which are important traditional food sources, is a fundamental threat to cultural continuity and food security.

Aerial surveys have indicated a dramatic decrease in narwhal numbers in Eclipse Sound: from more than 20,000 in 2004 to just over 10,000 in 2023. The remaining narwhals appear more stressed. In fact, a recent Fisheries and Oceans Canada study supported by WWF-Canada's Arctic Species Conservation Fund found a near doubling of their cortisol levels from 2013 to 2020.

MORE NOISE POLLUTION

Shipping is the most significant contributor to underwater noise pollution worldwide, affecting marine species' abilities to navigate, reproduce, feed and communicate. Marine mammals like whales are especially sensitive to acoustic habitat degradation, which can drive up the risk of fatal ship strikes and cause whales to become separated from their pods and calves. Underwater noise from ships servicing the mine is not only distressing narwhal, but likely contributing to the displacement of several marine species in Eclipse Sound.

Baffinland has implemented some mitigation measures, including ship slowdowns and convoys near Milne Inlet. It has also introduced larger bulk carriers that, while noisier, can reduce the overall number of transits. Nevertheless, its 2022 proposal to double production to 12 million tonnes annually was rejected by the Minister of Northern Affairs in part because the Nunavut Impact Review Board had concluded that the company could not adequately mitigate the expansion's potential environmental impact.

Although narwhal populations across Canada have remained stable so far, concerns persist about the species' ability to adapt to sea ice loss and rapidly growing industrial activities, such as shipping from developments like the Baffinland mine.

STEENSBY EXPANSION PLANS

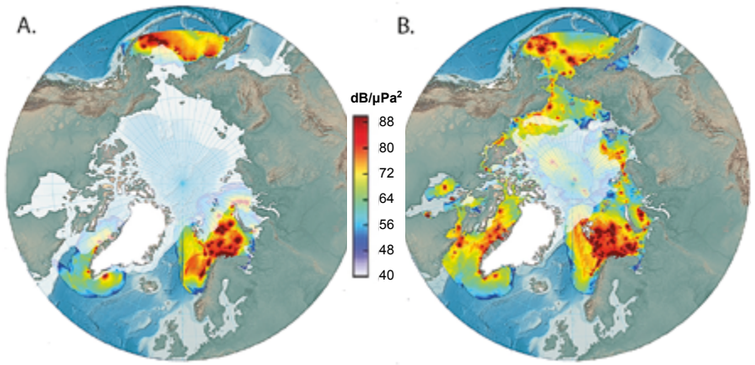
Construction of the new railway and port is expected to take four years. If realized, the Steensby expansion will triple ship activity associated with the mine. This will shift traffic from Eclipse Sound to the ecologically significant waters of Hudson Strait—considered a "superhighway for whales"—and to Foxe Basin, a summering ground for bowheads and the largest concentration of walrus in Canada. This region is also home to narwhals, polar bears and seals—a food web that supports food sovereignty for Inuit communities in the region.

The result of this additional shipping will be more underwater noise, more polluting discharges, and a higher risk of ship strikes and fuel spills. Harmful stack emissions, including sulphur and nitrogen compounds, would also increase dramatically, as would black carbon emissions, which accelerate sea ice melt, increase atmospheric warming, and contribute to heart and respiratory diseases in Arctic communities.

Despite its commitment to refrain from icebreaking in the spring, Baffinland's approval for year-round shipping remains concerning because icebreaking vessels can severely affect Arctic wildlife by provoking behavioural and physiological responses to noise, causing entrapment, and destroying and fragmenting sea ice habitat. Icebreaking also poses risks to Inuit who travel on sea ice because it can cut off their return routes.

Since the issuance of Baffinland's original project certificate 12 years ago, stakeholders and rights holders have gained a better understanding of how the mine's ship traffic negatively affects the marine environment and wildlife, such as whales. The potential economic benefits of the mine and its expansion plan must be weighed carefully against the significant environmental, ecological and cultural risks—and Inuit priorities must guide whatever comes next. ●

SAM DAVIN is a senior specialist in marine conservation and shipping with WWF–Canada.



These images show the levels and distribution of underwater noise from shipping in the Arctic Ocean in March (left, maximum sea ice extent) and September (right, minimum sea ice extent, most open water for shipping), 2015. Ship noise was mapped across the Arctic for the first time by the Arctic Council's Protection of the Marine Environment (PAME) working group in 2021. The report found a doubling of noise in parts of the Arctic over six years, from 2013 to 2019.

Note: Noise is measured at 25 Hertz, weekly median Sound Exposure Levels, in units of decibels per square micropascal.

Source: PAME 2021 report: https://www.pame.is/projects/arctic-marine-shipping/underwater-noise-in-the-arctic.

Underwater noise

COULD "SILENT ZONES" AND SUSTAINABLE USE BE THE ANSWER?

The underwater environment is acoustic. Visibility is low, and marine animals rely on sound to communicate and detect prey. Human-made noise—an often-overlooked form of pollution—disturbs these vital processes. But as **NIELS KINNEGING** explains, awareness is growing among marine managers that underwater noise must be managed for a healthy environment.

HUMPBACK WHALES USE song to communicate, while the much smaller porpoise uses bio-sonar to find prey. When human activities add noise to the marine environment, humpbacks can't communicate properly, and porpoises cannot find their prey. Humans have long viewed the sea as an economic opportunity to be developed. But shipping activities, seismic exploration and drilling are on the rise, while offshore wind energy has begun to look like a feasible alternative to fossil fuels. The resulting noise is adversely affecting marine life.

A SHORT HISTORY

Awareness of underwater noise as a serious threat to marine life first began to grow at the end of the last century. After mass strandings were linked to the use of military sonar, research was started within the military environment. ➤

In the first decade of this century, civil sources of underwater noise were recognized, and the European Marine Strategy Framework Directive (MSFD) became the first international legislation to frame underwater noise as pollution. Since then, the framework has shaped European policy on underwater noise. An expert group, TG Noise, was formed and published authoritative reports, such as monitoring guidance (in 2014) and reports on an assessment strategy and threshold values (in 2022). A number of important European Union–funded projects were conducted that established the knowledge basis for the implementation of these policies.*

At the basis of the framework is the notion of "good environmental status." According to the MSFD, marine waters have this status if they are ecologically diverse, dynamic, clean, healthy and productive, and if their use is at a level sustainable enough to safeguard their use for current and future generations. The MSFD aims to ensure that marine waters reach and maintain this status. This requires cyclic environmental assessments, monitoring, and a programme of measures carried out by EU member states.

THREE LENSES FOR ASSESSMENT

The MSFD also states that the spatial distribution, temporal extent, and levels of human-made underwater noise should not exceed those that would adversely affect populations of marine animals. The framework advocates for assessing underwater noise in three related aspects.

First, the noise level: in general, higher amplitudes (the strength or intensity of sound waves, measured in decibels) will affect marine animals more significantly than lower levels. Very high levels, such as those that might occur during explosions or piling, can cause serious injury or even death. Permanent or temporary hearing impairment may also occur. Even at lower levels, animals may flee. These responses can have serious impacts on wildlife populations and are the focus of many research projects.

The second aspect to consider is the spatial distribution of the underwater noise. Assessments generally consider what proportion of a region is affected by noise. In some areas, like the southern part of the North Sea, where shipping intensity is considerable, the average noise levels are too high everywhere. EU member states are considering designating low noise or "silent" areas as marine protected areas.

Finally, the duration of the noise should be considered in any assessment. Animals may be able to cope with short periods of high noise levels, given that these can also originate from natural sources, such as storms. However, prolonged periods may affect their health.

In 2022, the EU expert group for underwater noise defined threshold values for noise based on a combination of these three components.

MONITORING AND SOUNDSCAPE MAPS

Under the MSFD, EU member states are obliged to conduct environmental monitoring. For underwater noise, a novel approach is followed. Field measurements are combined with numerical modelling to produce a suite of soundscape maps to display details of the acoustic underwater environment. Groundbreaking projects have tested this monitoring approach in a variety of sea regions. Close co-operation between member states resulted in seamless maps capable of supporting the types of assessments discussed above.

Eventually, noise mitigation measures will need to be designed and implemented. These are already compulsory for various noise sources, and in 2023, the International Maritime Organization published guidelines for the reduction of underwater-radiated noise from ships.

Regulators are now considering whether to designate marine "silent zones" in areas that are both particularly noisy and home to various species that are especially sensitive to noise. These areas could be protected by limiting ship access and requiring ships to respect noise output limitations.

Under the European policies for protecting the marine environment, major advances have been made in our knowledge of underwater noise and its effects on marine animals and ecosystems. Practical management tools to control this type of pollution are now being developed. There is still a lot of work to do, but the advances in this field over the last decade are encouraging.

* Noteworthy projects are BIAS (Baltic Sea, 2013 to 2016), Jomopans (North Sea, 2018 to 2022), Jonas (Atlantic, 2019 to 2022), QuietMed (Mediterranean, 2017 to 2021), and SATURN (research, 2021 to 2025).

When human activities add noise to the marine environment, humpbacks can't communicate properly, and porpoises cannot find their prey.

A baby humpback whale comes for a closer look in the ocean outside the Dominican Republic.

Photo credit: Christopher Michel via Flickr.com (CC BY 2.0)

NIELS KINNEGING is a senior policy advisor for underwater noise at the Dutch Ministry of Infrastructure and Water Management. He was the project manager for Jomopans, an initiative to monitor ambient noise in the North Sea.

THE BACK PAGE

Credit: Yulia Ivashchenko/MOSCOW Project

The "official" end of commercial whaling

The Soviet Union's oldest whaling factory ship, the *Aleut,* sits off the coast of Kamchatka in 1958. That year, a moratorium on commercial whaling issued by the International Whaling Commission came into effect. Despite the global ban, countries such as Norway, Iceland and Japan continue to engage in commercial whaling activities.