WWF GLOBAL ARCTIC PROGRAMME

THE CIRCLE

MAGAZINE

2.2026

THE CONNECTED ARCTIC

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COVER: Arctic tern.
Photo credit: Bernd Thaller via Flickr.com (CC BY 2.0)

THIS PAGE: Erosion of the permafrost coastline on Herschel Island (Qikiqtaruk), Yukon, Canada. In some places, thawing permafrost is re-exposing old pathogens.
Photo credit: Gonçalo Vieira/Nunataryuk
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Editorial

The blue bond that connects us all

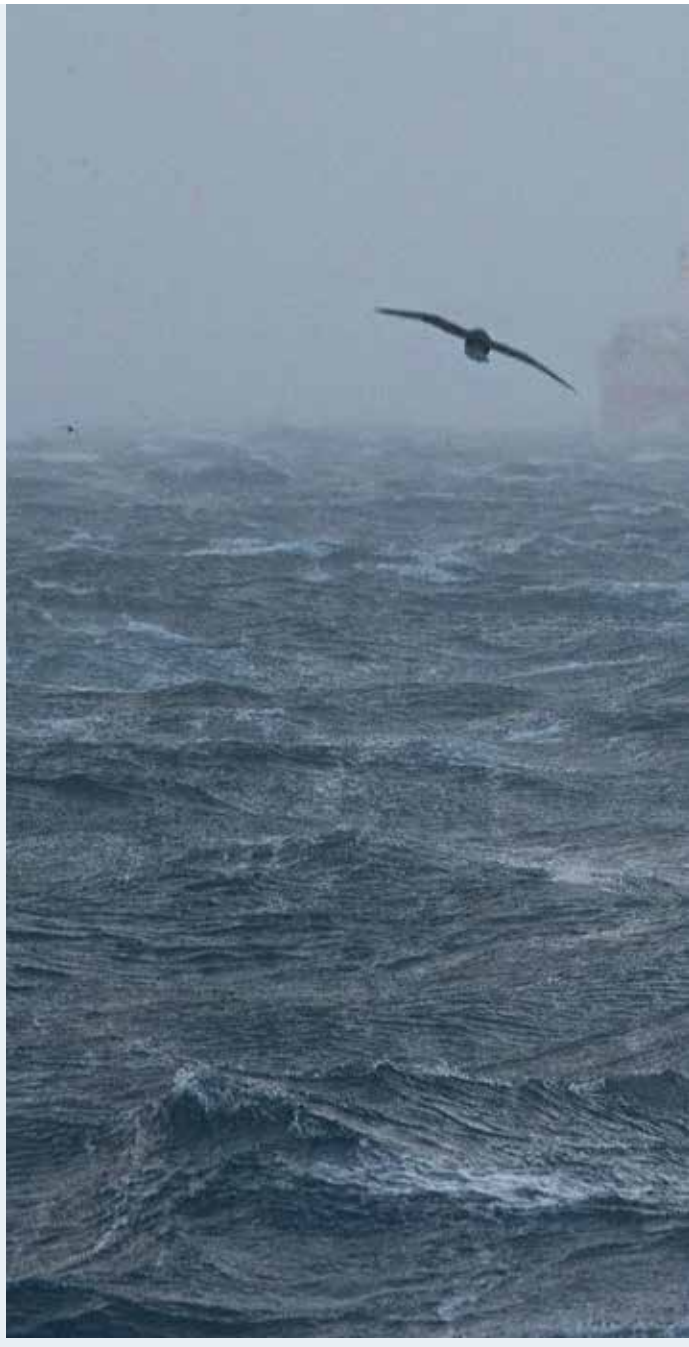
AT A TIME when the world seems increasingly divided, it is worth reflecting on what still connects us. Few things do so as powerfully as the ocean—a vast blue commons that binds our planet together. Covering more than 70 per cent of the planet, connecting ecosystems, cultures, economies and communities across borders, it reminds us of our shared dependence on a living, interconnected Earth.

Against today's strained multilateral landscape, the entry into force of the High Seas Treaty in January offers a rare and hopeful reminder that collective action is still possible. It marks a historic milestone for ocean and planetary health, establishing a long-awaited, legally binding framework to conserve and sustainably manage the two-thirds of the global ocean that lie beyond national jurisdiction.

At its heart, the High Seas treaty is about connectivity. It recognizes the ocean not as a patchwork of isolated spaces, but as a single, dynamic system. By enabling the designation of marine protected areas on the high seas, the treaty makes it possible to advance ocean-spanning, ecologically representative, well-connected networks. In doing so, it also supports the global commitment to protect and conserve 30 per cent of the ocean by 2030 (known as "30 by 30") while strengthening environmental safeguards, scientific cooperation and equitable benefit-sharing.

This matters because 30 by 30 is not simply a political target—it is an urgent, science-based call to action: it is what research shows is needed to sustain ocean resilience and the well-being of the billions of people who depend on it. Delivering on this ambition requires approaches that work with the ocean's natural connectivity rather than against it.

PAULI MERRIMAN is the interim Senior Director, Oceans, in WWF's Biodiversity Practice.



These solutions are urgently needed. The Arctic is warming faster than any region on Earth, experiencing the impacts of climate change earlier and more intensely. With the High Seas treaty now in force, safeguarding international waters is finally within reach.

In the Arctic, ArcNet—the Arctic Ocean Network of Priority Areas for Conservation—offers a compelling example of what a connected, whole-of-ocean approach can look like in practice. ArcNet identifies priority areas for conservation across the entire Arctic Ocean and adjacent seas, providing a coherent framework for establishing networks of marine

Photo credit: Canon / Brutus Östling / WWF-Sweden

protected and conserved areas. By focusing on ecological connections rather than isolated sites, ArcNet demonstrates how to support the resilience of Arctic biodiversity alongside the cultures and livelihoods that depend on a healthy Arctic Ocean, thereby offering a practical pathway to turn commitment into action.

Connectivity also helps tell the story of why ocean protection matters. Initiatives such as Arctic Blue Corridors and its global counterpart, Protecting Blue Corridors, reveal the hidden highways of the sea—migration routes that stretch up to thousands of kilometres and span Arctic to equatorial seas, connecting essential habitats for whales. Protecting these corridors means protecting life in motion while strengthening ecosystems that support climate regulation, ocean productivity and coastal economies.

This is a defining moment for the ocean. To bring the High Seas treaty's promise to life, governments, ocean industries, communities and scientists must act together, guided by the best available science and knowledge. WWF remains committed to working with partners to turn this collective ambition into lasting impact—because protecting the blue commons that connects us all means securing a living ocean for nature and people for generations to come. ●

LEARNING FROM LIVED EXPERIENCES

A "North-to-North" project

A NEW "NORTH-TO-NORTH" initiative is bringing Arctic communities together to strengthen resilience in the face of rapid environmental and social change. Running until March 2027, the project—whose official title is Enhancing Northern Connectivity: North-to-North Cooperation for Community Preparedness and Resilience—connects municipalities, Indigenous organizations, researchers and community leaders across the Arctic to share knowledge and practical solutions.

The focus is on how communities can better respond to disruptions like climate change impacts, infrastructure challenges, and shifting local economies. Rather than relying on top-down approaches, the initiative emphasizes cooperation at the community level, where lived experience and local knowledge can guide more effective responses. Participants exchange strategies, test approaches and adapt solutions to local conditions.

North-to-North is funded under the Nordic Arctic Programme, an initiative of the Nordic Council of Ministers, and implemented by a range of partners. As the official intergovernmental cooperation body for Denmark, Finland, Iceland, Norway and Sweden, the council supports Arctic cooperation.

The approach reflects a broader shift in Arctic policy toward collaboration, knowledge-sharing and locally grounded action—recognizing that resilience is not just about protecting infrastructure, but also about building strong, connected communities.

UNDERWATER NOISE

Arctic Ocean louder and more varied than thought

NEW RESEARCH IS challenging longheld assumptions about how quiet the Arctic Ocean really is. A study published in *npj Acoustics* analyzed nearly a decade of underwater recordings from Cambridge Bay, Nunavut, in Canada's Arctic. It found that the region's soundscape is far more diverse—and more heavily influenced by human activity—than current monitoring methods pick up.

Existing guidelines for measuring underwater noise in other parts of the world focus on a narrow set of low-frequency bands. But the research team found that ship noise extends well beyond those ranges. In summer, vessel noise reaches into higher frequencies that overlap with the hearing ranges of some marine mammals, particularly species such as beluga and narwhal.

Photo credit: Peter Prokosch, www.grida.no/resources/4150

Ship tracking systems underestimate the impacts of human activity in Arctic waters because many sounds come from small or untracked vessels.

Winter recordings revealed something else: even when the ocean is frozen, snowmobiles, aircraft and community machinery contribute significant noise, creating a year-round acoustic footprint. The researchers also found that many sounds come from small or untracked vessels. This means satellite-based ship tracking systems underestimate the impacts of human activity in Arctic waters.

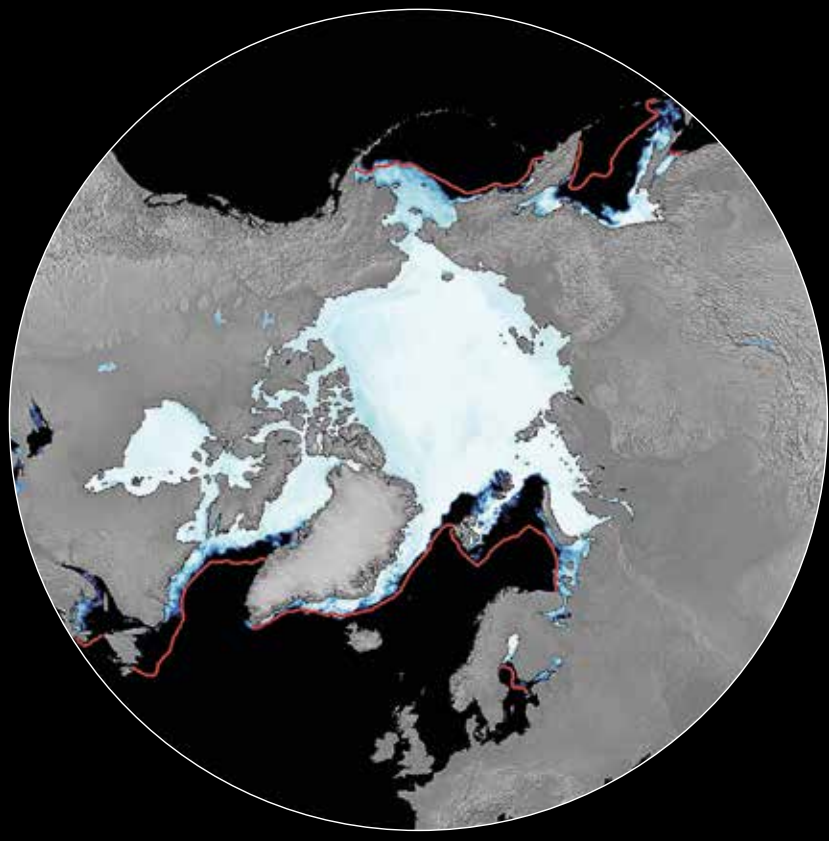
The findings suggest that Arctic-specific noise guidelines are needed, given that existing guidance—largely developed for temperate regions—does not reflect the realities of a rapidly changing Arctic. As sea ice thins and shipping seasons lengthen, a broader approach to acoustic monitoring may be needed to protect marine life that relies on sound to communicate, navigate and survive.

A DECADE OF DECLINE

Arctic sea ice hits a new record low

ARCTIC SEA ICE has plunged to yet another record low, underscoring how quickly the region is transforming. According to new data from the Copernicus Climate Change Service—the EU programme that tracks global climate indicators—winter sea ice extent in March 2026 was among the lowest ever recorded for the month, continuing a decade-long trend of sustained loss of winter sea ice.

More detailed measurements from the US-based National Snow and Ice Data Center show that this year's peak ice cover was roughly 1.3 million square kilometres below the 1981 to 2010 average. Observations show that the losses are concentrated in marginal seas, such as the Barents and Bering seas, where warmer waters and shifting currents are thinning ice from below.



Credit: European Union, Copernicus Climate Change Service Data

Arctic sea ice concentration on March 28, 2026. The red line shows the median ice edge for 1981–2010, indicating the extent typically expected at this time of year.

Even when winter ice expands, it is forming later, growing more slowly, and ending up thinner and more vulnerable to rapid melt.

Scientists describe the trend as a structural weakening of the Arctic ice system. Experts warn that reversing this decline will require steep cuts to greenhouse gas and black carbon emissions, noting that changes in the Arctic are a clear signal of broader climate instability.

FROM BEARS TO BIODIVERSITY

How polar bear conservation can influence marine life

PROTECTING POLAR BEARS could help safeguard a much wider web of Arctic marine life. According to new research led by the University of Alberta in Canada, polar bears can act as an "umbrella species," meaning that conserving the areas they depend on may also help to protect other species that share the same habitat.

Using two decades of tracking data from hundreds of bears in western Hudson Bay, researchers identified key areas where polar bears spend much of their time. These zones overlap with important habitat for seals—the bears' primary prey—as well as other marine species.

Because polar bears frequent areas where prey are available, protecting these areas may offer broader ecological benefits, although this approach does not account for all species and ecological processes in Arctic marine systems. Polar bears also support other wildlife by leaving behind carcasses that feed scavengers like Arctic foxes, wolves, ravens and gulls.

These findings suggest top predators can shape the Arctic ecosystem and, in practice, could help guide the design of marine protected areas in regions where detailed biodiversity data are often limited. In this way, polar bear data could serve as an objective starting point for conservation planning in areas where other information is scarce.

A community feast centred around niqipiaq*, or "real food."*

Photo credit: © Kevin Schafer / WWF

What connects us

NIQIPIAQ, RELATIONSHIPS AND CONSERVATION IN THE ARCTIC

The Arctic is often portrayed in terms of its most iconic elements—sea ice, polar bears, Indigenous Peoples. But from the point of view of the Iñupiat, who have long inhabited northern and northwestern Alaska, it is the connections among these that matter most. The Iñupiat live these connections through *niqipiaq*, or real food, which brings people together to harvest, prepare, share and eat, sustaining both community and way of life. **CORINA QAAĠRAQ KRAMER**, **CANA ULUAK ITCHUAQIYAQ**, and **HENRY P. HUNTINGTON** share their perspectives.

HENRY'S FIRST RESEARCH project on Indigenous Knowledge, years ago, looked at beluga whales. While he was interviewing several Elders in western Alaska, they started talking about beavers. Henry was a bit puzzled about what beavers had to do with belugas until one Elder explained that the beavers were damming streams where the fish that the belugas ate went to spawn. Henry hadn't considered such connections until that moment.

For Corina and Cana, on the other hand, this idea was hardly surprising. Understanding such connections is central to their Iñupiaq knowledge and culture.

A truism holds that western societies tend to think about objects, whereas Indigenous Peoples think about the relationships between them. This is certainly true among the Iñupiat in Corina and Cana's homelands in northwestern

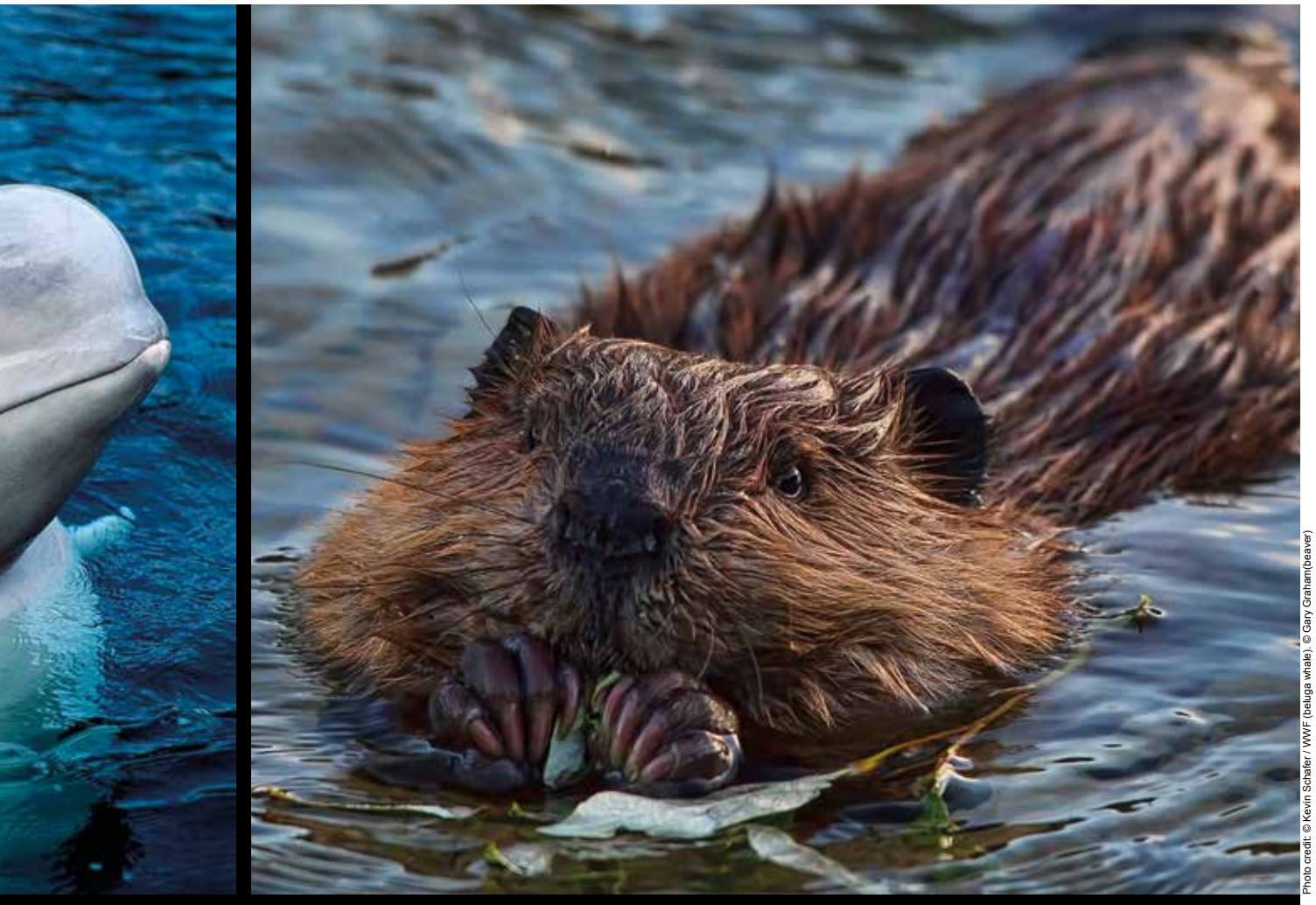


Photo credit: © Kevin Schafer / WWF (beluga whale), © Gary Graham(beaver)

Knowing how belugas and beavers are connected takes intimate knowledge of the local ecosystem.

Alaska. A deep understanding of connections—as in the relationship between beluga whales and beavers—has allowed people to thrive here for millennia, and it remains at the core of the Iñupiaq way of life today, with much to offer to conservation efforts.

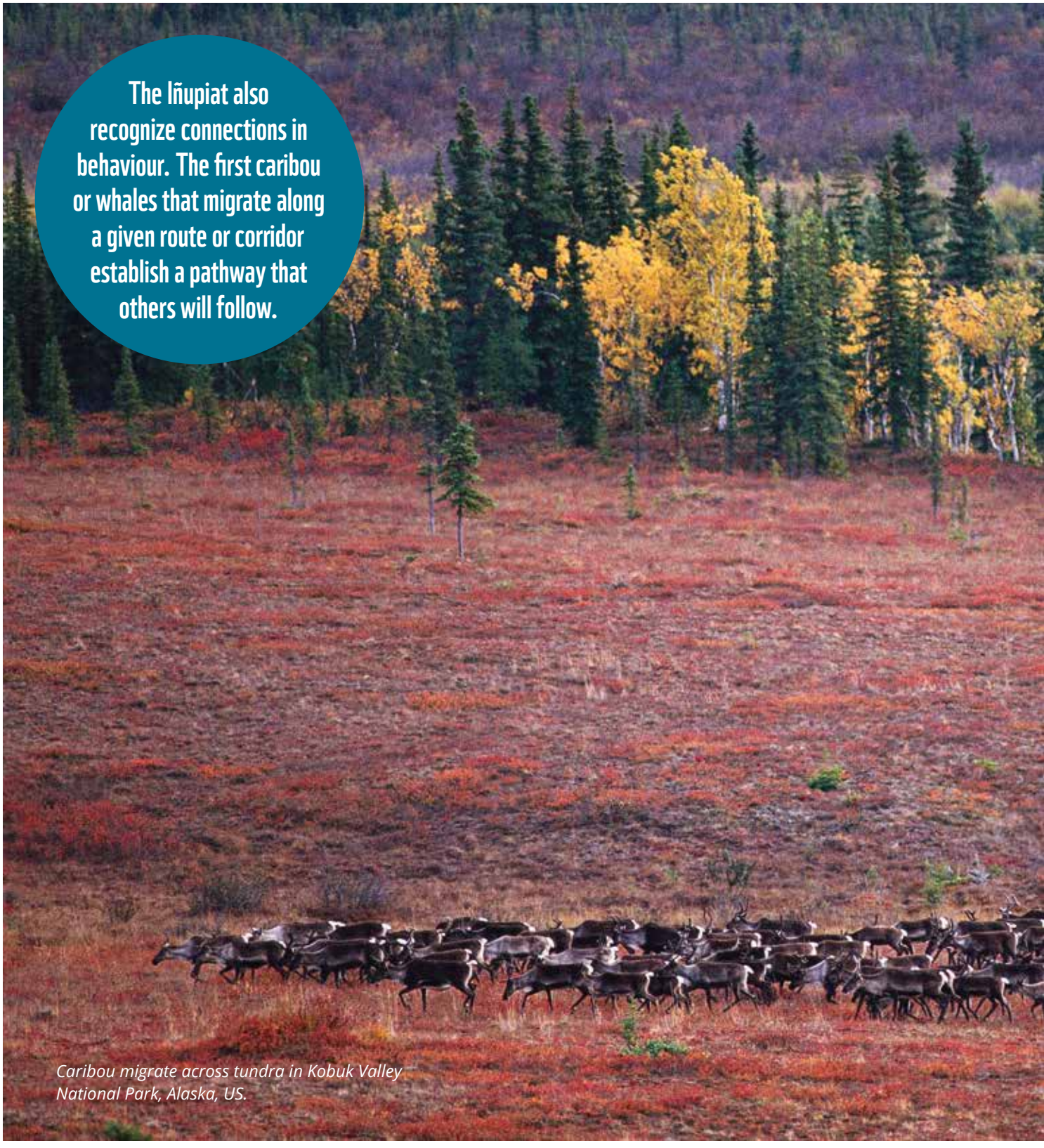
The importance of ecological connections is now well understood in institutional science and conservation. Polar bears eat seals, which eat fish, which eat plankton—and both bears and seals need sea ice and snow to make dens for resting and giving birth.

CONNECTIONS IN MOVEMENT AND BEHAVIOUR

The Iñupiat also recognize connections in behaviour. The first caribou or whales that migrate along a given route or corridor establish a pathway that others will follow. Disturbing those who are making the path will disrupt the migration, whereas letting the first ones pass undisturbed will allow hunters to harvest the animals that later travel a predictable route. Clearly, understanding and respecting animals' behavioural needs is just as important as paying attention to food webs, habitats and their connections.

Connections also include humans as part of the natural world, and for the Iñupiat, these particular connections are understood most clearly through *niqipiaq*, which means real food. When Corina's son harvests his first beluga, he will give it away, as is customary—a reminder that hunting is not about individual gain, but about our connection to animals and the community. A beluga harvest is never just the moment on the water. Families prepare together, travel together, and return home, where the work continues—cutting, sharing and ➤

A deep understanding of connections has allowed people to thrive here for millennia, and it remains at the core of the Iñupiaq way of life today.



The Iñupiat also recognize connections in behaviour. The first caribou or whales that migrate along a given route or corridor establish a pathway that others will follow.

Caribou migrate across tundra in Kobuk Valley National Park, Alaska, US.

putting the meat away—before the celebration of eating together. It is spiritual in nature. Everyone has a role: children learning by watching and helping, adults working with skill and care, Elders guiding with knowledge and experience.

These connections extend beyond the present moment. For the Iñupiat, they link our ancestors to us and us to our children. Through these practices, we hold on to something shared across generations in Iñupiaq life—a lived connection that continues each time food is harvested, prepared and shared. In this way, conservation is not only about sus-

Photo credit: © Staffan Widstrand / WWF

taining animal populations, but about sustaining the knowledge, practices and relationships that make harvesting possible. In other words, we ensure conservation by practising it together.

LIVING OUR VALUES

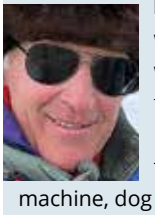
In those moments, the Iñupiat live the values that make them who they are: humility, sharing, cooperation, respect for Elders, love for children, spirituality, hard work, hunter success and respect for nature. Harvesting is not extraction, but part of conservation—grounded in gratitude and humility—and shown in how we work together, share and care for what gives itself so we may live.

Harvesting also keeps the Iñupiat connected to the land and each other. These are not only Iñupiaq values lived out, but lessons about connection—paying attention to relationships, nurturing our bodies, families and communities, and understanding that actions ripple across people, animals and environments. For his part, Henry has learned over time to look beyond isolated parts, to listen, and to understand his work as part of a larger system of relationships. Others can learn this too, carrying it forward in how they do research, build partnerships and make decisions.

For the Iñupiat, conservation is not an activity. It is a way of being: living as complete humans, connected to one another and to a healthy world that we all depend on—and that depends on how we choose to live our values. ●

CORINA QAAĠRAQ KRAMER is an Indigenous researcher and community partner living in Kotzebue, Alaska. She specializes in integrating traditional Indigenous Knowledges with western practices to improve the well-being and sovereignty of Tribal communities.

CANA ULUAK ITCHUAQIYAQ is an Iñupiaq scholar from Kotzebue, Alaska. She is the Founding Director of the Center for Sustainable Engagement in the Arctic at Virginia Tech.



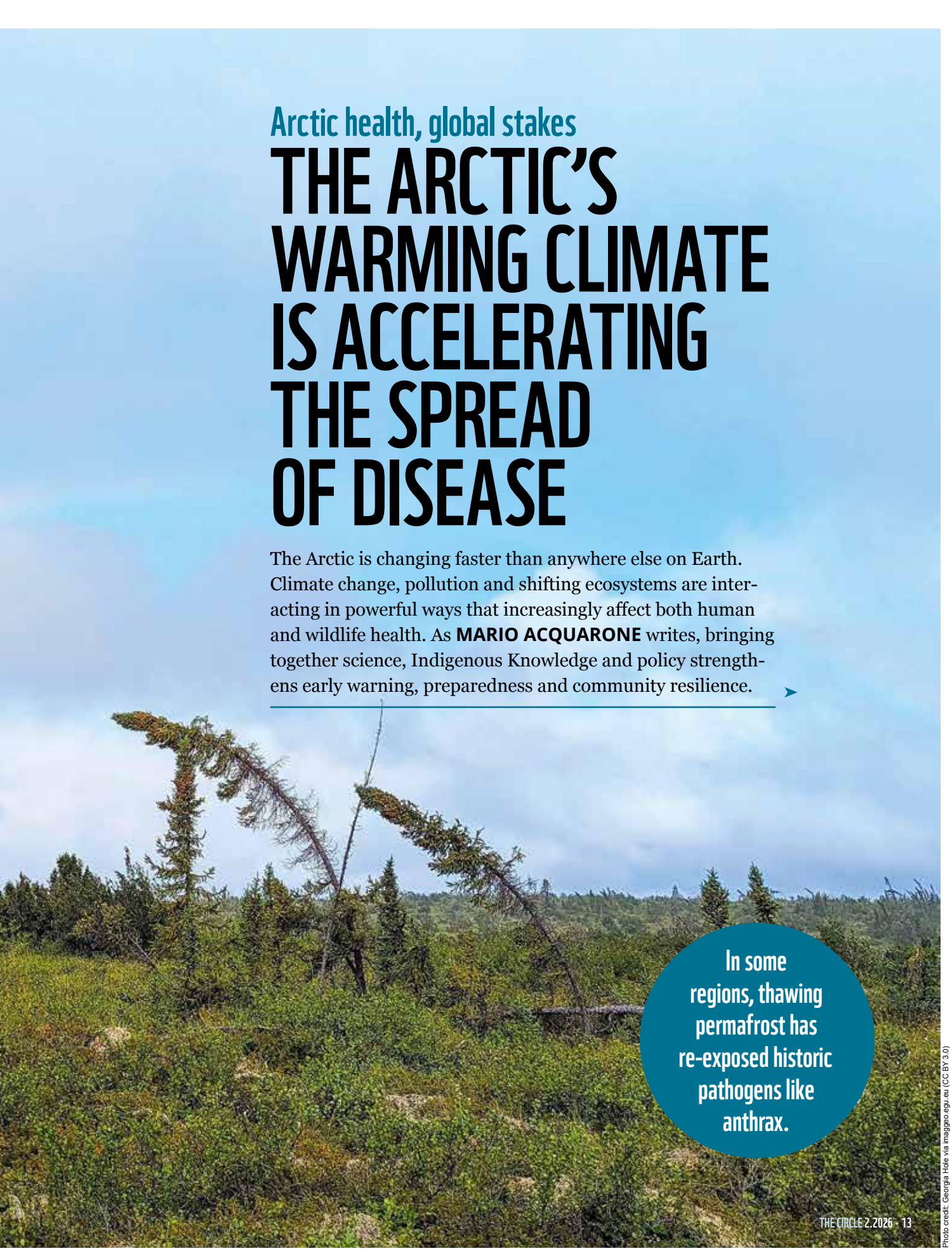
HENRY P. HUNTINGTON has worked in the Arctic and with Arctic communities for more than 35 years. He has also made long trips in the Arctic by snowmachine, dog team and small boat.

"Drunken trees" in the Inuvialuit Settlement Region, Northwest Territories, Canada. As permafrost thaws, destabilized landscapes can also re-expose long-frozen pathogens and reshape the spread of disease.

Arctic health, global stakes

THE ARCTIC'S WARMING CLIMATE IS ACCELERATING THE SPREAD OF DISEASE

The Arctic is changing faster than anywhere else on Earth. Climate change, pollution and shifting ecosystems are interacting in powerful ways that increasingly affect both human and wildlife health. As **MARIO ACQUARONE** writes, bringing together science, Indigenous Knowledge and policy strengthens early warning, preparedness and community resilience.



In some regions, thawing permafrost has re-exposed historic pathogens like anthrax.

Photo credit: Georgia Hole via imaggeo.egu.eu (CC BY 3.0)

HEALTH IN THE ARCTIC is influenced by rapid warming, long-range pollution, and the close, enduring connections between people, wildlife and ecosystems. Within this changing context, infectious diseases, especially zoonoses (diseases shared between animals and humans), are a growing concern. Roughly three-quarters of human infectious diseases are zoonotic, and many are climate-sensitive. This means that warming temperatures, altered precipitation patterns, and ecosystem change can directly influence where and how these diseases spread.

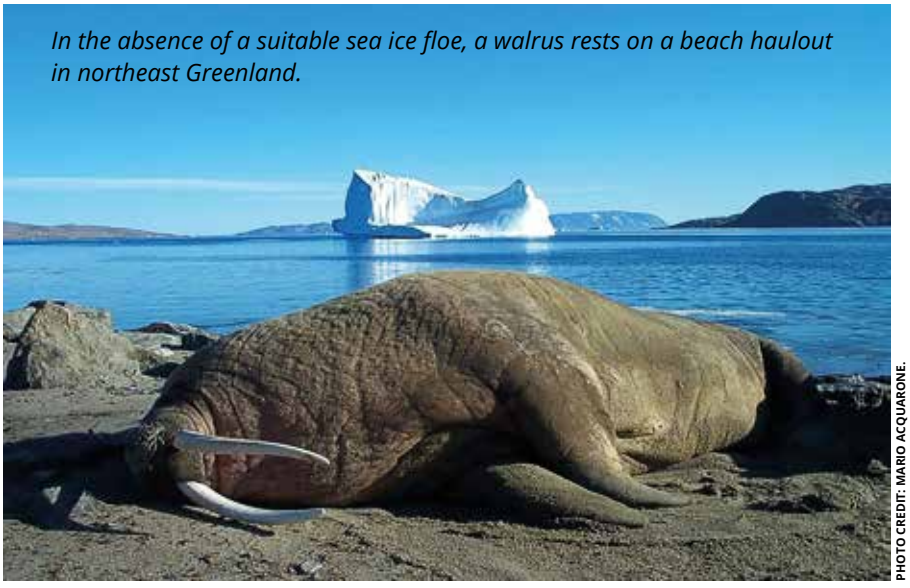
Arctic communities, particularly Indigenous ones, often face greater exposure and more severe consequences. Close contact with wildlife through subsistence hunting and food preparation—combined with reliance on traditional foods that may be consumed raw or minimally processed—can increase vulnerability. These realities are compounded by limited access to health care, diagnostics and public-health surveillance in remote areas as environmental change disrupts food security and food safety.

The Arctic has little local industry, yet it acts as a sink for contaminants transported from the industrialized lower latitudes by air and ocean currents. Per-

MARIO ACQUARONE is a marine mammal ecologist with a passion for the polar areas. He is Deputy Secretary with the Arctic Monitoring and Assessment Programme (AMAP).

Nenets reindeer herdswoman Vashya Profokiev eats raw reindeer meat, Kánin Peninsula, Russia, Arctic.

Photo credit: © Staffan Widstrand / WWF



In the absence of a suitable sea ice floe, a walrus rests on a beach haulout in northeast Greenland.

PHOTO CREDIT: MARIO ACQUARONE.

sistent organic pollutants (POPs)—such as polychlorinated biphenyls (PCBs) and per- and polyfluoroalkyl substances (PFAS), often referred to as "forever chemicals"—accumulate far from their sources along with mercury and other heavy metals.

Making matters worse, the concentrations of these substances increase as they move up the food web. This means the highest levels are found in top predators, such as polar bears, seals, whales and the people who depend on them for food. In this way, pollution becomes not only an environmental issue, but a direct threat to both wildlife conservation and human health.

CAUSING HARM ON MULTIPLE FRONTS

Contaminants affect wildlife in multiple, interconnected ways. They can suppress immune systems, reducing the ability to fight infections. They can disrupt endocrine and reproductive systems, undermining population viability. And they can increase susceptibility to disease, especially when combined with the stress of a rapidly warming climate. Animals that are already challenged by habitat loss and changing food availability are less resilient to these additional pressures.

As climate change forces wildlife to shift their ranges, diets and behaviours, their exposure to both contaminants and pathogens is changing as well. These shifts have been linked to an increased prevalence of brucellosis, toxoplasmosis, avian influenza and parasitic infections, among others. At the same time, mass mortality events in birds and marine mammals are becoming more frequent. These are visible signals of ecosystems under strain.

There was a time when the Arctic was protected by its remoteness. Not anymore.

ONE HEALTH is a holistic approach that recognizes that the health of wildlife and ecosystems underpins human health and well-being. It means that protecting biodiversity is essential not only for conservation, but for preventing disease, strengthening resilience, and securing a sustainable future.

Across the Arctic, the resilience of already stressed populations to climate change and related pressures is being eroded.

For humans, especially Indigenous Peoples, contaminant exposure and disease risks intersect directly. Chemical exposure, largely through the consumption of country foods, has been linked to immune effects, hormonal disruption and greater severity of infections. Food-borne zoonoses, such as trichinellosis, toxoplasmosis, botulism and anthrax, are persistent risks, shaped by both traditional food practices and rapidly changing environmental conditions. ➤

In some regions, thawing permafrost has re-exposed historic pathogens like anthrax, affecting not only wildlife (including reindeer), but the human communities that depend on them. This is forcing Arctic societies to navigate a dual challenge: they must safeguard culturally vital food systems while responding to emerging and evolving health risks.

In the Arctic, human, animal and environmental health are interconnected. Contaminants that weaken immune systems and climate change that reshapes ecosystems together amplify the risk that infectious disease will emerge and spread. Sentinel species, such as sled dogs and top predators, offer early warning signals critical for wildlife conservation and human well-being.

A ONE HEALTH RESPONSE

Current research points to the need for integrated One Health monitoring, more inclusion of local and Indigenous Knowledge, and coordinated observation of contaminants, wildlife disease and human health. Responding effectively requires collaboration across disciplines, sectors and borders.

Within this framework, the Arctic Monitoring and Assessment Programme (AMAP) serves as the Arctic Council's scientific backbone. Through long-term, circumpolar assessments, AMAP documents how contaminants, climate change and ecosystem disruption affect human and wildlife health, including how pollution and environmental stressors weaken immune systems, alter disease dynamics, and increase zoonotic risk.

There was a time when the Arctic was protected by its remoteness. Not anymore. Today, climate change and global pollution are converging to undermine wildlife and human health concurrently, outpacing our ability to monitor and respond. The region has become an early warning system for global health, teaching us that when pollution weakens immunity and climate change reshapes ecosystems, diseases emerge earlier, spread faster and hit harder. Ultimately, this means a One Health approach is not optional—it is essential. ●

Built from 30 years of satellite tracking data, BlueCorridors.org shows how whales travel across national boundaries and interconnected ocean ecosystems.

Map credit: BlueCorridors.org

New digital platform

BRINGING WHALE SUPERHIGHWAYS TO LIFE

In the Arctic, connectivity is not an abstract idea—it's alive in the movement of whales. Gray whales and humpbacks travel thousands of kilometres between Arctic feeding grounds and distant tropical or temperate breeding areas, linking ecosystems that span entire ocean basins. Narwhals and bowhead whales move throughout the Arctic during the seasons. These vast migrations and movement areas contribute to ocean health far beyond the Arctic itself. Yet until recently, much of what scientists knew about these routes lived in static reports, scattered datasets and inaccessible archives.


Chris Johnson

That changed with the launch of BlueCorridors.org, a collaborative digital platform and community initiative built from 30 years of satellite tracking data. The platform brings whale movements across the globe into full view for the first time—along with the growing risks that whales face as climate change reshapes their migratory corridors. (In April, it won a 2026 Webby Award in the Best Data Visualization category.) *The Circle* spoke with **CHRIS JOHNSON**, a marine conservation scientist and WWF's global lead for the Protecting Whales and Dolphins Initiative, about how the tool came to be, what it reveals about ocean connectivity, and why it's already influencing conservation strategies. ➤

Where did the idea for Bluecorridors.org come from?

This has been a massive collaborative effort from the original idea to the present. In 2022, we co-produced the first report on whales and marine connectivity, *Protecting Blue Corridors*. It mapped, for the first time, global whale migration, growing risks and conservation opportunities on a region-by-region basis. More than 50 research groups contributed about 30 years of data and more than 1,400 different satellite tracks. This led to work across WWF, including in the Arctic, exploring how we could implement its recommendations and practical conservation approaches.

Over the past couple of years, we realized the data needed to be available in a format that was more accessible than a static report or fixed maps. So we went back to the collaborators involved in the report and co-designed the concept with them. The question was, how could we take this approach and make the mapping available online?

We launched the Blue Corridors Initiative at the United Nations Ocean Conference in June 2025. This digital tool is part of that broader community-based initiative, which brings together scientists, community groups, nongovernmental organizations and governments in the Blue Corridors Initiative.

What can people learn from the tool right now?

When we launched the website, the first goal was to bring the data together and make the report content available online.

We are using it to share practical advice on growing risks, conservation opportunities and solutions related to whale conservation. It also helps us communicate more effectively with policymakers about the risks whales face in different places and the actions we can take in response. It gives a better picture of what it means to conserve marine connectivity.

Anyone can go online and see the satellite tag data we have for various whale species. You can look at it on a static globe, or you can see an animation of all ➤

Satellite tracking shows us where they're moving, where the migratory corridors are, and how climate change is affecting those movements.

Bowhead whales in Nunavut, Canada.

the data over one year, including how different whales move in different areas.

You can also overlay different threat layers: climate change, fisheries bycatch risk, shipping traffic. There are case studies from various regions, and the tool contains some of the narratives from the reports. You can see overlap for certain risks and what some of the solutions are.

Where do all the data come from?
They are mainly satellite tracking data. Over the past 30 years, researchers have been putting satellite tags on whales to see where they go. We can use photo identification of some species—for example, humpback whales, where a fluke photo is like a fingerprint. But satellite tracking lets us see their position over time, point to point, and that's the data we have in the platform.

This is still very much the first version of the tool. The next step is to build it into a more interactive decision-support platform for conservation. We wanted to launch it, see how people responded, and then grow it from there.

We have already had requests for different types of data use, so we plan to release a downloadable dataset in late May for non-commercial use. We are also bringing on new partners and adding new data from other whale and dolphin species.

Why are whale migration routes such a powerful way to understand ocean connectivity and ocean health, especially in the Arctic?
Ocean connectivity is a very abstract concept to communicate. Usually, when we interact with whales, we see them in one place, but that place means different things to different species in different parts of the world.

The Arctic Ocean's food-rich waters make it a key destination and feeding ground for baleen whales, like humpbacks, gray whales, blue whales and bowhead whales. Some whales, like bowheads, are endemic to the Arctic, but others visit the region only seasonally. Baleen whales move thousands of kilometres between their polar feeding grounds and tropical or temperate breeding grounds, and each species does it differently.

Satellite tracking shows us where they're moving, where the migratory corridors are, and how climate change is affecting those movements. Governments have provided positive feedback about the tool, especially in terms of visualizing whales' movements across

A North Pacific humpback whale breaches at sunset near Kupreanof Island in Frederick Sound, Alaska, US.

Photo credit: © Tony Wu / naturepl.com / WWF

national and internation jurisdictions. It's a powerful tool to communicate ocean connectivity.

This all started as a science communication project. Now we're building on all of the efforts with our partners to co-design and implement strategies to better conserve and protect populations, some of which are still recovering from commercial whaling.

How do you see climate change reshaping these corridors?

Climate change is affecting the prey of baleen whales in the polar regions along with their migratory timings and cues. For example, with gray whales, we're seeing impacts on the population in the northeastern Pacific. A theory is that climate change is impacting the availability of their prey in the Arctic, and in turn, their survival. In recent years, large numbers of gray whales have stranded during their migration south from the Arctic to their breeding grounds in Mexico, primarily due to starvation. There are recent studies showing that some populations are shrinking in size.

To better understand the problem and advocate for a solution, we need to bring different knowledge sources together—satellite tracking, Indigenous Knowledge and local observations. Right now, we can't use the data to predict changes in movement and migration, but we're exploring how AI could help develop a method for mapping future shifts in migratory corridors.

How do you hope different audiences will use this platform?

For WWF, we can only do this work in collaboration with the broader communities of experts. One study with 10 tracks is useful, but when you bring different knowledge and evidence together, you can look at trends, migratory corridors, and how to mitigate issues like shipping and growing fisheries bycatch.

For the public, the map is a powerful tool to show how species migrate across oceans and connect what's happening from the polar regions to the temperate and tropical ones.

For governments, it's simple to understand to help action management. When you watch an animation, dynamic and seasonal management makes sense.

We see visualizing blue corridors as an important way to communicate how the ocean works, show where future investment is needed to fill knowledge gaps, and inform the actions we need to take together. ●

Uninvited guests

HOW THE ARCTIC IS CONNECTED (AND DISCONNECTED) BY POLLUTION

Pollutants and contaminants have become an unwelcome part of Arctic landscapes and socio-ecological systems. As **ADAM STEPIEN, THORA HERMANN, ÉLISE LÉPY** and **TAHNEE PRIOR** write, by its very presence, pollution acts as an uninvited connector between different places and times. It is also corroding the intimate linkages that have long existed between Arctic peoples and their environment.

A MULTI-YEAR INITIATIVE, the Horizon Europe ICEBERG project (short for Innovative Community Engagement for Building Effective Resilience and Arctic Ocean Pollution-control Governance in the Context of Climate Change) is trying to address these issues.

ICEBERG is examining a broad range of pollutants—from persistent organic pollutants (POPs) and heavy metals to macro- and microplastics and emerging contaminants, such as per- and polyfluoroalkyl substances (PFAS)—through lab-, imaging- and community-based research. Researchers draw on local observations and experiences, samples from sediments and marine litter, and data collected using drones and time-lapse cameras. This multidisciplinary research project relies on dialogue with Arctic communities at study sites in southern Greenland, northeast Iceland and western Svalbard. Its early findings reveal the connections that pollution creates across space and time, as well as challenges that pollutants pose for Arctic societies' relationships with their environments.

It has been well understood for decades that diverse pollutants in the Arctic—especially POPs and heavy metals—originate from distant industrialized regions in North America, Europe and Asia. These contaminants accumulate in the Arctic environment, where they affect human and animal health.

Scientists and policymakers are increasingly focused on plastic pollution, which includes litter on Arctic beaches and in coastal waters from local and international fishing operations as well as mismanaged waste generated within the Arctic and globally. For example, recent ecosystem-scale assessments, including work by the International Council for the Exploration of the Sea, identified microplastics and chemical contaminants as among the most significant pressures on the Central Arctic Ocean. Other concerns include nano- and microplastics from sources such as polyester clothing as well as tires and road traffic in Europe ➤

Chemical compounds banned in the 1980s have been found in recent sediment samples from Kongsfjorden in Svalbard.

Kongsfjorden, Svalbard, Norway.

Photo credit: Tom Phillips via Flickr.com (CC BY 2.0)

The ICEBERG project aims to address multiple contaminants that connect global industrial centres around the world to the Arctic.

Garbage lies on a beach on Phippsøya, the largest of the Seven Islands group in Svalbard, Norway. Phippsøya is just over 1,000 km from the North Pole.

Photo credit: Peter Prokosch, www.grida.no/resources/3490

and North America, including studded tires in the Nordic countries.

CONNECTING THE DOTS FROM INDUSTRY TO THE ARCTIC

The ICEBERG project aims to address multiple contaminants that connect global industrial centres around the world to the Arctic.

In Svalbard, researchers have found dust particles—such as black carbon (soot) and other airborne contaminants—on glaciers as well as microplastics and PFAS in the fjords. Given that few such pollutants are emitted in the Arctic—from sources such as shipping, industry or waste—these have clearly arrived in the archipelago from more southerly latitudes, carried by long-distance air transport and ocean currents.

In addition, litter collected on Arctic beaches shows that plastic waste can be carried north by ocean currents from across the North Atlantic Ocean and the Barents Sea. ICEBERG researchers have also analyzed food samples from southern Greenland and northeast Iceland and detected long-range transported chemical contaminants.

There is also growing awareness that climate change is amplifying pollution as melting glaciers and thawing permafrost release contaminants that were emitted decades ago back into the environment. These so-called legacy contaminants have usually been trapped in ice for 40 or 50 years before being released again. For example, chemical compounds banned in the 1980s have been found in recent sediment samples from Kongsfjorden in Svalbard.

AN ARCTIC HEALTH DILEMMA

Pollutants like these are affecting the intimate cultural connections that have existed for generations between Arctic peoples and their environment. Awareness of rising pollutant levels in the tissues of marine mammals and fish can pose a dilemma for Arctic communities: traditional foods are at the heart of identities, cultures and livelihoods, but may contain contaminants, while imported groceries offer less nutritional value and do not contribute to cultural continuity.

It's easy to see how generating knowledge about contaminants can be a sensitive issue. As a result, scientists from various disciplines must conduct research in collaboration with Arctic communities, respecting their values and diverse knowledge systems. ICEBERG and other research projects are working to abide by these principles.

But we also need action by and cooperation among Arctic and national policymakers, regulators at the source of the pollution, and Arctic civil society, including Indigenous Peoples. There are encouraging examples—including in the work of the Arctic Council and the development of international long-range pollution conventions covering POPs and mercury—and efforts to conclude an agreement on plastics are ongoing.

While pollution is not a connector that any of us would have chosen as a unifying force, it is something that could create a sense of collective responsibility for the Arctic, whether we are located in Brussels, Washington, Delhi, Tokyo or Beijing. Policies targeting Arctic pollutants do not depend on the participation of major global economies in Arctic governance. Effective actions can address emissions, waste management, and industrial processes in the countries where long-range pollution begins.

We are all part of the problem, but we can also be part of the solution. You do not need to live or work in the Arctic to make a positive impact. Become a citizen scientist, join a community clean-up, or simply consume less plastic. The choices that can make a difference are nearly endless. ●

ADAM STEPIEN (pictured), **THORA HERMANN**, **ÉLISE LÉPY** and **TAHNEE PRIOR** are ICEBERG project researchers from the University of Lapland, the University of Oulu, and Women of the Arctic.

Connected efforts, lasting solutions

GHOST GEAR IN GREENLAND

Below the ocean surface, discarded fishing equipment—known as ghost gear—continues to harm ecosystems and livelihoods. In November 2025, Oceans North Kalaallit Nunaat, a Greenlandic nongovernmental organization, gathered representatives from across sectors to discuss sustainable solutions, including prevention, retrieval and post-retrieval handling. As **PARNUNA EGEDE DAHL** writes, the workshop explored how a coordinated national strategy could address this growing problem in Greenland.

Ghost gear recovered from Arctic waters around Ilulissat, Greenland, including live snow crabs and fish. Abandoned nets and lines continue to harm marine ecosystems long after they are lost.

THE NET HAULER creaks as the heavily loaded vessel rocks and the dripping rope is slowly hauled in. Suddenly, a dark mass breaks the surface: a tangled mess of old fishing nets, lines, hooks and weights. Caked in mud and seaweed, it holds drowned carcasses alongside wriggling fish and crabs.

This foul-smelling ghost gear may have been lying on the seabed for decades—continuing to fish all the while. Retrieving it is hard, dirty, risky work. But it is essential for the health of Greenland's marine ecosystems.

Ghost gear is fishing equipment that has been lost, abandoned or otherwise discarded at sea. It can include longlines and pound nets. In Greenland, such items can be lost due to rough seabed conditions, strong currents, ice movement, or poor gear quality or setup. Existing ghost gear can also entangle new equipment, creating a self-reinforcing cycle of loss.

Once it is lost, the gear can continue to catch fish, crustaceans, seabirds and marine mammals for years. This undermines the sustainability of fisheries, poses safety risks, harms people's livelihoods, causes economic losses for communities, and adds pressure and pollution to Arctic marine ecosystems that are already vulnerable.

GHOST GEAR WORKSHOP

As a multi-factorial challenge—shaped by environmental conditions, fishing practices and management systems—ghost gear requires a comprehensive solution. That is why Oceans North Kalaallit Nunaat brought fishers,

Photo credit: Ilulissani Aalisartut Piniartullu Peqatigiffiat (IAPP)

The older line and gillnet seen here—overgrown with algae and seaweed and entangled with brittle stars—indicates that this ghost gear found near Ilulissat had been in the water a very long time.

PARNUNA EGEDE DAHL is a Greenlandic Inuk and biologist who works as a special advisor focusing on science, communication and campaigns.

Photo credit: Ilulissani Aalisartut Pinnartullu Peqatigiffiat (IAPP)

authorities, researchers, companies and educational institutions together for a workshop in Nuuk in November 2025.

The aims were to shift the focus from retrieval alone towards a more preventive and strategic approach and to develop a shared, coordinated response to ghost gear. The discussions covered prevention, retrieval, after-life handling, and the way forward. The resulting report, available upon request, contains recommendations meant to inform Naalakkersuisut (Greenland's government).

As workshop participants pointed out, clean-up efforts are challenged by the underreporting of lost gear, which happens at least in part because reporting systems are complex and follow-up and consequences are lacking. Still, building on earlier pilot initiatives, including work supported by WWF in Greenland, fisheries associations and the Greenland Institute of Natural Resources led clean-up efforts from 2019 to 2024, retrieving tons of gear. Supported by the government, Oceans North Kalaallit Nunaat, and other sponsors, these efforts make a difference. Because cleaned-up areas experience fewer future losses, retrieval can function as prevention.

However, scaling these efforts requires specialized equipment, strong local collaboration, and stable funding within a coordinated, strategic framework. Coastal and offshore gear require different coordination and financing models. As a result, the workshop recommended that specialized actors be licensed to carry out clean-ups.

Once it is lost, the gear can continue to catch fish, crustaceans, seabirds and marine mammals for years.

PREVENTING LOSS

Participants agreed that clean-up alone cannot solve the problem. Prevention is key: without stronger connections between technology, knowledge and fishing practices, ghost gear continues to accumulate faster than it can be removed. To combine positive incentives with timely consequences for failing to report lost gear, proposed solutions included better gear quality, a standardized marking system, and digital tools for registration, tracking and reporting. Losses could also be reduced by training fishers in proper gear setup, local conditions and reporting requirements and by sharing knowledge of high-risk areas. ➤

Once ghost gear has been retrieved, handling its after-life responsibly helps prevent it from becoming landfill waste. In Greenland, weights are reused. However, in the absence of sorting and recycling facilities, the rest ends up in local landfills or is transported to centralized waste-management facilities. There, recyclable materials are shipped abroad, while non-recyclables are incinerated.

Workshop participants discussed alternative options for sorting, reusing and recycling gear, emphasizing that solutions must be adapted to local conditions and infrastructure. Some ideas show promise, such as deposit-return schemes for sorted gear or small-scale local processing, but these need political support and national coordination.

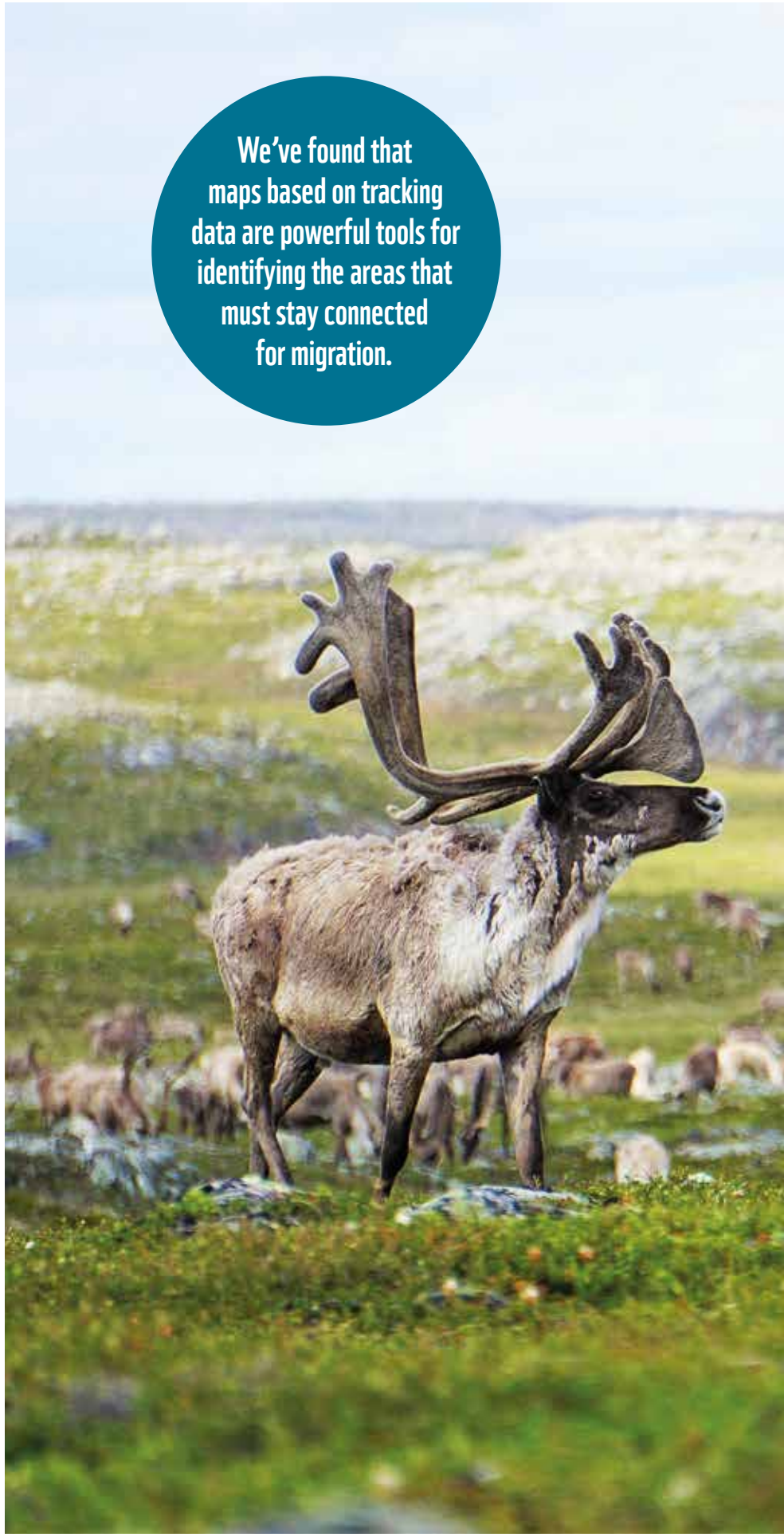
FROM ISOLATED EFFORTS TO A SHARED STRATEGY

The workshop made it clear that ghost gear cannot be addressed from just one angle. Effective solutions require sustained coordination between various parties, including fishers, authorities and companies, and must be supported by clear responsibilities, stable financing and connected systems. As a result, participants called for a Greenlandic strategy that moves beyond isolated clean-up towards preventive steps throughout the life cycle of fishing gear.

This includes linking Greenlandic ghost gear challenges to international fishing practices and waste streams so lessons can be shared in both directions. Ultimately, addressing ghost gear means strengthening the connections between people and the ocean across sectors, regions and borders.

Ghost gear is a shared, cross-border challenge that cannot be solved by any single actor or country. We need to coordinate long-term efforts across the entire life cycle of fishing gear, and solutions must be grounded in shared responsibility at the local, national and international levels. ●

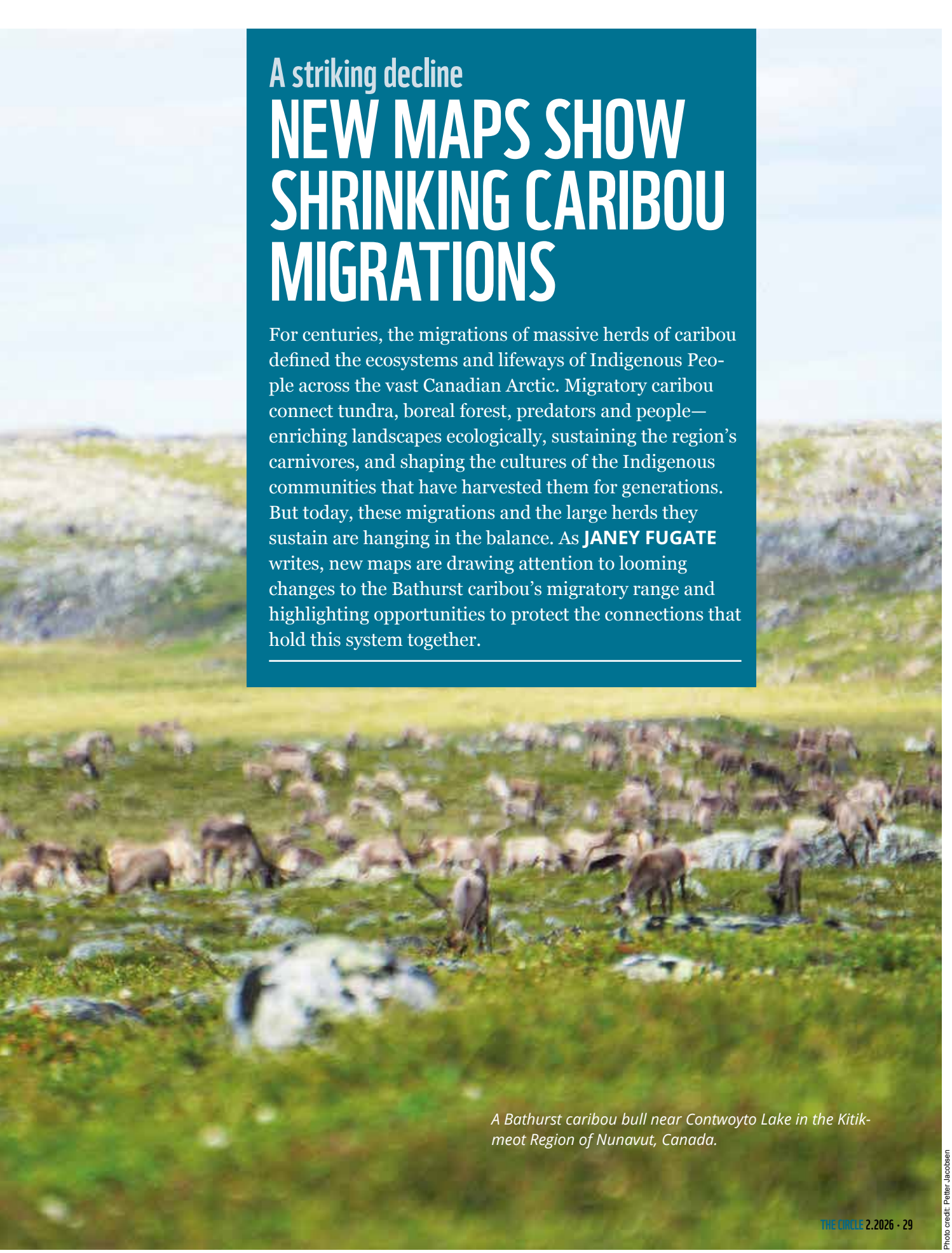
We've found that maps based on tracking data are powerful tools for identifying the areas that must stay connected for migration.



A striking decline

NEW MAPS SHOW SHRINKING CARIBOU MIGRATIONS

For centuries, the migrations of massive herds of caribou defined the ecosystems and lifeways of Indigenous People across the vast Canadian Arctic. Migratory caribou connect tundra, boreal forest, predators and people—enriching landscapes ecologically, sustaining the region's carnivores, and shaping the cultures of the Indigenous communities that have harvested them for generations. But today, these migrations and the large herds they sustain are hanging in the balance. As **JANEY FUGATE** writes, new maps are drawing attention to looming changes to the Bathurst caribou's migratory range and highlighting opportunities to protect the connections that hold this system together.



A Bathurst caribou bull near Contwoyto Lake in the Kitikmeot Region of Nunavut, Canada.

Photo credit: Petter Jacobsen

THE BATHURST HERD of barren-ground caribou, named for their historic calving grounds near Bathurst Inlet, once ranged from Nunavut all the way to northern Saskatchewan. Some caribou travelled more than 500 kilometres on their yearly migrations. The annual pulse of their movements across the landscape provided food and sustenance for humans and other wildlife alike.

Today, the herd is declining. The population, which numbered about 400,000 in the 1980s, had fewer than 4,000 members in 2025, according to recent surveys. But it's not just their numbers that are dwindling. The herd's migratory range has also contracted. In response, the Global Initiative on Ungulate Migration partnered with WWF-supported researchers and Indigenous stewards to map the Bathurst caribou migration in new detail.

A broad goal of the initiative is to promote connectivity across migratory landscapes—and we've found that maps based on tracking data are powerful tools for identifying the areas that must stay connected for migration. Our new maps document critical habitat, show the historical extent of movements, and pinpoint emerging threats.

A ROAD RUNS THROUGH IT?

The Bathurst's range sits within the recently designated Arctic Economic and Security Corridor, a proposed $40 billion Canadian infrastructure project to build an all-season road from the Northwest Territories to a new deep-water port at Grays Bay, Nunavut. The project has received heightened attention from the Canadian government, with the prime minister recently adding the initiative to a list of "nation-building projects," meaning it may be fast-tracked.

JANEY FUGATE is a Project Manager for the Global Initiative on Ungulate Migration, a consortium of scientists building an open access tool that makes migration maps available for use in spatial planning.

Photo credit: Petter Jacobsen

Bathurst cows and calf.

But our new maps illustrate how the road would cut straight through the Bathurst caribou's core migration area, passing very close to the herd's calving grounds and effectively bisecting the herd's current range.

Three diamond mines already operate in areas known to be preferred by the herd. Indigenous stewards and researchers have documented large-scale caribou avoidance of these areas. Winter ice roads that service the mines can also act as barriers, limiting where and how caribou move across the landscape. When migration routes are disrupted in this way, animals may be delayed or diverted from critical feeding and calving grounds, contributing to further losses.

Our new maps illustrate how the road would cut straight through the Bathurst caribou's core migration area.

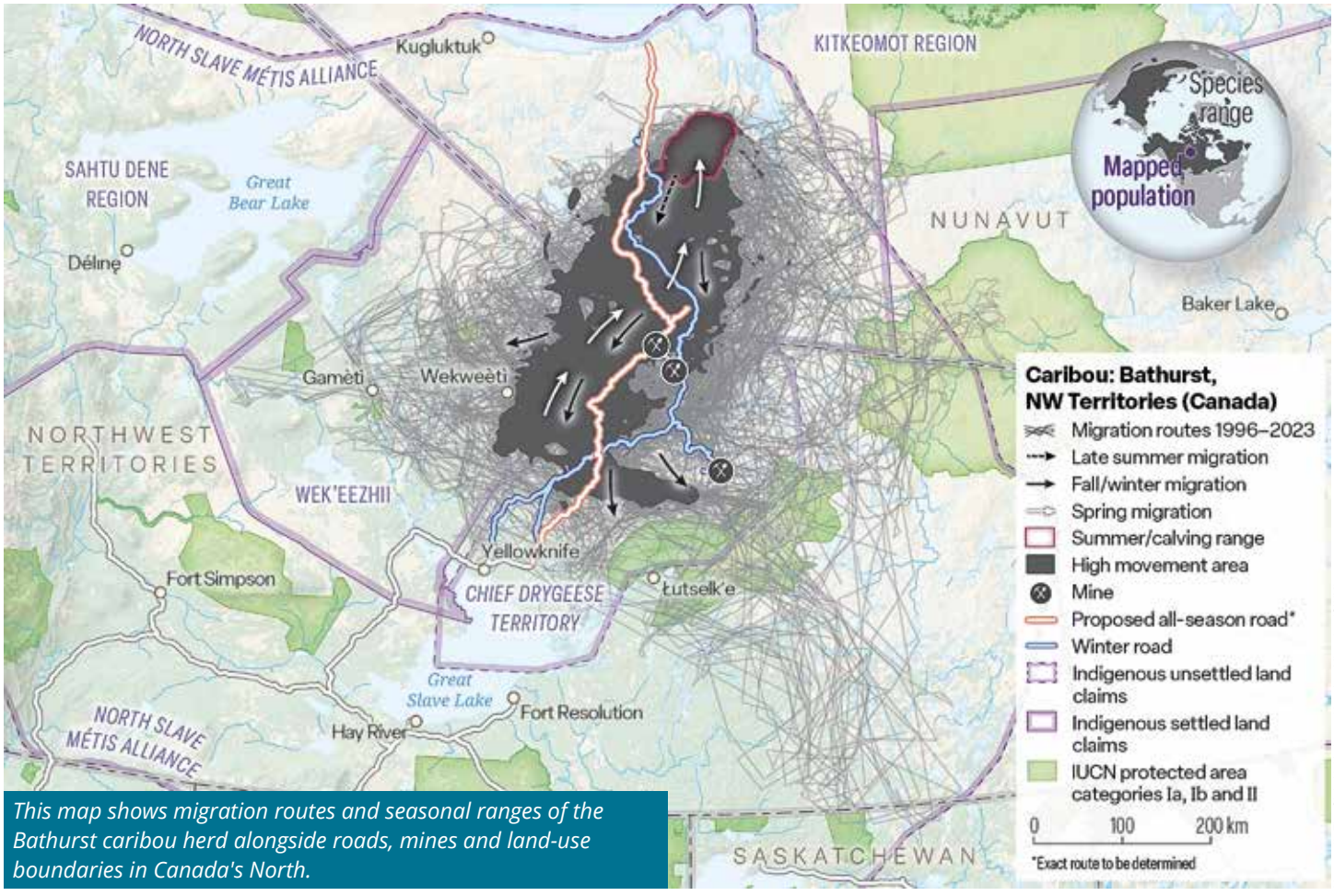
Caribou tracking data and detailed maps can help inform how development is planned, including where infrastructure is located and how it is designed. When used in this way, these tools can support decisions that reduce disruption to seasonal migrations.

INDIGENOUS-LED RESTORATION AND MANAGEMENT

The caribou herds of the Arctic are among the only wild, migratory ungulate populations in the world to which Indigenous communities still maintain strong traditional ties—and their migrations are among the longest among ungulates in the world.

"The steep decline of the Bathurst herd is not just a biological concern. It represents a profound cultural and ecological loss," says Orna Phelan, a wildlife biologist with the North Slave Metís Alliance (NMSA). As one of the Indigenous communities that stewards the caribou, NMSA has said that conserving this herd also means safeguarding their history, their identity and the health of the land we all share.

The Bathurst herd is emblematic of the pressures facing migratory caribou worldwide. As a species, barren-ground caribou have declined by 65 per cent over the last 20 to 30 years. They face multiple threats: rising temperatures, increased insect harassment, declining vegetation quality, and more frequent rain-on-snow events that lock away



This map shows migration routes and seasonal ranges of the Bathurst caribou herd alongside roads, mines and land-use boundaries in Canada's North.

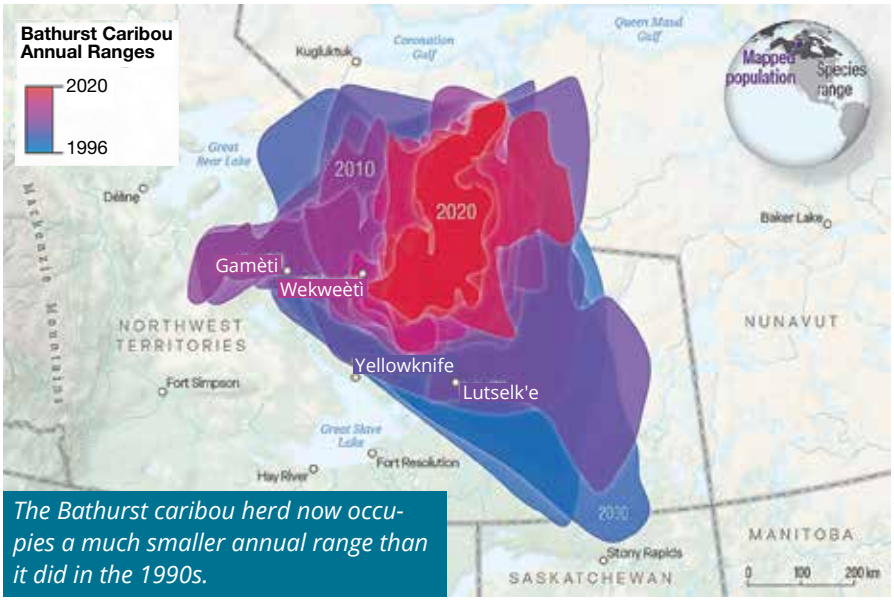
Map credit: The Global Initiative on Ungulate Migration (GIUM)

lichen—their primary winter food source—under thick ice.

In the Bathurst's migratory range, Indigenous-led guardians, harnessing traditional knowledge and on-the-ground observations, are intensively monitoring traffic and caribou behaviour on and around roads and mines. Working in close partnership, researchers are trying to understand how the caribou are responding to various kinds and levels of disturbance, with an eye toward specific mitigation solutions that can make linear infrastructure, such as roads, more caribou friendly.

Mapping methods tested in the Bathurst caribou's range could prove useful for the other large caribou herds that still inhabit the circumpolar north, allowing these regions to avoid stark population declines and preserve the long-distance movements that caribou require.

"Among all the caribou's astonishing adaptations to not only survive, but thrive, in the Arctic, perhaps none is more important than the ability to move freely across large landscapes," says Elie Gurarie, a wildlife scientist who has studied caribou for a decade. "By working closely with First Nations, Inuit, territorial governments and non-governmental organizations, we're not only documenting change, but shaping solutions." ●



The Bathurst caribou herd now occupies a much smaller annual range than it did in the 1990s.

Map credit: The Global Initiative on Ungulate Migration (GIUM)

New routes, new passengers

COULD AN INCREASE IN SHIPPING BRING NEW SPECIES INTO ARCTIC WATERS?

In the Arctic, connectivity is often described as the relationships between water, species and people. One of the clearest—and fastest-changing—examples of ecological connectivity is the spread of non-Indigenous marine species northward. As sea ice retreats and shipping increases, new biological pathways are opening across the circumpolar region. These pathways are already reshaping the risks, management challenges and future of Arctic ecosystems.

To understand how these shifts are unfolding, *The Circle* spoke with **KIMBERLY HOWLAND**, a research scientist with Fisheries and Oceans Canada and one of the authors the Arctic Council's Marine Invasive Alien Species in Arctic Waters report. She explains how sea ice loss is transforming shipping routes, how organisms can hitchhike their way to the north, and why the Arctic could soon be a new hotspot for biological invasions.

How does climate-driven loss of sea ice increase the movement of ships in the Arctic?

Sea ice loss is increasing the accessibility of the Arctic by opening up new shipping corridors, like the increased use of the Northwest Passage. It's also extending the length of the shipping season. In areas that already had shipping, the navigation season can now be longer. Together, these changes are increasing the numbers of ships entering Arctic waters.

These changes in ice conditions makes the region more attractive for extractive industries—mining and hydrocarbon—as well as for tourism, with cruise ships and yachts, and for fishing. All of these activities have increased, especially over the past decade.

What does increased shipping mean for the movements of organisms themselves?

All ships can have biofouling. This refers to organisms attached to surfaces that can be transported, like a ship's hull. Organisms can also be moved in ballast water that cargo ships take up in source ports to provide stability when they are empty. There are international measures to deal with this. For example, the International Marine Organization (IMO) has adopted biofouling guidelines to manage the accumulation of aquatic organisms and developed regulations requiring ships to have treatment systems on board. These systems can use ultraviolet radiation or chlorine-based treatment to kill organisms, but the process is not 100 per cent. The systems treat the water as it's taken on board and, in the case of chlorine, they neutralize the chlorine before discharging it.

Are there particular shipping corridors where the risk of biological transfer is especially high?

The shipping corridors where we see a high level of connectivity and good climate match will be those at greatest risk—for example, between northern Europe and ports in the Arctic, such as Svalbard or northern Canada, or between ports in northern Asia and areas like Alaska.

Alaska, northern Labrador and Hudson Bay also contain habitats that show suitability for a number of invasive species that have the potential to arrive through shipping.

How likely is it that non-Indigenous species introduced through shipping can live in Arctic waters?

If the temperatures and other conditions are such that they can survive, then they may establish themselves. The habitat needs to be suitable—but sometimes species surprise us and survive where we didn't think they could.

Temperature is really the key element. Species need water at the correct temperature for a sufficient window of time to allow for reproduction and development. Then they need to be able to survive the Arctic winter, under the ice.

As the Arctic warms, we're getting longer windows of open water. This increases the probability that eventually we will have a window long enough for ➤

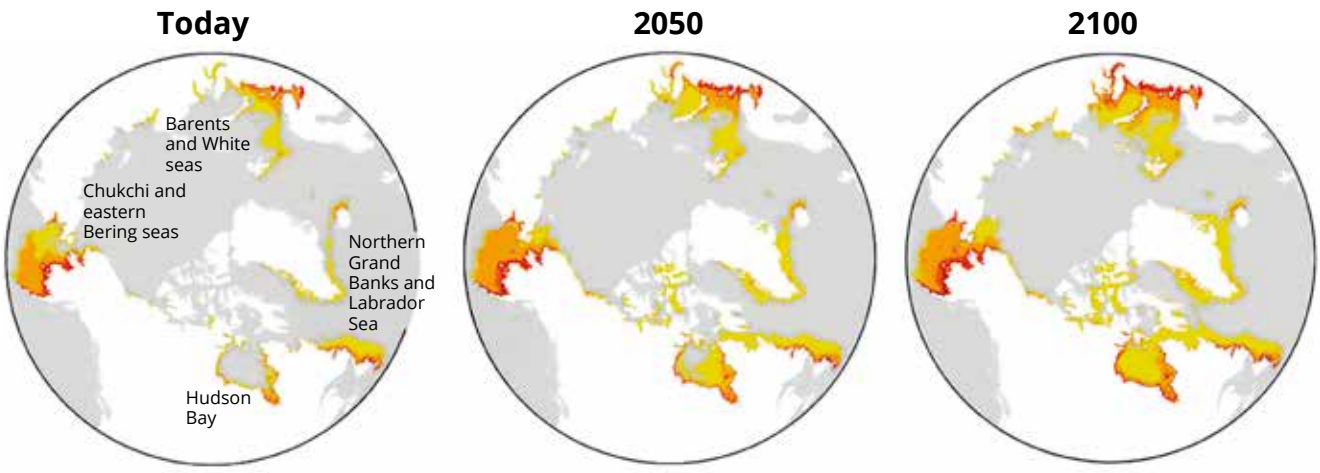
As the Arctic warms, we're getting longer windows of open water. This increases the probability that eventually we will have a window long enough for new species to survive, reproduce and establish.

Kimberley Howland conducts intertidal surveys for non-Indigenous species near the Port of Deception Bay in Nunavik, Canada.

Photo credit: Kimberley Howland

Warming Arctic waters could create new hotspots for invasive species

As sea ice retreats and shipping routes expand, more parts of the Arctic are becoming suitable for non-Indigenous marine species. Areas at highest risk—where many species could survive—are projected to grow significantly by the end of the century.



Based on models of projected suitable habitat for 23 high-risk species with potential for ship-mediated introduction to the Canadian Arctic.
Adapted from: *What and where? Predicting invasion hotspots in the Arctic marine realm*. https://doi.org/10.1111/gcb.15159

Photo credit: Justine Sutherland

Conducting coastal baseline survey work near Qikiqtarjuaq, Nunavut,Canada, the site of a planned deepwater port.

new species to survive, reproduce and establish.

Which species are on your radar?
We've identified somewhere in the ballpark of close to 200 cold-water species that can handle marine waters and that we know can be moved by ships (or have a life history that would facilitate movement by ships). We've actually found some of these in ballast water that we're testing. Having a list of species to watch for is really useful. When you detect one where it doesn't belong, it's a red flag.

One example is a type of zooplankton (*Eurytemora affinis*) that can live in waters ranging from freshwater up to about 40 parts per thousand in salinity (saltier than typical open-ocean water). It's a very adaptable species and tends to be adapted to cool water.

The Arctic is still a place where we have a chance to do better.

How might a single introduced species affect Arctic ecosystems?
It depends on the species and what native species are living where it's introduced. If it has a "niche" similar to a closely related native species, there can be competition. In some cases, if the species are closely related, they can interbreed, and then you end up with hybridization and loss of native species. If the introduced species is predatory, it can cause problems for native prey species.

Green crabs are a good example. They're very aggressive predators. They out-compete native crabs and reduce native prey, which may affect other native predators and the prey species themselves.

What are the biggest challenges in preventing the movement of new species into a region like the Arctic, where ecosystems—and shipping routes—cross multiple jurisdictions?

The Arctic is a huge, highly connected region, and it's very remote. Many Arctic communities are small, with limited ability and infrastructure for research and monitoring. Awareness has increased with Arctic Council interest—there's been plain-language outreach, and our team has been trying to get the word out about the potential risks. But actually doing monitoring takes leadership and collaboration. Having a coordinated effort across all Arctic states is a challenge.

In Canada, with the large port associated with the Mary River development (a large iron ore mining project in Nunavut), ships are required to take enhanced preventative measures based on recommendations from the Canadian government. They're required not only to treat ballast water, but also to exchange it offshore before entering Arctic waters. Having broader requirements for enhanced preventative measures like these across the Arctic would be a really good thing.

There is also the Polar Code, but its provisions on invasive species rely largely on existing IMO measures—like ballast water and biofouling guidance—rather than setting out Arctic-specific requirements. Strengthening and applying these measures more consistently across the Arctic would be a major step forward. The measures that the IMO has implemented are definitely helping, but the Arctic is a more pristine area where we have an opportunity to go further. There are people in the Arctic who are highly dependent on the marine environment for their subsistence—the Inuit, in particular. There needs to be an extra level of protection there.

Awareness is increasing, but prevention and monitoring need to grow with it. The Arctic is still a place where we have a chance to do better. ●

The High Seas treaty

FROM LEGAL BREAKTHROUGH TO OCEAN ACTION

Arctic Ocean currents, species and ecosystems are endlessly connected, and the Biodiversity Beyond National Jurisdiction (BBNJ) Agreement—commonly known as the High Seas treaty—marks the first global effort to manage the high seas with that connectivity in mind. As **ALISTAIR GRAHAM** explains, the agreement introduces enhanced cooperation with and among previously isolated sectoral management and conservation bodies—such as those responsible for fisheries, shipping and seabed activities. It also provides for the establishment of marine protected areas (MPAs) and operationalizes commitments to environmental impact assessments (EIAs) as set out in the United Nations Convention on the Law of the Sea.

AFTER NEARLY TWO decades of development work, the United Nations adopted the High Seas treaty in 2023. More formally known as the Agreement on the Conservation and Sustainable Use of Marine Biological Diversity of Areas beyond National Jurisdiction, the treaty encompasses the high seas beyond coastal state exclusive economic zones and the seabed area administered by the International Seabed Authority.

As with all new treaties, realizing this one's potential will require nongovernmental organizations, scientists and advocates—including WWF—to persuade states and their governments to change how they do business, not only in terms of how they cooperate with each other internationally, but how government agencies cooperate internally. It will also require interested parties to adjust their advocacy strategies. Moving from the current situation of isolated sectoral management to holistic, integrated, ecosystem-based management will require sustained commitment and much patience from everyone with an interest.

The provisions of the treaty are a package deal between the global South of developing countries and the global North of developed countries. In return for their support, developing countries gain access to a system for sharing the benefits of marine genetic resources (biological materials with potential ➤

ALISTAIR GRAHAM is a lifelong conservationist with four decades of experience in international treaty development. For the last 20 years, he has worked with WWF–International on the development of the BBNJ Agreement.

commercial or scientific value) along with stronger commitments to capacity building and technology transfer. As a result, it is important to ensure that ambitions related to MPAs and EIAs are pursued in a way that strengthens such development assistance.

FROM COMMITMENT TO COOPERATION

Part 1 of the BBNJ Agreement establishes a cooperation framework that strikes a prudent balance between not undermining existing sectoral management arrangements and strengthening and enhancing cooperation with them.

This means collaborating not only with and among formal sectoral management bodies—such as the International Seabed Authority, International Maritime Organization, and regional fisheries management organizations—but also with and among a wide range of other instruments and bodies with expertise in marine conservation and sustainability. These include the Convention on Biological Diversity, the Convention on International Trade in Endangered Species of Wild Fauna and Flora, the International Whaling Commission, and the Convention on the Conservation of Migratory Species of Wild Animals (and its related agreements), among many others. In fact, a new term has been coined to describe all these arrangements collectively: legal instruments, frameworks and bodies, or IFBs.

The great challenge and opportunity for WWF and other interested parties involves a fundamental shift in advocacy strategy. Rather than approaching sectoral management bodies as outsiders hoping to influence decisions, we can now work with governments' conservation lead agencies to engage IFBs that have conservation expertise—and get those IFBs to seek cooperation from their sectoral counterparts in ways that advance shared conservation objectives. WWF's global network of national and regional offices positions us particularly well to work with government agencies to deliver cooperative outcomes.

But the biggest news resulting from the adoption of the BBNJ is that we now have a legal framework for the adoption of ecologically representative, well-connected networks of cross-sectoral MPAs for conservation purposes—networks that, by design, can span both national waters and areas beyond national jurisdiction, consistent with guidance from the International Union for Conservation of Nature. The ancient "freedom of the high seas" is now recast: instead of the oceans belonging to no one, they can now be seen as belonging to everyone. And the capacity to establish MPAs establishes biodiversity conservation as a legitimate use of ocean space

The ancient "freedom of the high seas" is now recast: instead of the oceans belonging to no one, they can now be seen as belonging to everyone.

alongside traditional uses like shipping, mining or fishing.

The BBNJ Agreement also operationalizes the provisions in the United Nations Convention on the Law of the Sea that require EIAs for all planned activities as part of the broader commitment to protect and preserve the marine environment. This creates a valuable new opportunity: WWF and other organizations can now call on regional fisheries management organizations to ensure that joint EIAs are conducted for all participants in the fisheries under their management authority, with explicit attention to cumulative impacts. Similarly, we hope to persuade the International Maritime Organization to develop a safe shipping corridors approach—one in which joint EIAs for all ships using a given route would establish shared responsibility arrangements to reduce risks to wildlife.

FROM GLOBAL FRAMEWORK TO REGIONAL ACTION

But these new opportunities will not achieve themselves. Interested parties and government agencies with an interest in the world's oceans will need to get together at appropriate scales to explore what is possible. WWF has been arguing that we should take a "regional implementation of global standards" approach, where cooperating at the scale of the regional ocean basin offers the best balance between ecological and diplomatic realities.

The Arctic represents one of the most compelling early opportunities for BBNJ implementation. The existing Arctic Council is well positioned to lead the way by convening the broad range of interested parties that effective implementation demands. Through that process, the council can foster the establishment of MPA networks, explore whether any reform to existing institutional arrangements is warranted to deliver enhanced cooperation, and ensure that EIAs are conducted for all planned activities in the region.

The ocean doesn't stop at national borders—and now, finally, neither does our commitment to protecting it.

The ocean doesn't stop at national borders—and now, finally, neither does our commitment to protecting it. ●

Small-scale fishers are seen near Buru Island, Maluku, Indonesia. Fishing activity in this area illustrates the global scope of the High Seas treaty, which aims to strengthen cooperation across interconnected ocean ecosystems.

Photo credit: © WWF-US/Sirachai Arunrugstichai

A bird's eye view

WHAT OUR PLANET'S GREATEST TRAVELLERS CAN TELL US ABOUT ARCTIC CONNECTIVITY

The Arctic tern breeds at the top of the world and winters at the bottom of it—a round trip of up to 70,000 kilometres every year. Its extraordinary journey, like so many Arctic animal migrations, perfectly embodies the far-reaching connections that tie the Arctic region to every corner of the planet. As **COURTNEY PRICE** and **REAGAN AYLMER** explain, understanding and protecting those connection pathways, both on land and sea, is at the heart of CAFF's work on connectivity.

STAND ON a rocky Arctic coastline under the midnight sun and you will hear the terns before you see them, a sharp cackling from birds that weigh barely 100 grams.

These tiny, social birds make fiercely protective parents, known to dive-bomb anything—from fox to eagle to human—that comes too close to their nests. They are noisy, resourceful and improbably small for what they are about to do: when the season ends and the polar light fades, these birds leave their breeding grounds across the circumpolar Arctic

Understanding where the connections are strongest is the first step to keeping them intact.

and chase the sun southwards via the Atlantic, past the coast of West Africa, and down into the Southern Ocean that surrounds Antarctica.

Then, after a few months of hunting and fishing under the Antarctic sun, they turn around and journey all the way back to the Arctic. A single tern will travel the equivalent of three round trips to the moon over its 30-year lifespan.

ERRATIC POPULATION CHANGES

About 200 bird species breed in the Arctic each summer, and almost all are migratory. Their routes span every continent and ocean, connecting the Arctic biologically, ecologically and even socially to the rest of the planet. As the Arctic Migratory Birds Initiative Flyways show, these birds are forever ➤

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An adult Arctic tern feeds its young, Iceland.

A strong breeding season in the Russian tundra counts for little if the stopover a bird depends on weeks later has been paved over.

on the move, travelling down migratory corridors (called flyways) and connecting us all.

But their journeys are becoming more challenging. International monitoring data tell a story of stark and uneven population declines. CAFF's Arctic Species Trend Index, which tracks population trends across more than 300 Arctic species, and the 2021 State of the Arctic Terrestrial Biodiversity Report, which assessed 88 tundra-breeding bird species, reveal the same troubling picture: some populations are stable or recovering while others are in freefall.

For shorebirds—the sandpipers and knots whose calls define an Arctic summer—the losses have been severe. More than half of all these wader species are declining, with populations along the East Asian-Australasian Flyway down by as much as 70 per cent. Some species have lost up to 90 per cent of their numbers over the last few decades.

But the Arctic is only part of the story. The rest and refuelling stopovers that birds depend on mid-migration, like intertidal mudflats and coastal estuaries, are disappearing as development increases. Illegal hunting takes a further toll that is, by its nature, difficult to account for. Climate change is scrambling the seasonal cues that birds and their prey have relied upon for millennia: snowmelt and shifting time frames for insect emergence make it harder for parents to feed and raise their chicks.

For example, a strong breeding season in the Russian tundra counts for little if the stopover a bird depends on weeks later has been paved over. In other words, what happens at one end of a migration route is inseparable from what happens at the other. Any conservation approach must be built around these connections.

CONNECTING DECISION-MAKERS

This is precisely the logic behind CAFF's Arctic Migratory Birds Initiative, better known as AMBI. Launched to address declines that no single country could tackle alone, AMBI connects governments, scientists and communities across major flyways: the Americas Flyway, the African-Eurasian, Central and East Asian-Australasian flyways, and the circumpolar flyways. By bringing together diverse entities, it ensures the right people are at the table to make decisions that can make or break a migration route.

AMBI's approach delivers results. In 2019, flyway nations along the East Asian-Australasian corridor acted on a recommendation from the initiative to establish a dedicated task force on illegal hunting and trade under the East Asian-Australasian Flyway Partnership. In addition, many non-Arctic states have taken targeted steps to conserve Arctic-breeding migratory bird species, providing species-specific plans and

The tidal flats of the West Coast National Park in South Africa are a wintering site for long-distance migratory Arctic birds like curlew sandpipers, little stints and ringed plovers.

Photo credit: Peter Prokosch, www.grida.no/resources/3733

greater legislative protection while identifying and securing essential habitats.

For instance, China, the Republic of Korea, and Guinea-Bissau have inscribed sites that Arctic-breeding migratory birds depend on as UNESCO World Heritage Sites. Such milestones show what countries can achieve when they share data, build trust and work toward a common goal across borders.

APPLYING THE SAME IDEAS TO MARINE LIFE

The same principle holds true beneath the waves. CAFF's State of the Arctic Marine Biodiversity Report showcases how beluga whales, bowhead whales and ringed seals undertake migration routes that span multiple national jurisdictions. Protecting them requires exactly the kind of cross-border coordination that AMBI has pioneered for birds.

In Hudson Bay, belugas are already showing us what happens when the ecological script starts to shift: their migration timing has moved in response to warming waters. Sea ice retreat doesn't only mean less ice. Its disappearance also unravels a delicate system that places food sources in the right place at the right time, builds routes that have been consistent across centuries, and affects Arctic wildlife whose survival depends on the existence of these unique connections.

CAFF and Protection of the Arctic Marine Environment (PAME) are now developing a marine spatial planning tool that will identify and prioritize the areas that sea ice-dependent species rely on most and put that knowledge directly into the hands of those who decide what gets protected. Understanding where the connections are strongest is the first step to keeping them intact.

As summer draws to a close, an Arctic tern flies from its nest on a rocky shoreline and turns south, beginning a journey that will take it through the jurisdictions of dozens of nations, across habitats that are variously protected and unprotected, monitored and overlooked. Migration is the Arctic's oldest and most insistent argument for global cooperation. In that context, CAFF's work to understand and advance connectivity remains essential. ●

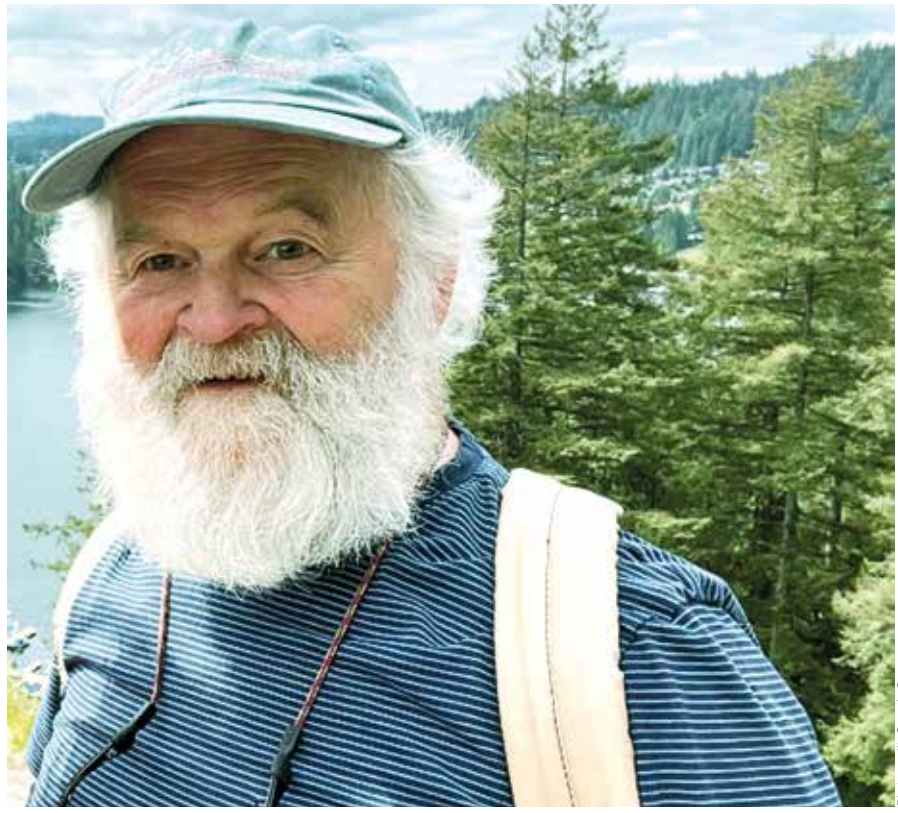

Photo credit: Georgia Sauve

Don Russell dedicated his career to caribou research.

A scientist's legacy

WHAT THE CARIBOU TAUGHT DON RUSSELL

Don Russell, who dedicated his career to caribou research and contributed articles to *The Circle*, passed away earlier this year. His colleague, **ANNE GUNN**, reflects on his achievements and the legacy he leaves behind for caribou and the people who depend on them.

You are what you eat.

Perhaps that's not an immediately obvious summary of Don Russell's contributions to caribou conservation, but it's an apt one, nonetheless. Don understood that what a female caribou ate predicted her protein and fat reserves—essential for her calf's survival and her chance of conceiving another calf. Don used that understanding to develop a computer model that could predict how the presence of a road, mine or oilfield would affect caribou behaviour, even (or especially) in a warming climate.

For example, Don's modelling showed ➤

ANNE GUNN is a Canadian caribou biologist who worked closely with Don Russell for 30 years.

that the development of an oilfield on the Porcupine herd's calving and summer ranges in Alaska and the Yukon could result in a population decline of 3 to 19 per cent, depending on the leasing scenario. Projections of the cumulative impacts of industrial developments and climate change on trends in herd size constitute vital information for people who share the caribou ranges—for those who, in essence, depend on the caribou's future.

READING THE LAND, BUILDING THE MODEL

Don's profound insights into the link between a female caribou's diet and her success at raising a calf evolved during his first foray into Arctic fieldwork on the coast of Alaska in the early 1970s, when he worked with his mentor, Robert "Bob" White, on caribou forage intake. He went on to study forage intake relative to digestion for his master's thesis, gaining considerable expertise in computer modelling in the process. His modelling work grew increasingly sophisticated and realistic as he added variables—in particular, how an individual caribou allocates energy and protein to its growth and

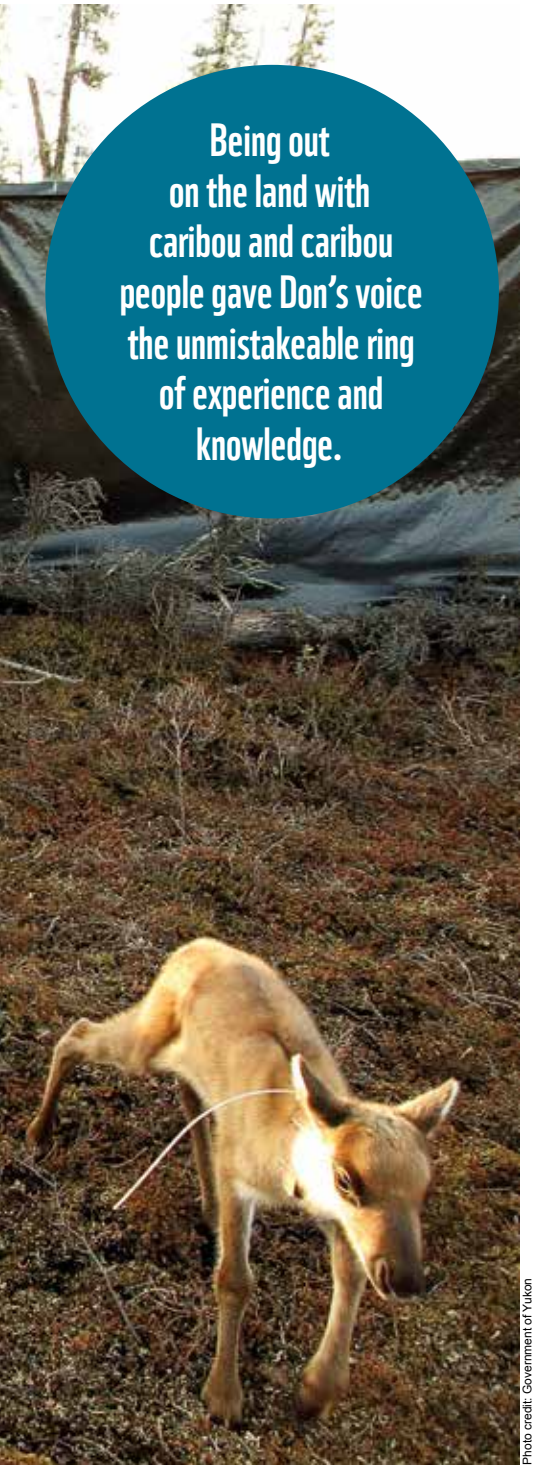

Photo credit: Government of Yukon

Being out on the land with caribou and caribou people gave Don's voice the unmistakeable ring of experience and knowledge.

Photo credit: Government of Yukon

Both photos: Don Russell at the Chisana caribou captive rearing camp, summer 2005. Pictured with Sharon Russell at left.

how that relates to its calf's growth and survival.

To achieve this level of realism, Don collaborated with other biologists, often Bob White. But they weren't just sitting at their desks looking at computer screens. Underpinning the modelling work were long days and weeks spent observing caribou and recording their daily habits and activities in minute detail: How many times did caribou paw through the snow to reach forage? How many minutes did they run to avoid clouds of mosquitoes? All of this information was relevant.

Don began his career as the habitat biologist for the Government of Yukon Game Branch (a Yukon conservation agency) in 1976. Later, he was the caribou biologist and eventually the manager for the Canadian Wildlife Service in Yukon. During those years, Don was a member of both the Porcupine Caribou Management Board and the Wildlife Management Advisory Council (North Slope) and co-chair of the International Porcupine Caribou Board. His many years of fieldwork—being out on the land with caribou and caribou people—gave his voice the unmistakable ring of experience and knowledge and made him an invaluable participant among co-management decision-makers.

THE MEASURE OF THE MAN

As a person, Don was empathetic and kind. As a scientist, he was both curious and formidable, keenly attuned to caribou behaviour and evolutionary fitness, and passionate about the herds' survival. As a field biologist, he was patient and keenly observant.

Don's open and collaborative nature brought him into contact with research that illustrated how caribou herds differed across the Arctic. As a result, it was a natural step for him to take the lead in building a network—CircumArctic Rangifer Monitoring and Assessment (CARMA)—to document the impacts of climate change, industrial development and social change on caribou and wild reindeer herds in Greenland, Russia, Alaska and northern Canada.

Don's death is a blow to caribou conservation, but his legacy is immense and ongoing. His insights into caribou adaptability yielded indispensable guidance on how to monitor and mitigate the many threats to both caribou and caribou people. And he left us with a powerful exemplar of the value and necessity of working together—one that the CARMA network continues to embody. ●

THE BACK PAGE

Credit: David Parker/Science Photo Library

Generations of connection

This 19th century European illustration depicts an Inuit hunter paddling a kayak during a hunt—an enduring example of the deep connections between Arctic peoples, marine species and ocean ecosystems. The Inughuit of northwestern Greenland continue to practise a traditional way of life, using kayaks and harpoons to hunt narwhal. Narwhals have long been harvested by Inuit in northern Canada and Greenland, and a regulated subsistence hunt continues today.