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WORKING TOGETHER FOR THE ARCTIC

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COLLABORATION
WORKING TOGETHER FOR THE ARCTIC

COVER: Ice fishing for Arctic char, Canada.
Photo: © Staffan Widstrand / WWF

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We must cooperate across borders to solve shared problems

IT'S LATE AUGUST, and I am writing this column on the train as I travel back to Stockholm from a visit to Kiruna, a Swedish town some 200 kilometres north of the Arctic Circle. I have many fantastic impressions, such as seeing Arctic foxes and reindeer, visiting the Tavvavuoma wetland and Lake Råstojaure, and attending in-depth discussions with our Saami hosts about reindeer herding and Saami history.

Among all these experiences, one is especially worth noting: the temperature has ranged from 22°C to 25°C during my visit—unusually warm. Our host in the Saami village of Lainivuoma mentioned that he has almost never experienced tropical nights—with temperatures higher than 20°C—before. Yet there had been several such nights this summer. The old worn-out saying is correct: the Arctic is hot.

In fact, it is so hot politically that the media tend to get it wrong. Earlier in August, the biggest Swedish daily, *Dagens Nyheter,* ran a story titled "The new Arctic—the quiet conflict few talk about." The Arctic is an irresistible topic for a journalist looking to write a dramatic story. The rapidly changing area has many challenges—that much is true. But they are no longer new, and the obvious question is whether they should be seen through the lens of great power conflict or through the lens of those who live in and depend on the Arctic. I would say we have to see it through the latter. Cooperation and pragmatic handling of issues are the keys to responsible Arctic management, today and in the future.

For example, the Arctic foxes we saw would probably not exist today if not for the collaborative conservation work done by WWF and Norwegian and Swedish authorities. Fifty years ago, there were only 30 or so of these foxes left in Sweden, but now there are around 400. A key aspect of this work has been the Norwegian-Swedish cross-border joint management plan. The habitat of the Arctic fox spans both countries, and the foxes run back and forth over the border. This is only one example of success in international species protection. There are many others, including plans supporting polar bears and narwhal.

The list of Arctic challenges that will require cooperation to address is long. The region's unique nature and climate present similar challenges for most Arctic countries and offer the opportunity for all countries to learn from each other. I had the privilege of being at the centre of such cooperation in my previous career as a diplomat, when I was chair of the Senior Arctic Officials of the Arctic Council from 2011 to 2013. This was a time when the spirit of cooperation was at a high. Today, the Council's work has been put on pause, not due to developments in the Arctic but to events outside the region, such as the war in Ukraine. The announcement in June that some of the Council's activities would soon resume was welcome.

When much-needed cooperation seems fragile and at risk, it is worth remembering the words of the Arctic states and Permanent Participants as stated in their 2013 vision for the Arctic: *We are confident that there is no problem that we cannot solve together through our cooperative relationships on the basis of existing international law and good will.*

GUSTAF LIND is WWF-Sweden's Secretary General. He has spent much of his career addressing Arctic issues, both as a Swedish diplomat and as the Arctic ambassador and chair of the Arctic Council's Committee of Senior Officials.

There are more Arctic foxes in Sweden these days thanks to joint conservation efforts.

The list of Arctic challenges that will require cooperation to address is long. The region's unique nature and climate present similar challenges for most Arctic countries and offer the opportunity for all countries to learn from each other.

Photo: © Seppo Kerätnen / WWF

RUSSIA WILDFIRE WATCH

Fire, destruction and toxic smog

IT HAS BEEN another difficult year for wildfires in Russia. The country's Aerial Forest Protection Services published statistics in early August indicating that wildfires had burned at least 3.2 million hectares of forest in the country's Siberian and Far East regions since the start of 2022.

Nearly half of the blazes were in the Khabarovsk region in the far east, though the west Siberian Khanty-Mansiisk autonomous district, across the country, was also severely affected. So far, the two regions have seen 2.14 per cent and 1 per cent of their territories burn, respectively. Fires blazing through villages in the Krasnoyark region in the east also killed at least eight people. A state of emergency was declared over the entire territory of Sakha, which has also been affected by toxic smog from the fires, including in residential areas.

Russia's peak fire season typically begins in late May and lasts about 17 weeks. Last year, record-breaking wildfires in northeastern Russia consumed some 18.8 million hectares of forest. According to Global Forest Watch, fires were responsible for 69% of tree cover loss in Russia between 2001 and 2021. These wildfires are releasing millions of metric tons of carbon dioxide, contributing to the climate crisis.

BUILT BACK BETTER

Arctic research station reopens in Canada

THE CANADIAN High Arctic Research Station, which had been open for only six months before the COVID-19 pandemic forced its closure, has reopened—and operators say the pause gave them an opportunity to make it even better.

Located in Cambridge Bay, Nunavut, the $250 million, state-of-the-art station was built to boost innovation in Arctic science and technology, welcome visitors and offer researchers accommodation and technical services. It supports research needs that range from ecosystem monitoring to DNA analysis. It opened in August 2019, then closed again early in 2020.

The unexpected closure ended up allowing staff to prepare for an influx of researchers returning to the Arctic and looking for connectivity. The station now offers a powerful public Wi-Fi network, a 3D printer and a mobile robot that can connect with people beyond Cambridge Bay, such as to get information about repairs or provide communications services.

During the long pause, researchers worked with the community of Cambridge Bay to help collect data while staff continued to fine-tune the new facility.

EVALUATING APPROACHES TO SCIENTIFIC DISCOVERY

Remote collaboration supports breakthroughs

WHILE MANY ASSUME that face-to-face interaction is critical for generating new ideas, a recently published study out of the University of Oxford suggests that the rise of remote collaboration over the past few decades actually increased scientific discovery.

Researchers explored the link between the rise of remote collaboration and the increasingly incremental nature of scientific discovery—with, for context, the generally accepted idea that new ideas are becoming harder to find. They investigated how, against this backdrop, the rise of remote collaboration shaped the trajectory of science between 1961 and 2020.

They found that the negative effects of remote collaboration grew more muted over time, suggesting that the benefits of scientists being physically located in the same place declined as communications technology improved. Beginning in the 2010s, with the advent of video conferencing technologies, the negative impact tapers off and even becomes positive.

The authors caution that this doesn't necessarily mean face-to-face interactions no longer matter. Digital meetings require planning, so spontaneous encounters are still important to scientific discovery. On balance, they found that local (in-person) and digital knowledge networks work best as complements to one another rather than substitutes.

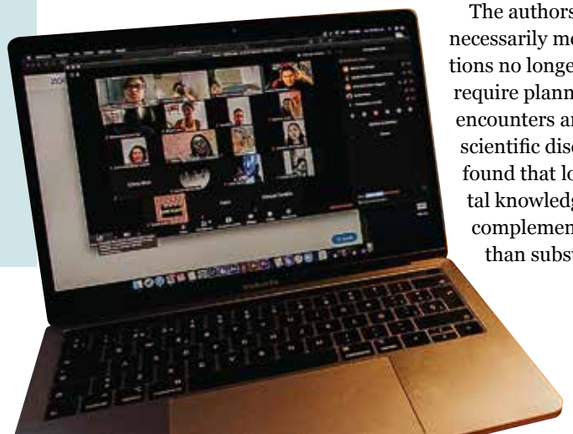
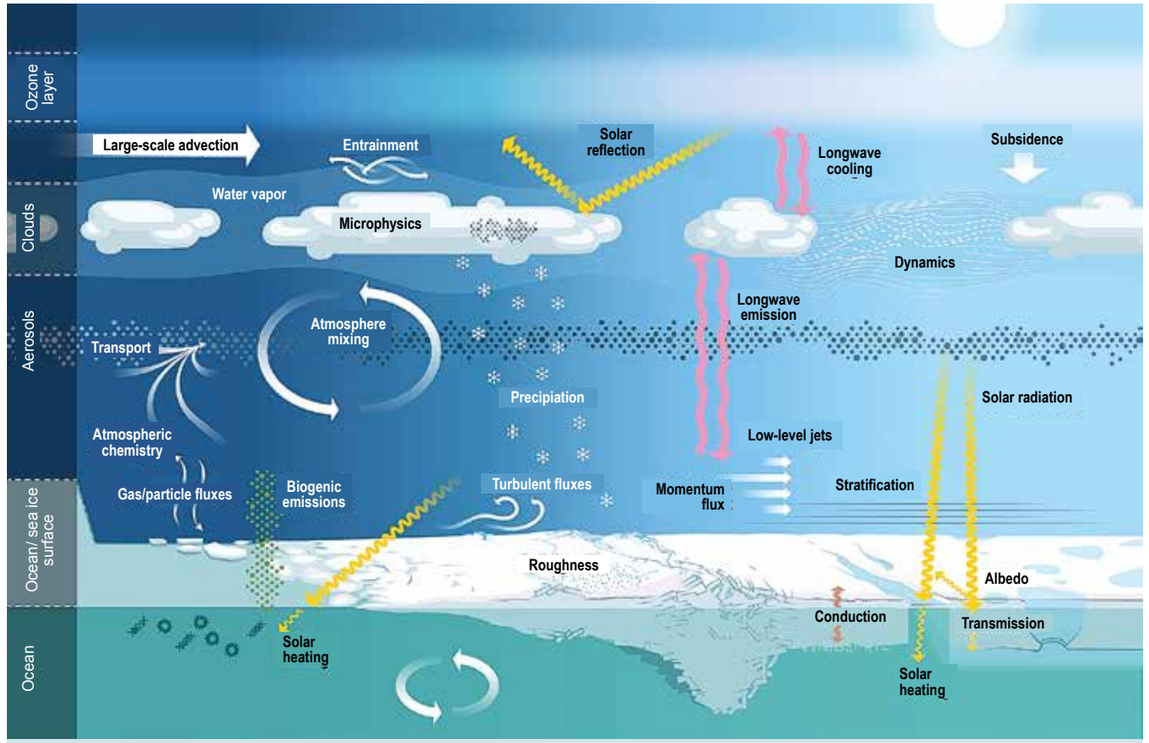


Photo: Gabriel Benois on Unsplash



Atmospheric processes over the central Arctic Ocean. This illustration shows the primary zones and processes examined by the atmosphere team during the year-long MOSAiC expedition that began in September 2019.

From Shupe et al. Overview of the MOSAiC expedition: Atmosphere. *Elementa: Science of the Anthropocene* (2022) 10 (1): 00060. Reproduced with permission.

MOSAIC STUDY

Warm air mass found to carry "extreme" pollution from Eurasia to the Arctic

A RECENTLY PUBLISHED STUDY is sounding alarm bells about a highly polluted warm air mass observed in the Arctic from 2019 to 2020. It found that the pollution concentration was significant enough to be concerning.

The Multidisciplinary drifting Observatory for the Study of Arctic Climate (MOSAiC) expedition was the largest-ever exploration of climate processes in the Central Arctic region. It aimed to gain a better understanding of the drivers of Arctic-accelerated climate change and how it is affecting the region.

The expedition saw an international team of scientists spend a year drifting in Arctic ice aboard the *RV Polarstern*. The collected data showed that a mass of warm air carrying pollutants from northern Eurasia had made its way into the high latitudes. The study is the first to reveal the chemical and microphysical properties of particulate matter swept into the Central Arctic by a warm intrusion.

Although it isn't rare for warm air masses to reach the Arctic, the researchers were startled by the pollution concentration, which they said essentially "transformed the Arctic from a remote low-particle environment to an area comparable to a central-European urban setting."

Photo: Dezmond Sayazie

BQCMB board of directors, May 2022. Left to right: Mathew Tokaruk, Government of Saskatchewan; Mitch Campbell, Government of Nunavut; Leslie Wakelyn, BQCMB biologist; Dennis Larocque, Camsell Portage, Saskatchewan; Harry Aggark, Kivalliq Wildlife Board; Napoleon Denechezhe, Northlands Denesuline First Nation; Jimmy Laban, Black Lake Denesuline First Nation; Vicki Trim, Government of Manitoba; Archie Gahdele, Lutsel K'e Dene First Nation; Joannie Kennah, Government of Manitoba; Stanley Adjuk, Kivalliq Wildlife Board; Jan Adamczewski, Government of Northwest Territories; Earl Evans, Northwest Territories Métis Nation; Lynne Bereza, BQCMB; Tina Giroux-Robillard, BQCMB; Ernie Bussidor, Sayisi Dene First Nation.
Front row: Elder Joe Marten, Fond du Lac Denesuline First Nation.
Missing: Simon Enuapik, Kivalliq Wildlife Board.

It takes a village

PROTECTING BARREN-GROUND CARIBOU IN CANADA

Conserving barren-ground caribou populations for the benefit of the northern communities that have relied on them for millennia is not the work of a single organization. As **TINA GIROUX-ROBILLARD** writes, it will take the coordinated efforts of many organizations working toward a shared goal to ensure there are caribou not only for today, but for the future.

IN THE PAST, many of the Indigenous People of northern Manitoba, northern Saskatchewan, the Northwest Territories and Nunavut depended on the Beverly and Qamanirjuaq caribou for food, clothing and shelter. Their days and lives revolved around the caribou because they followed these migratory animals during hunting seasons. When the animals were scarce, starvation—sometimes even death—could ensue.

Modern lifestyles have reduced these regions' dependence on caribou, but not the significance of the animal to Indigenous Peoples' cultures and lifestyles. Because of the high cost of transporting food and other goods into northern Canada, caribou meat continues to be an important food source. As well, encouraging youth to hunt responsibly ties them to the traditions of their past, strengthening and enriching life in Indigenous communities.

A BRIEF HISTORY OF CARIBOU THREATS—AND MANAGEMENT

In the late 1970s, declining population estimates created fear that the caribou herds were becoming endangered. There were also concerns that encroaching industrial development and the large numbers of people moving north could harm the caribou's environments. Canadian federal, provincial and territorial governments and scientists turned to caribou hunters to work together as a team to "co-manage" the herds. The recognition that western and Indigenous knowledge are equally essential gave rise to the Beverly and Qamanirjuaq Caribou Management Board (BQCMB) in 1982.

The BQCMB was the first co-management board of its kind in North America, and since those first tentative days, trust has been built and mutual respect created. The common goal—to slow the decline of the herds—has never changed. As the board's executive director, I'm still helping the board to work towards it.

Nonetheless, the decline continues. And the BQCMB, now in its 40th year, is working with the Government of Canada and the territorial and provincial governments of Nunavut, Northwest Territories, Manitoba and Saskatchewan to develop its fifth 10-year management agreement to secure operational funding to continue its work through 2032. At the same time, we are consulting with the Inuit, Métis and Dene people, who rely on these animals, to gather information and develop a plan for managing the herds over the next decade.

It is a daunting task, given that the BQCMB's basic administrative functions (holding two board meetings a year, conducting research, producing a bi-annual newsletter, and submitting an annual report) easily use up the core funding that the organization receives each year.

Thankfully, there are a number of agencies and organizations—including WWF-Canada—that support our goals and objectives beyond these core functions. It is this "extra" support that enables BQCMB members to travel to northern communities and hear directly from individuals who are eager to preserve a traditional way of life that includes caribou. Indigenous knowledge is needed to understand the herds' behaviour, is key to developing an effective management plan, and must be gathered more often than just twice a year, when the board meets.

Caribou and calf.

Photo: Thomas Sammurtok

Contributions from a variety of sources, both public and private, are critical to the board's existence and work. Thanks to our funding partners, over the years the BQCMB has developed targeted educational campaigns around respectful hunting and submitted written comments on issues like habitat protection, land use planning, harvesting, and mineral exploration and development projects. The board has participated in public hearings and environmental reviews, developed harvest reporting programmes, hosted workshops and held poster contests for caribou range schools.

And while it must be noted that the BQCMB is completely independent of its funding partners and relies solely on good science and community knowledge for its conclusions, it is also true that without their support and cooperation, the board's effectiveness would be severely diminished—with potentially dire consequences.

Because of the high cost of transporting food and other goods into northern Canada, caribou meat continues to be an important food source. As well, encouraging youth to hunt responsibly ties them to the traditions of their past.

WORKING TO BEAT THE ODDS

We know the caribou face many threats to their existence. Improper hunting practices, exploration and development, and roads are the most pressing concerns. Others are increased harvesting, wildfires, pollution, weather, disease, parasites, predators and climate change.

Because of these factors—many of which are related and connected to climate change—barren-ground caribou herds are declining all over the North, and recent information points to continued declines in both the Qamanirjuaq and Beverly herds. Without proper management, these herds could decline to the point of no return. This has already happened to the Bathurst herd, which dropped from 470,000 in the mid-80s to about 6,100 today.

A similar plunge among the Qamanirjuaq and Beverly herds would cause incredible hardship for the Indigenous People and communities that have relied on these animals since time immemorial.

And so, our work continues. With help from our valued supporters, we will continue gathering knowledge, monitoring the herds and moving toward our goal: to ensure the long-term conservation of these caribou herds for future generations of northern Canadians. ●

TINA GIROUX-ROBILLARD is the executive director of the Beverly and Qamanirjuaq Caribou Management Board. She is the first woman and first Indigenous person to hold this position since it was created in 1982.

Artistic persuasion

CAPTURING THE REALITY OF CLIMATE CHANGE ON FILM

The words “climate change” and “art” aren’t often used in the same sentence. But for the people behind the Arctic Arts Project, the two are closely connected. Started 12 years ago by US-based photographer Kerry Koepping, the project aims to bring the science of climate change alive and show the world what climate chaos looks like by visually documenting the changes happening in the Arctic. The project has grown from just a handful of artists to include almost 100 photographers, filmmakers, scientists and conservationists from around the world—all working together for a common goal.

ANDREA SPARROW is the project’s executive producer. She spoke to *The Circle* about why the project uses art to highlight the negative impact humans are having on the planet—and how those involved hope to change some minds about climate change in the process.

Andrea Sparrow is a US-based photographer and executive producer of the Arctic Arts Project.

This glacier below Mount Kitchener in Banff National Park, Canada is in dramatic retreat, like many others in the area.

Photo: Andrea Sparrow, Arctic Arts Project

We want our beautiful visuals to bring people in, not with fear, but in a way that lets us bridge political divides. This is simply a worldwide crisis that needs to be addressed.

Photo: Florian LeDoux, Arctic Arts Project

Photo: Florian LeDoux, Arctic Arts Project

These photos of a polar bear and an Arctic fox were taken in eastern Svalbard. Both species are struggling with the impacts of climate change.

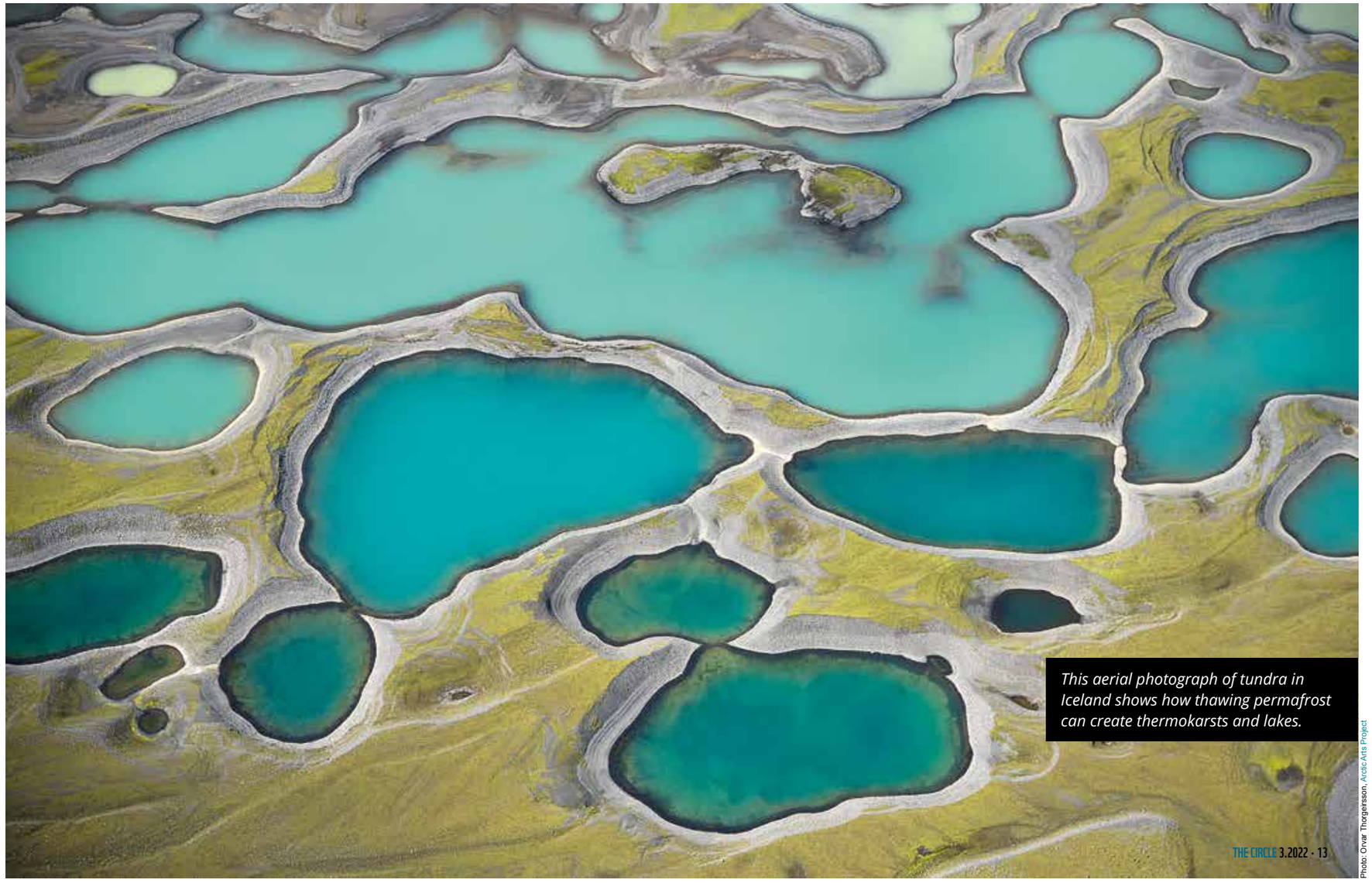
How would you describe the Arctic Arts Project?
I would say we visually communicate the science of our changing climate. Scientists are good at measuring and producing data, and that's critical for understanding how our planet is changing. But sometimes scientists have a hard time showing people what it means: what it looks like and how it manifests in the landscapes of the planet.

Yet it's really important to find a way to show people the Arctic. It's changing much more quickly than the rest of the planet—around three times faster—so it's easy for people to appreciate how dramatic the changes are there. And I think when people can see these changes, they have a different response than when they hear them described by scientists in a more clinical way.

Of course, the science is very important because it quantitatively measures change. We try to bring climate change to the public in a way they can understand—but that is also true to the science.

How did the project get started?
It basically began as a very loose affiliation of photographers who were travelling in the Arctic and seeing these drastic changes. Kerry [Koepping] lives in Boulder, Colorado, where the University of Colorado Boulder's Institute of Arctic and Alpine Research (INSTAAR) is located. Kerry had gone to Denali (the highest mountain peak in North America) and noticed that below the mountain, there was this patterning on the ground that was just so unusual. He came back and showed it to the scientists at INSTAAR, and they were like, "Oh, that's basically permafrost melt." Kerry realized then that you could document the changing climate by showing how it impacted the Arctic landscape. He started acquiring imagery from people to develop this visual story of climate change.

How do you bring that visual story of climate change to the public?
Our visual products are usually either videos or photographs for our website and for presentations. We do public presenta- ➤

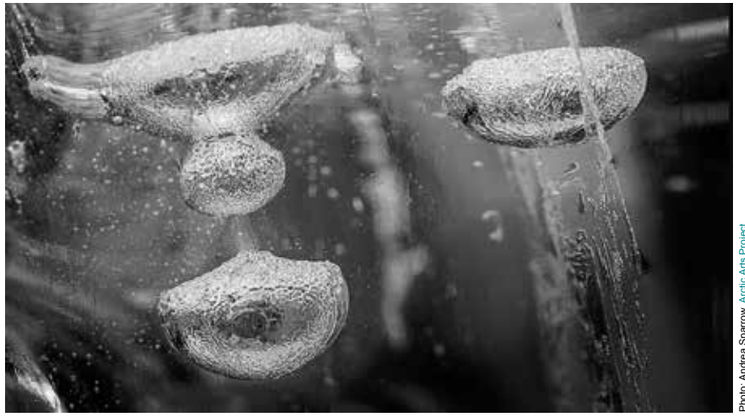


This aerial photograph of tundra in Iceland shows how thawing permafrost can create thermokarsts and lakes.

Photo: Orvar Thorgeirsson, Arctic Arts Project

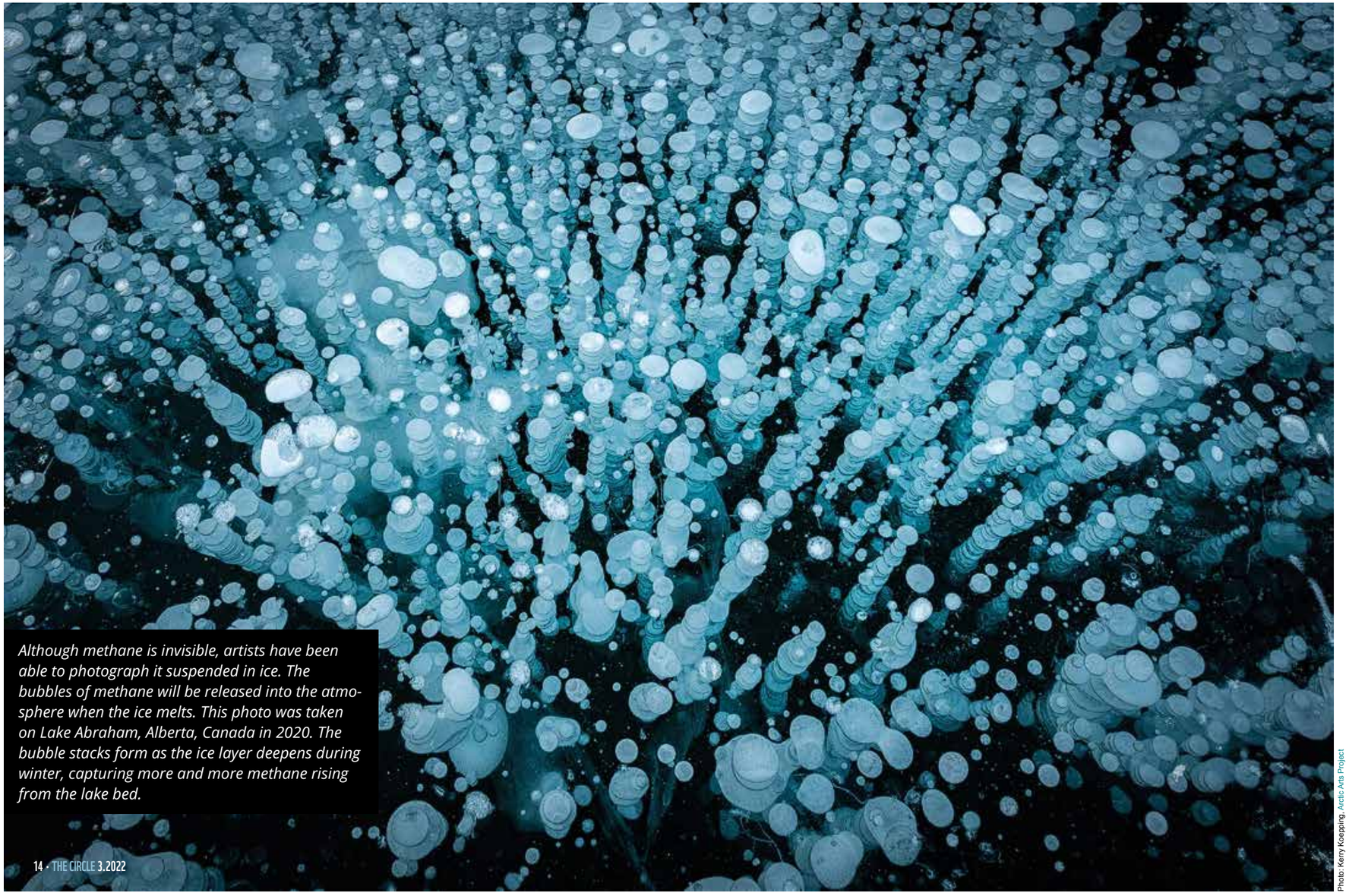
Tiny methane bubbles with autumn leaves and algae in Scoresbysund, Bear Island, eastern Greenland.

Photo: Andrea Sparrow, Arctic Arts Project



This photo of methane bubbles frozen in Lake Abraham, Alberta, Canada, shows the structure of the bubbles in ice.

Photo: Andrea Sparrow, Arctic Arts Project



Although methane is invisible, artists have been able to photograph it suspended in ice. The bubbles of methane will be released into the atmosphere when the ice melts. This photo was taken on Lake Abraham, Alberta, Canada in 2020. The bubble stacks form as the ice layer deepens during winter, capturing more and more methane rising from the lake bed.

Photo: Kerry Koepping, Arctic Arts Project

tions about what we're seeing and the science behind it. For example, all of our films are shown on a giant screen in the main area of INSTAAR, and some of INSTARR's scientists use them in their classrooms. We're trying to provide visual tools to the people who are working to make changes because most people can't relate to just the words of science—they need to see what the scientists are talking about to really grasp it. It brings it home in an entirely different way.

The title of your organization is the Arctic "Arts" Project. How is what you're doing art?

Well, it is an interesting line to walk, but everyone in the project is either a professional photographer or filmmaker and is contributing really high-quality visuals. That is important to us. Each image needs to be extremely compelling. It needs to be beautiful. It's not a snapshot, it's something that requires some vision and skill to capture. People are drawn to beauty, and if you can pull them in with compelling beauty and they realize what they're looking at—that's essentially the hook.

What are some examples of changes you've been able to capture in a beautiful, visual way?

Methane is a very interesting one. Methane is not something you can see in the environment or atmosphere, but it has a massive impact—greater than CO_2 by a long shot. We have gone into the Arctic—to Alaska, Greenland, Iceland and the high Alpine regions of Canada—and found ways to "see" methane. Normally, there's no way for people to visualize what is happening. But we've been able to show massive areas in Alaska, for example, where changes in the tundra are thawing permafrost and releasing methane. You can see it bubbling up in the water. Or you can capture methane in ice—methane bubbles are literally captured for a period of time until the ice melts and releases them into the atmosphere.

What difference do you hope you're making?

I don't know that it's necessarily measurable, but I will say that we have had many encounters with people who have seen our films or presentations or exhibitions and have said things to us like, "I had no idea that that's what that meant." They know things are warming, but what does that actually look like? What does glacial melt look like? What does change in the tundra look like? When they see it and they can read a layman's explanation of the science, they can understand it. We want our beautiful visuals to bring people in, not with fear, but in a way that lets us bridge political divides. This is simply a worldwide crisis that needs to be addressed. But we want to communicate with facts, not with hyperbole. When I hear people say, "You know, I didn't realize that, but now I get it," I know the work we're doing is valuable. ●

The high seas

CAN COOPERATION ON FISHING IN THE CENTRAL ARCTIC OCEAN THRIVE AS GEOPOLITICAL CONFLICTS PERSIST?

The concept of cooperation is embedded in most international treaties. In keeping with this principle, the duty to cooperate in the conservation and management of living resources in the high seas is at the heart of the Law of the Sea and was fundamental to the negotiation of the Agreement to Prevent Unregulated High Seas Fisheries in the Central Arctic Ocean. As **NADIA BOUFFARD** explains, the process used to reach and implement this agreement is a great example of successful international cooperation—but ongoing commitments will be needed to continue it.

THE COLLAPSE of high seas fish stocks—such as that of the pollock in the Aleutian Basin near Alaska—haunts fishers, communities and fisheries managers to this day. These collapses have usually followed intense fishing activity that took place before scientists could fully understand the risks or managers could impose regulations.

Recognizing the need for caution and conservation in the face of changing ice conditions in the Arctic—not to mention the risk that fishing fleets will eventually reach the area and cause history to be repeated—the five Arctic coastal states negotiated the legally binding Agreement to Prevent Unregulated High Seas Fisheries in the Central Arctic Ocean (known as the CAO Fisheries Agreement).

COOPERATION AND CONSENSUS

Canada, Denmark (Faroe Islands and Greenland), China, Iceland, Japan, Norway, Korea, Russia, the US and the European Union signed the landmark agreement in 2018. From the start of negotiations to the agreement's entry into force following ratification by all signatories, the process is a testament to what can happen when countries are dedicated to working together for a common goal.

The agreement is meant to prevent unregulated fishing in the high seas area of the Central Arctic Ocean—an area roughly 2.8 million square kilometres in size—by establishing an interim prohibition on commercial fishing. This prohibition will remain until scientists can determine whether commercially viable fish stocks are present in the area and can be fished sustainably. In that event, the agreement also provides the basis for an orderly transition to a regulated fisheries management regime that would be negotiated by the parties.

Substantive decisions like this require the consensus of all parties.

KNOWLEDGE-BASED DECISION-MAKING

An important focus of the agreement is the need to acquire data and knowledge to support fisheries management decisions. With a view to improving our understanding of the area's marine ecosystems, the parties are required to establish a Joint Program of Scientific Research and Monitoring by June 2023. An innovative aspect of the agreement is the obligation to consider Indigenous and local knowledge in the development of the programme and to factor this knowledge into decision-making. The Inuit Circumpolar Council participated throughout the negotiation process and remains involved.

The agreement underscores the need for cooperation—not only among the countries involved, but with others, particularly Arctic Indigenous Peoples—to gather knowledge of the area and its resources, to better understand what impacts a fishery may have on fish stocks, other living resources and the ecosystem, and to establish regulatory measures before commercial fishing is authorized.

More research is needed to understand how unregulated fishing could threaten the fragile Arctic ecosystem.

Photo: © Elisabeth Kruger / WWF-US

IMPLEMENTATION AND ONGOING DIALOGUE

The countries that signed the agreement (nine countries plus the European Union) have been working together since 2019 to develop the tools needed to implement it. Fortunately, so far, the ongoing geopolitical conflicts have not prevented this work from moving forward. The inaugural meeting of the parties is scheduled to take place in November 2022 in Korea. A key objective will be to advance the work in order to meet the agreement's timelines.

The CAO Fisheries Agreement breaks new ground by preventing unregulated fishing before it occurs. In doing so, it is the first of its kind. More groundwork is still needed to better understand how such fishing may threaten the fragile Arctic ecosystem and to provide for processes that support cooperation among the parties and others involved.

The agreement imposes a heavy burden to achieve consensus on substantive decisions—a feat that may prove challenging moving forward, particularly in the current geopolitical context. Continued dialogue and cooperation among the parties and with local Indigenous Peoples will be critical. ●

TIMELINE OF THE CAO FISHERIES AGREEMENT

NADIA BOUFFARD chairs international fisheries and oceans bodies, including the Conference of the Parties to the Agreement to Prevent Unregulated High Seas Fisheries in the Central Arctic Ocean.

Photo essay: Birds without boundaries

WORKING TOGETHER TO PROTECT MIGRATION ROUTES, BREEDING SITES AND OVERWINTERING AREAS

EVERY YEAR, millions of migratory birds visit the Arctic. Sadly, many of the wader species, such as the bar-tailed godwit or red-necked phalarope, are declining due to threats they encounter along their migration routes and overwintering areas. In the long term, the effects of climate change will destroy some important breeding sites in the Arctic. A multi-dimensional Tavvavuoma project in northern Arctic Sweden aims to safeguard the birds and palsa mires in the Arctic and to strengthen, protect and restore the birds' resting and overwintering areas further south. The project—a collaboration between WWF, Birdlife Sweden, scientific researchers, Saami reindeer herders, local entrepreneurs and Swedish authorities—is part of the Arctic Migratory Birds Initiative, which is run by Conservation of Arctic Flora and Fauna, the biodiversity working group of the Arctic Council. (A related project is studying how climate change will affect birds and reindeer herding in Tavvavuoma.)

Tavvavuoma is a breath-taking landscape with mires that stretch all the way to the horizon. The number of bird species and individuals in some of the area's palsa mires is astonishingly high.

Tom Arnbom, a project leader with WWF–Sweden, is convinced that it's impossible to visit the area without wanting to return. "There is always something new to experience," he says.

One of the project's long-term goals is to create a new national park in Sweden to protect this landscape. The aim is to introduce a new management scheme that will include traditional Saami knowledge and permit regulated recreational fishing and hunting to create local jobs.

Photo: Niclas Ahlberg/N

Male ruffs have arenas where they fight each other to be chosen by females. The arenas are often located on the tops of palsas so that these spectacular birds can keep an eye on potential predators while they show off. The Tavvavuoma project is using transmitters to find out where the ruff overwinters.

Photo: Niclas Ahlberg/N

The exuberant song of bluethroats can be heard everywhere in Tavvavuoma. These birds migrate to the Arctic to breed during the summer months. In fall, they leave Sweden and head toward southern Asia. Every year, they fly almost 15,000 km while migrating.

A palsa is a hill created by sphagnum moss (peat) that has been pushed up by permafrost. Inside the hill, there is a core of ice. Palsas are habitats for numerous bird and insect species. Those in the Tavvavuoma area can reach a height of seven metres—a great vantage point for many birds. Palsa mires are threatened by climate change.

Photo: Tom Arnbom

Photo: Håkan Steen

The Tavvavuoma project is a collaboration between WWF–Sweden and Birdlife Sweden. Led by Tom Arnbom of WWF–Sweden, it is a strategic partnership in which the two organizations' competencies complement each other.

Photo: Tom Arnbom

The Arctic summer is short, but it explodes with biological riches. Millions of birds migrate to this polar region to feast on the generous buffet of insects. In Tavvavuoma, the sun does not drop below the horizon for an entire month in summer. (Similarly, winters feature a month with no sun.)

Photo: Tom Arnbom

Tavvavuoma—a 55,000 hectare system of flat mires—is the largest palsa mire in Sweden. The area is rich in biodiversity, especially in terms of birds and insects. It sees only a few hundred human visitors a year, mainly Saami reindeer herders, sport fishers and grouse hunters.

Developing a shared vocabulary

LESSONS IN CROSS-CULTURAL COMMUNICATION ABOUT CLIMATE

The impacts of climate change in the Arctic extend to the core of communities' well-being, affecting their food security, safety, culture and sovereignty. As **CHLOE NUNN** tells us, this demands that discussions of climate solutions cut across scientific disciplines and be conducted with respect for multiple ways of knowing, being and doing. Her educational journey across marine ecology and social science uniquely shaped her graduate research and she is now using an ever-growing understanding of different disciplines and perspectives to broaden the climate conversation.

WHEN I ARRIVED in the tiny island community of Uummannaq, Greenland in July, the sun had been up since March. It glinted across the sea, reflecting off icebergs and leaving them bright white in the bay. The sound of sled dogs and Greenlandic polka filled the air. A car drove down the crumbling road on its way to a Kaffemik, a traditional coffee and cake event with dancing and singing. The heart-shaped mountain for which the town is named created a backdrop for the celebratory fireworks.

Once I'd gained my bearings in Uummannaq and discovered the joys of covering my windows with tin foil to get a full night's sleep, I was able to turn my attention to my research. The first step was to present my proposed questionnaire to my local collaborator. I had been thinking of the questionnaire as something of a lifeline: I'm a quantitative marine scientist, and it would provide me with numbers. So I experienced a quiet panic when my collaborator convinced me to change my methodology on the spot and use interviews only.

But I deferred to her local knowledge—and ultimately, it was the right decision, not to mention a lesson in research adaptation and on-the-ground flexibility.

THE INFLUENCE OF LANGUAGE

The next lesson I learned was that not only do our individual needs and desires shape our perspectives on the climate crisis, but that our values and worldviews shape the language we use to talk about it. I realized this early in my research when I noticed that my interviewees seemed to find my questions confusing and irrelevant. In the end, the phrase "climate change" didn't actually feature in any of the questions I asked. Rather, I received much more informative answers when I included references to the concrete components of climate change that touched community members directly every day.

For example, I heard stories of cars driving across sea ice, films being projected onto the sides of icebergs, and elders teaching youth traditional fishing methods. I was also told about the increasing unpredictability of icebergs, and how calving at the glacier edges was making travel nearby unsafe. I was told about a shift in the timing of the momentous return of the sun due to a change in ice cap height, and about residents of a neighbouring community who had been made refugees when a tsunami in the fjord destroyed their homes.

The author, Chloe Nunn, takes a polar dip while camping near Uummannaq.

Photo: Gydja Johannesen

THE IMPORTANCE OF RELATIONSHIPS

Taking the time to build trusting relationships was key to my research, particularly because it forced me to work at the pace of the community. I ended up taking the time to reflect on my own relationship with climate change impacts.

I come from an economically, ethnically and politically privileged background and have generally lived in climatically stable, temperate locations. Until I began my research in the Arctic, the conversations and education I'd had about climate change were typically in academic or political settings. They were much more abstract than, for example, the fact of unsafe sea ice preventing hunters from bringing food home to their families. Worsening storms, heat waves and coastal erosion—which are all tangible climate impacts in the UK—don't seem to elicit urgent action to mitigate climate change. Perhaps the intangible language we tend to use keeps the topic at bay.

My experiences in Uummannaq taught me that to address the climate crisis—and to include everyone in the conversation about it, from the most vulnerable communities to the wealthier cities and consumers that are the biggest contributors to it, and everyone in between—we have to be cognizant of how we invite people into discussions, the language we use, and the differences in perspectives. We must place humanity in the foreground of our work and get to know our fellow community members, locally and globally. ●

CHLOE NUNN is a UK-based transdisciplinary marine ecologist and social scientist. A 2018 National Geographic Explorer, she is also co-president of the UK Polar Network and a member of the Study for Environmental Arctic Change (SEARCH) co-production project.

Snowmobiles travel over sea ice in Uummanaq, Greenland.

Photo: Lawrence Hislop, www.grida.no/resources/1150

Narwhal on the move

COLLABORATIVE KNOWLEDGE-GATHERING ABOUT MIGRATION CAN HELP US UNDERSTAND SPECIES' ADAPTABILITY

Many Arctic species migrate to cope with drastic seasonal differences in environmental conditions and food availability—and as the climate crisis alters Arctic landscapes, many are adjusting their patterns. Narwhal were once thought to migrate predictably throughout their ranges. But **COURTNEY SHUERT** wonders: as other species show signs of adjusting to the changing Arctic environment, how flexible may narwhal turn out to be—and what might the answer tell us about other species' adaptability?

Narwhal are thought to follow culturally learned migratory routes.

Photo: Carsten Egevang, Arctic Arts Project

CONSERVATION EFFORTS have made great strides in protecting Arctic ecosystems. When multiple species inhabit an area year-round or seasonally, conservation targets are relatively easy to figure out. But it's less straightforward when species move around more.

Migration can make conservation management more challenging because entire populations may move out of protected areas for periods of time, sometimes across vast distances or geopolitical boundaries. However, some migrating species may offer clues as to how Arctic wildlife will fare in the future. Scientists are studying narwhal—which may live upward of 100 years—to understand the ability of long-lived species to cope with the impacts of climate change by altering their migratory patterns.

Scientists are studying narwhal—which may live upward of 100 years—to understand the ability of long-lived species to cope with the impacts of climate change by altering their migratory patterns.

WHAT'S BEHIND MIGRATION?

Species migrate for different reasons: to find food, mate and breed, or escape harsh winters. Many travel vast distances to the Arctic to take advantage of the plentiful food available in summer. Some of the most iconic Arctic species are year-round residents, yet they still exhibit strong migratory behaviours. For example, polar bears, narwhal and beluga move seasonally between near-shore and offshore regions to cope with the extreme seasonality of life in the North.

Migratory patterns in the Arctic are often tied to sea ice. While some species, such as seals and polar bears, depend on the presence of sea ice, other marine mammals may be limited by it because they must be able to access the water's surface to breathe. But sea ice is becoming less predictable, and this variability is having an impact on both year-round residents and seasonal visitors. Rising temperatures and less predictable weather patterns are threatening species' ability to move through, use and interact with their environments across the entire food web, from microscopic plankton to the largest whales.

LIFESPAN AND ADAPTIVE CAPACITY

We are beginning to understand how well species can cope with these changes and how these changes may impact migration. While we anticipate that many short-lived species—like the small passerine birds that seasonally visit the Arctic—will be able to adjust their migration strategies through mechanisms of evolution, many long-lived species (which have long generation times) may be limited to adjusting their behaviours to match the rate of climate change.

Over the past few decades, narwhal equipped with satellite transmitters have offered researchers important insights into how they may be coping with change. Narwhal typically spend summers in the fjords and sounds of Greenland and the Canadian Arctic before changing sea-ice conditions force them to deeper waters offshore for the winter. Like many whales, narwhal are thought to follow culturally learned migratory routes.

The satellite tags have revealed that narwhal that summer in the north of Baffin Island are departing the area later for their autumn migration. The difference in the average departure timing amounts to about two weeks over a 21-year period.

This variability in timing is closely linked to changing sea-ice conditions: narwhal stay later in their summering areas when Arctic sea ice is low. Although their migration route remains generally the same, these narwhal have been observed to use a variety of routes to reach their wintering areas, with some staying close to the coast and others preferring deeper waters offshore. Individual narwhal that use the near-shore route also appear to stop over at productive deep-water fjords along the coast of Baffin Island, possibly to rest or refuel.

Other Arctic species known to exhibit migratory behaviours, such as Greenland halibut and shark, show affinity to these same regions and migrate at the same time.

MAKING USE OF COLLABORATIVE KNOWLEDGE

When populations or communities follow similar areas of use during the migratory period, we refer to the areas as migratory corridors, and these may offer achievable targets for conservation. However, corridors sometimes cross international boundaries or important shipping lanes, highlighting the need for collaborative knowledge-gathering to track migration and mitigate future impacts through adaptive management.

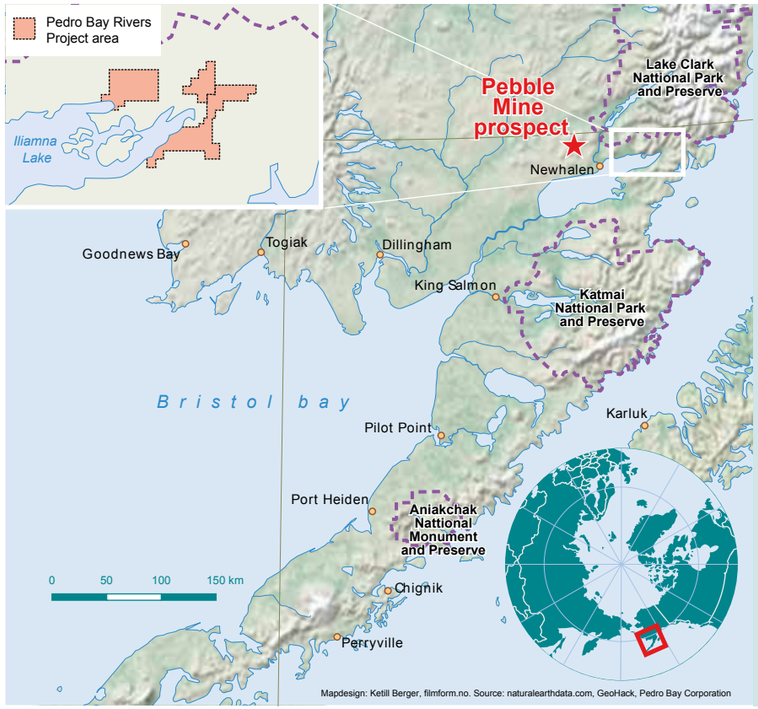
The fact that narwhal show flexibility in their migration timing despite their long life spans highlights the possibility that many other marine species may also be able to adjust their behaviours to changing conditions in the Arctic. As interest in the region grows—and as species' migration timings and use of space shift in response to climate change—it will be crucial to bring together prior research, traditional knowledge and current observations to develop the adaptive management tools to help species survive.

Evidence continues to mount that many species use similar migratory corridors. Making use of collaborative knowledge from all levels of Arctic ecosystem organizations will be paramount to our ability to forecast community-level effects and best protect the Arctic ecosystem. ●

COURTNEY SHUERT is a post-doctoral research fellow at the University of Windsor focusing on the behavioural ecology and ecophysiology of marine mammals in a changing world.

Photo: © Paul Colangelo / WWF-US

An aerial view of a landscape in the Bristol Bay watershed, Alaska, United States.



BY THE NUMBERS

- Bristol Bay provides hundreds of millions of nutritious, sustainable meals to dozens of local communities, other Americans and the world through sustainably harvested sockeye salmon.
- The watershed supports the world's largest sockeye salmon run, producing about 46 per cent of the world's harvest.
- In 2022, Bristol Bay's sockeye salmon harvest amounted to nearly 60 million metric tons—26 per cent more than had ever been caught in a single season.
- The fishery generates US$2.2 billion in annual economic revenue and sustains 15,000 jobs annually.

Watershed moment

PURSUING PERMANENT PROTECTION FOR ALASKA'S BRISTOL BAY

Bristol Bay is one of the world's most productive marine ecosystems. It is also synonymous with commercial fisheries: local communities and businesses rely on wild-caught salmon for their livelihoods. **SARAH ZAAIMI** lays out how WWF is working with the local community to help to protect this unique Alaskan ecosystem.

SEASONED AFTER YEARS of standing against the Pebble Mine project, the Bay communities are now leading the Bristol Bay Victory Challenge (BBVC) to obtain permanent protection for this iconic Alaskan ecosystem.

The Bristol Bay watershed is one of the only remaining pristine habitats on Earth for salmon, which drive the region's ecological, economic and cultural health. Largely untouched by industrial development, Bristol Bay and its salmon support the subsistence needs of more than 30 local Alaska Native communities and thousands of Alaskans within and beyond the region. The proposed Pebble Mine project would be one of the world's largest open pit mines, exposing the watershed to billions of tons of mining waste for decades to come.

"Local and global communities have pursued the permanent protection of Bristol Bay for decades due to its centrality in the lives and identities of western Alaskan cultures," says Steve MacLean, managing director of the US Arctic Program at WWF. "The BBVC also recognizes and safeguards the unmatched economic and nutritional value of Alaskan salmon fisheries for businesses and people."

WWF recently joined the BBVC, a five-year, Indigenous-led, US$50 million catalytic fundraising effort to protect this extraordinary watershed and the wildlife it supports while also driving large-scale investment in the sustainability and prosperity of the Bay and its people. WWF and other BBVC partners have committed to jointly raise funds to secure regulatory and legislative protection for land in the Bristol Bay watershed and provide sustainable economies for the communities around nearby Lake Iliamna.

PRIORITIZING THE PROTECTION OF THE PEDRO BAY RIVERS

The most immediate need is to secure protection for private, Alaskan Native-owned land around Pedro Bay. In 2021, the Pedro Bay Corporation, an Alaska Native Corporation, agreed to place a conservation easement on 17,800 hectares of land that encompassed four major salmon-producing rivers in the Pedro Bay region on the east end of Lake Iliamna. The initiative is known as the Pedro Bay Rivers Project.

"The community of Pedro Bay and the Pedro Bay Corporation are glad to finally see this project coming to fruition," says Matt McDaniel, CEO of the Pedro Bay Corporation. "The proposed easements bisect the route for the northern road that Pebble Mine developers proposed to transport ore from the mine to a shipping port on Cook Inlet. This easement will put a literal and figurative roadblock on the development of Pebble Mine, and support a local, Indigenous community that has been steadfast in its opposition to the Pebble Mine."

To protect important salmon rivers and habitats, the US government recently indicated its intent to have the Environmental Protection Agency prohibit the disposal of mine waste or tailings in the proposed Pebble Mine footprint. This positive step gives WWF and BBVC partners the opportunity to close the conservation easement in Pedro Bay and pursue the regulatory and legislative protections that will protect the ecosystem and ultimately help secure sustainable economies in the area.

WWF will continue to work with BBVC partners, Alaska Native communities and stakeholders to raise funds to complete the Pedro Bay Rivers Project by the end of 2022. ●

WWF and other BBVC partners have committed to jointly raise funds to secure regulatory and legislative protection for land in the Bristol Bay watershed and provide sustainable economies for the communities and economies around nearby Lake Iliamna.

SARAH ZAAIMI is a WWF programme officer on the ocean team at WWF–US.

The lesser white-fronted goose has a short bill that is specially adapted to forage in low-growth meadows.

Cooperating to restore species

THIS CRITICALLY ENDANGERED NORDIC GOOSE IS MAKING A RECOVERY

In the span of a single century, the number of lesser white-fronted geese in Nordic countries plunged from thousands of breeding pairs to just a few dozen. Now, as **TIITU SAARIKOSKI** explains, cooperation between multiple countries along the birds' migration route is helping the critically endangered population recover.

THE LESSER WHITE-FRONTED GOOSE, or *Anser erythropus*, is one of the most endangered birds in the Nordic countries: it is estimated that there are currently fewer than 100 individuals left.

A small, dark brown bird with a white blaze on its crown and black spots on its belly, this goose is smaller and daintier than its close relative, the greater white-fronted goose. A bright yellow ring around its eyes and a shorter bill also distinguish it from its non-endangered counterpart. These geese nest on the ground on open tundra. They are very timid, especially during the breeding season.

UNSUSTAINABLE HUNTING CAUSES DECLINE

Although the most urgent need for protection is for the severely collapsed Fennoscandian population, the lesser white-fronted goose is endangered throughout its range, which stretches from the Nordic countries to eastern Siberia. At the start of the 20th century, the goose was a common sight in Lapland during its breeding season, but today its only known Nordic breeding sites are in Norway. It winters in northern Greece and passes through several European countries, including Finland, on its migration journey.

In the 1910s, it was estimated that about 10,000 lesser white-fronted geese migrated through Finland in spring to reach their Lapland breeding areas. However, hunting and the deterioration of their staging and wintering habitats led to a collapse in the population, and in the worst years—the early 2000s—only a few individuals were seen in the Finnish spring staging area. Excessive hunting, especially in the geese's wintering areas and resting places along their migration routes, is the main culprit behind their decline.

Unlike most other goose species, the lesser white-fronted goose depends on low-growing, often salty natural meadows. Changes in land use and the overgrowth of these habitats by bushes and reeds (resulting from, among other things, the abandonment of traditional land-use practices) have led to the loss of feeding habitats because the goose, an herbivore, has a very short bill that is specially adapted to forage in low-growth meadows.

The lesser white-fronted goose is endangered throughout its range.

A JOINT EFFORT BEGINS

In Finland, the decline of the lesser white-fronted goose was first noticed in the seventies and eighties. In 1984, a conservation team from WWF–Finland began to systematically monitor the birds' spring migration and survey their breeding areas in Lapland.

However, because the geese pass through several European and central Asian countries on their migration route, it was clear from the beginning that they could not be saved by the efforts of just one country. Since 1997, joint European Union LIFE projects began investigating the geese's migration routes and worked to train citizens in the countries along these routes to identify and protect the birds.

These investigations revealed that, interestingly, lesser-white fronted geese don't all choose the same migration route. The geese that have bred most successfully fly to Greece through Hungary, whereas those whose breeding has failed have tended to fly through Russia, Kazakhstan and Ukraine. This route is much longer and more dangerous because the geese are more likely to be shot by hunters.

In 2020, the third international lesser white-fronted goose EU LIFE project began. Running until 2025, it aims to halt the decline of the Fennoscandian population. It will also try to stabilize or expand the birds' breeding range and help ensure that adequately managed, protected habitats are available at all key sites.

To that end, the project includes restoring the habitats of the lesser white-fronted goose, assessing the effects of climate change on the birds, and raising awareness among humans of their plight. In addition to Finland, other countries involved in the project include Greece, Hungary, Lithuania and Estonia.

COOPERATION PAYS OFF

So far, the conservation efforts seem to be working: over the past few years, more than 100 lesser white-fronted geese have rested in Finland during their migration journeys. However, the population decreased again over the latest year due to several successive bad breeding years.

Since 2020, for the first time in 50 years, part of the population has begun to stop over in Finland during the autumn migration. Cooperation with local hunters has enabled the geese to rest undisturbed during the couple of weeks they spend in Finland. Once they arrive, waterfowl hunters are warned about their presence and can voluntarily reduce their hunting at dusk. In the dark, it's easy to confuse lesser white-fronted geese with other geese, and the loss of even one would be significant for the extremely endangered species.

The last time a lesser white-fronted goose was confirmed to nest in Finland, it was 1995—almost 30 years ago. But if the population continues to strengthen, these geese may rejoin the Finnish breeding fauna, just as the Arctic fox did in 2022.

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TIITU SAARIKOSKI is a WWF–Finland communications specialist focusing on climate issues.

Mental health

ELEVATING THE VOICES OF INUIT YOUTH

Temperatures in the Canadian Arctic are rising several times faster than elsewhere in the world. This is resulting in ecological changes that are impacting the mental health and well-being of Inuit communities, including their youth. A collaborative project called Carving out Climate Testimony: Inuit Youth, Wellness & Environmental Stewardship is working with youth to address change.

KARLA JESSEN WILLIAMSON and **JEN BAGELMAN** are the principal investigators of the project, which is one of 13 recently funded by the Canada-Inuit Nunangat-UK Arctic Research Programme. Along with other researchers at their universities, they are working with youth aged 18 to 24 in four northern communities in Canada—Tuktoyaktuk, Kuujjuaq, Makkovik and Rankin Inlet—to explore how local practices can identify solutions to the changing climate and elevate youth voices at the same time. They spoke to *The Circle* about how they are looking to Unikkausivut (storytelling) and other artistic expressions to convey how Inuit youth are experiencing climate change and come up with constructive responses.

Youth interview Elder Charles Q. Gruben about sea ice changes along the shore in Tuktoyaktuk, NWT, Canada.

Photo: Jaro Malanowski

Photo: Johan Stoman

Group photo taken after the youth interviewed the late Randal "Boogie" Pokiak for the youth-led film, Happening to Us. *Row 1 left to right: Jaro Malanowski, Eriel Lugt, Brian Kikoak, Michele Tomasino and Maéva Gauthier. Row 2 left to right: Darryl Tedjuk, Carmen Kuptana, Randal "Boogie" Pokiak and Nathan "Muk" Kuptana.*

Photo: Maéva Gauthier

Eriel Lugt interviews local harvester Mason on his subsistence hunting practices and the changes he has seen.

Photo: Maéva Gauthier

Darryl Tedjuk practices his new camera skills.

How would you describe this project?
JEN: We're using storytelling and other art-based tools to capture the impacts of climate change and develop some responses to the challenges. We're trying to elevate youth leadership. In essence, it is about empowering the youth leaders and other researchers, artists and activists who live in these areas. I think it's important to acknowledge that the project is part of a new funding programme that has collaboration at its heart. In particular, I think this new programme aims to elevate research expertise in the Arctic. So, it's not about flying a bunch of white academics to the Arctic, but acknowledging the strengths already based in this diverse region.

What is the connection between climate change and the mental health of Inuit communities?
KARLA: Climate change impacts the physical environment, of course, but it also has social effects because it changes the migration patterns of the sea and land mammals that Inuit depend on. It also changes the normal patterns of sea-ice freeze-up. Thawing permafrost and eroding coastlines have consequences for homes, buildings and transportation in communities. All of these disruptions are compounded by the fact that people are still dealing with the legacy of colonial systems, and their knowledge system has been set aside. We hope to be able to provide new knowledge, or organize the knowledge that is based on their own observations of what is going on, to help youth meet their own needs.

KARLA JESSEN WILLIAMSON is an Inuk assistant professor in the University of Saskatchewan's College of Education and co-principal investigator on the Carving out Climate Testimony: Inuit Youth, Wellness & Environmental Stewardship project. She was born and grew up in Greenland.

JEN BAGELMAN is co-principal investigator of the study and a reader (associate professor) at Newcastle University in England. She is originally from Yellowknife, Northwest Territories.

Why focus on youth for this project?
KARLA: Because they're the ones who are going to be living with the effects of climate change and who are going to have to make changes to their culture as a result. We also felt, as a group, that this segment of society has been neglected and really needed to be empowered.
JEN: The Intergovernmental Panel on Climate Change (IPCC) has noted that youth are a vulnerable group when it comes to climate change. It has dramatically changed their ability to live on the land the way even their parents did. The reality is that there are higher suicide rates, particularly for Inuit youth, due in large part to colonial practices, policies and mindsets. We think it is urgent to begin better resourcing Inuit communities and listening to them, especially the young people.

What role will the youth play in the project?
JEN: We're building on the youth leadership strengths that already exist in these communities but have not been resourced efficiently and effectively up until now. These youth will be guiding the research questions and co-designing the workshops that we hold. Young people will have opportunities to present their own research to the IPCC. They'll have an opportunity to present it in their own terms to this influential panel, including through art and storytelling.

What do you want to come out of this project?
KARLA: For too many years, it's been about researchers coming into the community for two weeks at a time, at the most, and leaving with knowledge that is later published by academics and remains inaccessible to the people most affected. So we would like to see a sense of ownership on the part of the community of the knowledge that's being gathered.

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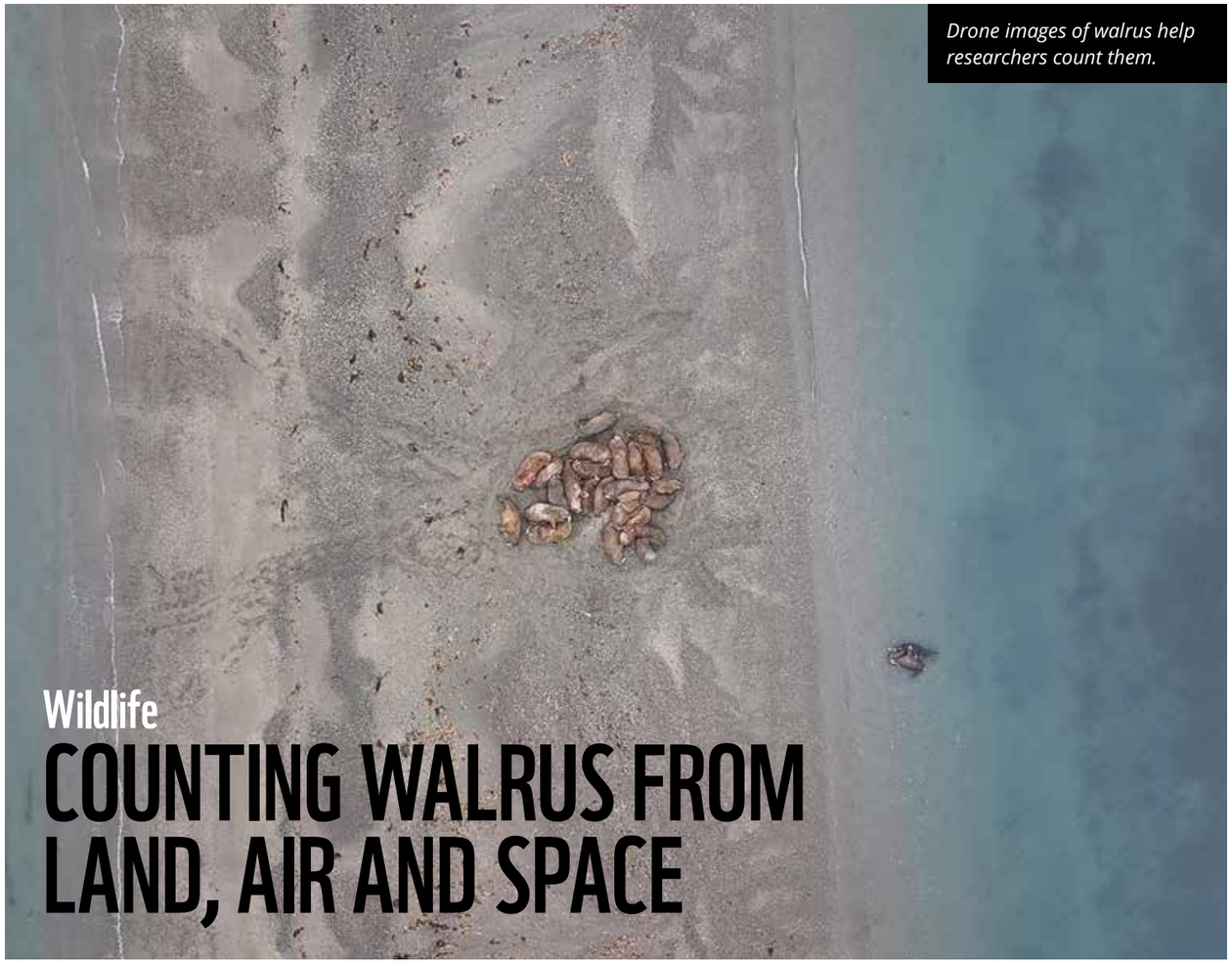
Why do you think this kind of collaboration is important to address the impacts of climate change?
JEN: We know that many of the crises we face globally are the result of western cultures implementing their visions, ignoring and often violently displacing diverse cultural knowledge systems. These knowledges need to be brought to the forefront. In the case of the Arctic, researchers need to stop treating Inuit communities as passive endurers of climate change and instead understand them as sources of incredible knowledge gained over generations, especially in terms of adaptation and monitoring change. These communities have an understanding—through the very visceral act of being in that landscape and experiencing the dramatic changes to their realities—that we can't actually glean from distant geographies. ●

■ Carving out Climate Testimony builds on an existing four-year participatory video project with youth in Tuktoyaktuk led by Maéva Gauthier from the University of Victoria with Jaro Malanowski from Avatar Media and Michèle Tomasino from Mangilaluk School with support from the community, the Tuktoyaktuk Community Corporation, Inuvialuit Regional Corporation, the Social Sciences and Humanities Research Council of Canada, MITACS, the Government of Canada, and many others. It will help young leaders in the community use other arts-based tools to document change and support mental health.



Drone images of walrus help researchers count them.

Photo: © Hannah Cubaynes

Wildlife

COUNTING WALRUS FROM LAND, AIR AND SPACE

As the summer sea ice retreats dramatically due to the climate crisis, walrus are gathering in larger and larger numbers (and more often) on Arctic beaches and shorelines, forming what are called terrestrial haul-outs. As **HANNAH CUBAYNES, ROD DOWNIE** and **PETER FRETWELL** tell us, learning what these shifting habitats mean for the animals' survival is critical, and requires accurate population counts repeated over a number of years to better understand trends. That work depends on the efforts of many people, including citizen scientists.

IT'S A COOL but sunny July day, and our team has spotted a walrus haul-out. We are on a boat at Sarstangen, a narrow spit that extends from Spitsbergen Island to Forelandsundet in northern Norway's Svalbard Archipelago. We're anchored about 300 metres to the east to observe the walrus from afar.

Eventually, after a polar bear guard from our expedition has checked that it's safe, we go ashore and spread out across the isthmus to conduct ground counts from different angles. With the help of a drone flying at a precautionary height of 55 metres, we are also able to gather images from above.

This is the first of three field excursions we will take on this trip as part of the Walrus from Space project.

BUILDING A BETTER FUTURE FOR WALRUS

Led jointly by WWF and the British Antarctic Survey, the five-year citizen science project was launched in October 2021 with the aim of better understanding how the climate crisis is affecting the Atlantic and Laptev walrus populations and helping to secure a future for them in the changing Arctic. But we aren't doing this work alone: we are working with scientists around the Arctic. And the project also co-opts the public's help to detect walrus in thousands of high-resolution satellite images of more than 25,000 square kilometres of Arctic coastline. Citizen scientists use Walrus from Space, which is built on Maxar's GeoHIVE crowdsourcing platform, to help us find and count Atlantic and Laptev walruses across the Arctic.

From the comfort of their homes, they scan satellite images and spot areas where walrus haul out onto land, providing us with vital data about the distribution of walrus populations and the timing of their haul-outs. So far, more than 11,000 aspiring conservationists from around the world have already reviewed more than half a million online images of walrus in the Arctic taken in 2020, and are now reviewing imagery captured in 2021. (If you'd like to help them, you can join the project by creating an account on GeoHIVE.)

Our fieldwork in Svalbard this summer in collaboration with the Norwegian Polar Institute involved validating these data by doing ground counts and drone counts. At the same time, we commissioned a new five-day window of Maxar satellite imagery collections.

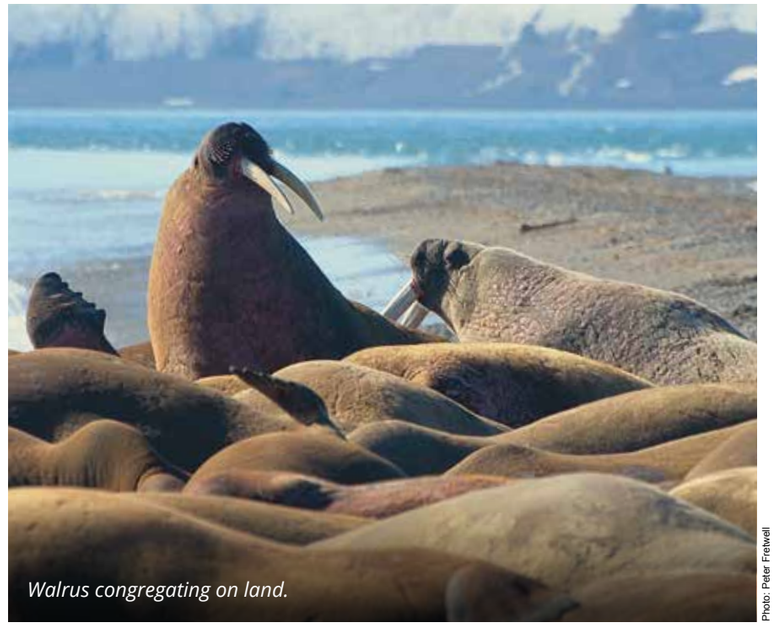
The next step will be to compare our ground count and the counts from the drone images to what we can see on the satellite images commissioned this summer. Luckily, the timing of the satellite imagery coincided precisely with our visit to Sarstangen, with the satellite images collected just 15 minutes after the drone images were captured. This will be extremely useful in helping us evaluate the data because we will be able to compare walrus counts from three different vantage points: ground, air and space.

The value of having an alternative counting method to enhance accuracy is clear: although our team counted an average of 38 walrus on the ground in this first Sarstangen excursion, the imagery captured by the drone indicated 71.

MOVING TO THE NEXT PHASE

Right now, the "finding walrus" campaign is live on the GeoHIVE platform with the satellite imagery collected in summer 2021. In November 2022, we will launch the counting campaign. In this next phase, members of the public will use the images that were identified as containing walrus, and count the walrus in each scene. We will use multiple volunteers to count the walrus in each image so we can get the most accurate data possible.

We plan to repeat this process with new satellite imagery over the next few years to give scientists a much better idea of walrus population numbers and how the walrus are interacting with their icy (but changing) environments.



Walrus congregating on land.

Photo: Peter Fretwell

Walrus from Space on GeoHIVE

GeoHIVE is a platform that enables organizations to identify and verify change at scale quickly with help from advanced machine learning and geospatial experts. It hosts campaigns on a website where crowd members use Maxar satellite imagery to answer questions about satellite images and tag or draw bounding boxes around features of interest.

Our 2022 Svalbard fieldwork gave us crucial information about the accuracy of the satellite counts. With the continued help of citizen scientists around the world, we can better understand the impact of the changing climate on walrus and help safeguard them into the future. ●

HANNAH CUBAYNES is a research associate focusing on the study of wildlife using satellite imagery. She is also the technical lead on the Walrus from Space project.

ROD DOWNIE leads the Polar & Climate group at WWF–UK and is co-director of the Walrus from Space project.

PETER FRETWELL is a geographic information officer with the British Antarctic Survey. He leads the organization's Wildlife from Space project and is the science lead on the Walrus from Space project.

THE BACK PAGE

After the Storm

Photo: Kerry Koepping, Arctic Arts Project

This photo, titled *After the Storm*, was taken by Kerry Koepping, a US-based photographer and the executive director of the Arctic Arts Project, at the mouth of Kanjiafjiord, Illulissat, Greenland. Great icebergs like this one break from the glaciers that originate at the Greenland ice sheet. These glaciers are calving and melting at record levels, becoming water in the world's oceans.