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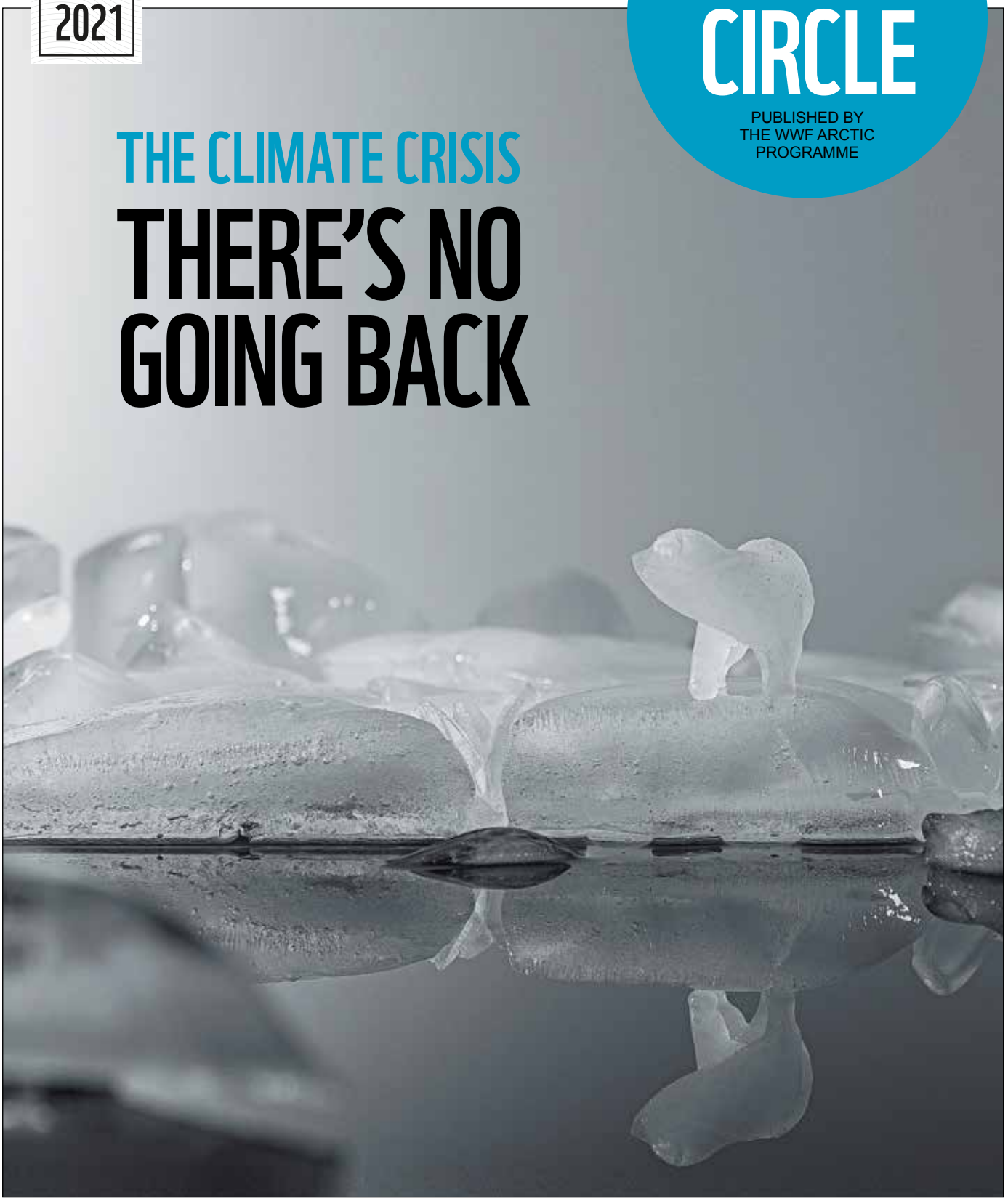
THE CLIMATE CRISIS

THERE'S NO GOING BACK



ARCTIC CLIMATE CHANGE

The Circle 3.2021

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COVER: In this clip from an animation called "Keep 1.5° C Alive" by NOMINT, a polar bear pauses for a moment on disappearing ice.

ABOVE: Icebergs, Kaiser Franz Josef Fjord, Northeast Greenland National Park.

Photo: Peter Prokosch, www.grida.no/resources/3921

Responding to rapid Arctic climate change: Is the future cancelled for lack of interest?

SEA ICE determines much of the nature of life in and around the Arctic Ocean. Research published this year by *Nature* demonstrated how historic changes in ice conditions in the channel between Greenland and northernmost Nunavut, Canada were linked not only to biological productivity and abundance of species in the area immediately south, but also to the very presence of people in Greenland. This unique area, Pikialasorsuaq, is the largest, most productive polynya (area of open water surrounded by sea ice) in the northern hemisphere. It is home to stunning biodiversity and underpins livelihoods, communities and Inuit culture. Efforts are underway to safeguard and manage Pikialasorsuaq for the benefit of future generations.

But these endeavours face huge challenges: a concerning insight arising from the above research is that the historic changes in climate and sea ice that coincided with the regional collapses and onsets of animal and human populations were subtle compared to what the Arctic is now experiencing. Small shifts in climate will determine whether adaptation is possible or whether some areas will need to prepare for major transformations—or even collapses.

> It seems like the pilot has asked us to brace for immediate impact, and collectively we have decided to continue watching the movie instead.

This insight points to an *existential* need to plan adaptation and tightly integrate the efforts to do so with international efforts to transform our fossil-fuelled economic model to limit the crisis. This issue of *The Circle* shows many encouraging examples of attempts to come to grips with what lies ahead. However, neither the scale of these initiatives nor their level of integration with emission reduction efforts is doing justice to the *existential* dimension of the interdependent adaptation and transformation issues that affect life in the Arctic.

With science painting an ever-clearer picture of what kind of future we can expect under different emission scenarios—and given the Intergovernmental Panel on Climate Change's "virtual certainty" that warming in the Arctic will continue to be multiple times stronger than the global average—it seems like the pilot has asked us to brace for immediate impact, and collectively we have decided to continue watching the movie instead.

This fall, parties to the Paris Agreement will meet in Glasgow to take stock of countries' pledges to reduce emissions. The agreement is spurring some governments to adopt stronger targets, but few countries have submitted updated pledges or put policies in place to meet them. A prominent recent analysis found that the current policies would lead to 2.9˚C of global warming by 2100—a figure nearly double the Paris Agreement target and insufficient to leave the Arctic with at least some sea ice most summers. So what's next?

MARTIN SOMMERKORN is head of conservation with the WWF Arctic Programme.

The nationally determined contributions (known as NDCs) made by Arctic and other countries know little about the plight of the Pikialasorsuaq region and its people, or about the natural and cultural diversity that we all depend upon, which will be increasingly lost with every tenth of a degree of warming. So we must rise to tell them from the floe edge, from the coast lines, hills and plains, and from the fishing, hunting and calving grounds. We must create the NDCs we want to see. We must make the next iteration of pledges more just.

An all-hands-on-deck approach to adaptation planning will empower participation in decision-making on climate issues and leverage more just national and global climate targets along with support for building resilience. We can promote it as the "3Ps": Participate, Plan, Pledge. I would like to add a fourth one: Please get involved. We need a whole-of-society approach to the climate crisis, and there is no time left to lose. ○

THE END OF PERENNIAL ICE?

Winds blow old Arctic sea ice into the melt zone

IN WINTER OF 2020–21, researchers observed that record-breaking winds blew large swathes of perennial Arctic sea ice into the melt zone. Perennial ice is ice that survives the Arctic summers. Thick and resilient, it's a critical part of the Arctic's climate and ecology and helps keep the Earth cool.

According to a study from University College London, this seems to have happened when the polar vortex collapsed, producing an unusual pattern of surface winds that swirled clockwise around the centre of the Arctic Ocean, driving the perennial ice from north of Greenland—where it is more likely to remain frozen—southward into the Beaufort Sea, where it is increasingly unlikely to survive the summer.

Sea ice melting in the Beaufort Sea.

Foto: Danielle Brigida, CC, Flickr.com

Sea ice covered in snow reflects up to 90 per cent of incoming sunlight back into space. But as polar sea ice melts, sunlight increasingly hits the open ocean, where more than 90 per cent is absorbed, warming the planet. Melting perennial ice is a problem for the climate because it means ever more sunlight is absorbed.

Recent climate models project that the coverage of sea ice at the September minimum could drop to conditions that are recognised as "ice-free" by 2035.

SWEDEN

Using AI and Earth observation data to analyse permafrost thawing

WHEN IT COMES to understanding permafrost thaw, scientists have long wrestled with critical knowledge gaps: fieldwork is challenging in vast, remote areas like the Arctic. But artificial intelligence (AI) is poised to make their work easier.

A new cross-sector collaboration between Stockholm Environment Institute, Stockholm University, Alfred Wegener Institute and Accenture is exploring ways to study the speed, extent and impacts of abruptly thawing permafrost in the Arctic by scaling up the use of AI and creating new partnerships. The project will offer more accessible data and tracking trends over time and measure the speed and magnitude of thawing across regions. Compared with conducting isolated spot measurements in person, this work has the potential to generate a deeper understanding of permafrost thaw more quickly.

Researchers will analyze time-based datasets to understand current trends and predict future ones. Ultimately, they hope to create an online dashboard to contribute data to climate negotiations and climate policy.

NORWAY

Citizen scientists spend the COVID-19 pandemic in the Arctic

www.heartsintheice.com/blog/

SEA ICE, WATER, phytoplankton, auroras, clouds, microplastics and wildlife all have at least one thing in common: they can be observed in or from the Arctic. And for 18 months of the COVID-19 pandemic, a pair of female citizen scientists stationed themselves in the Arctic to do just that, with a special focus on the effects of the climate crisis.

With 46 years of polar travel and expedition experience between them, Canadian Sunniva Sorby and Norwegian Hilde Fålun Strøm settled into a small, uninsulated trappers' cabin in Svalbard about 140 kilometres from the nearest community. They arrived in 2019, planning to stay nine months. When the pandemic hit, they decided to stay a second winter.

Serving as "climate witnesses," they sent data to the Norwegian Polar Institute and NASA about the changes they noticed in ice conditions, animals and the atmosphere. NASA studied their coping and isolation techniques to glean insights that could be useful for future space exploration expeditions. The women left Svalbard at the start of summer 2021, and are contemplating a similar adventure in the Canadian Arctic.

You can read more about their experience in their blog, Hearts in the Ice.

ARCTIC FIRES

Understanding "zombie" wildfires

Wildfires, Uvgoon Creek, Alaska.

Photo: National Park Service, Public domain

THE IDEA of the dead coming back to life has inspired the term "zombie" to describe fires in parts of Alaska and Canada that can hide in the soil, survive eight or nine months of wet, sub-zero conditions, and reignite when the weather warms up again.

The phenomenon of smouldering soil isn't new, but the ability of these fires to survive between seasons is just starting to be studied in depth. A study published this year in *Nature* describes how researchers tried to identify the factors that are making such underground fires more common.

By mapping re-emerging fires, the researchers found that they tend to occur near the original burn scar and require no additional ignition source: 89 per cent began within the bounds of a fire from the previous year, and most began around the end of May, almost a month after the onset of snowmelt. The researchers concluded that hotter summers are setting the stage for these fires, pointing to the climate crisis as the culprit.

Knowing where and when the fires are likely to appear may make it easier to control flare-ups.

COP26 in Glasgow

One last chance to avoid

What is COP26?

The Conference of the Parties, or COP, is an annual meeting of the 197 parties to the United Nations Framework Convention on Climate Change. The talks are hosted every year by a different country with the aim of advancing global efforts to address climate change. The first COP meeting was held in Berlin, Germany in 1995. This year, the 26th conference (COP26) will take place in Glasgow from November 1 to 12, a year later than planned due to the COVID-19 pandemic.

The Paris Agreement resulted from COP21 in 2015. The agreement sets out targets to limit global temperature increases to no more than 2°C above pre-industrial levels.

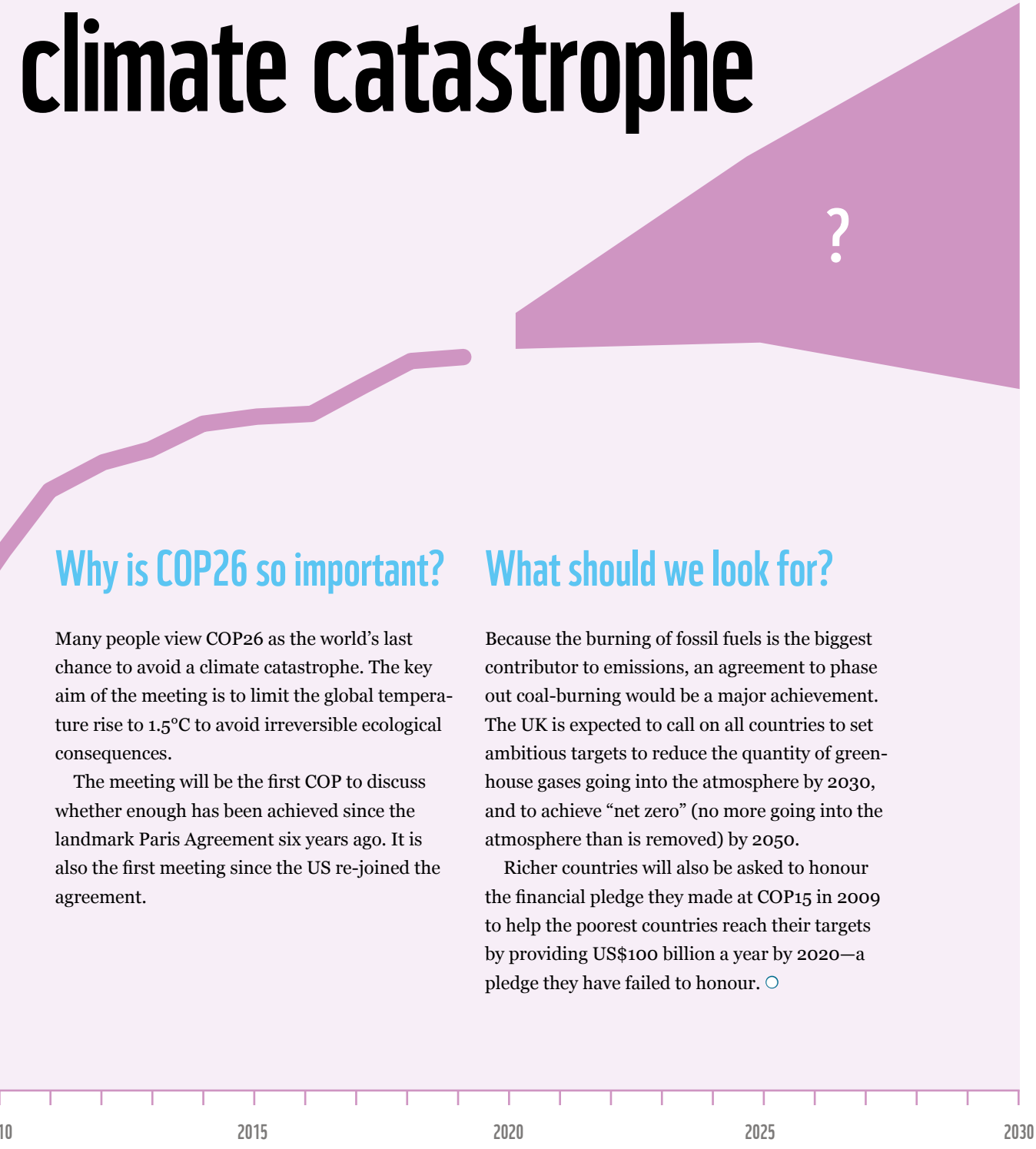
Where do the Paris Agreement targets stand today?

Although the Paris Agreement put climate change at the top of the agenda for many nations, no country has yet to meet its requirements to keep global warming well below 2°C. The Climate Change Performance Index is an annual report that evaluates 14 indicators to track how well the 57 countries are addressing the climate crisis. Together, these countries account for 90 per cent of global emissions. Although Sweden, Denmark and Norway were three of the index's top five performers in terms of climate action in 2021, two other Arctic nations—Canada and the US—were among the poorest.

Greenhouse gases: Projected range and progression of emission levels 1990-2030

Source: United Nations Framework Convention on Climate Change Secretariat synthesis report on nationally determined contributions under the Paris Agreement, September 2021.

climate catastrophe



Why is COP26 so important?

Many people view COP26 as the world's last chance to avoid a climate catastrophe. The key aim of the meeting is to limit the global temperature rise to 1.5°C to avoid irreversible ecological consequences.

The meeting will be the first COP to discuss whether enough has been achieved since the landmark Paris Agreement six years ago. It is also the first meeting since the US re-joined the agreement.

What should we look for?

Because the burning of fossil fuels is the biggest contributor to emissions, an agreement to phase out coal-burning would be a major achievement. The UK is expected to call on all countries to set ambitious targets to reduce the quantity of greenhouse gases going into the atmosphere by 2030, and to achieve "net zero" (no more going into the atmosphere than is removed) by 2050.

Richer countries will also be asked to honour the financial pledge they made at COP15 in 2009 to help the poorest countries reach their targets by providing US$100 billion a year by 2020—a pledge they have failed to honour. ○

Brown bear catching salmon, Katmai National Park, Alaska.

Photo: Christoph Strässler, CC, Flickr.com

WWF's Arctic Conservation Forecast Initiative

Staying one step ahead of climate change

For decades, saving the magnificent salmon of Alaska's Pacific Northwest has meant protecting Bristol Bay. But as PETER CHRISTIE explains, the climate crisis is making conservation more difficult—and forcing the salmon to look elsewhere.

THE MAJESTIC, RIVER-THREADED watershed in southwest Alaska is the most productive salmon area in North America—and WWF and others have long battled to keep mining and other industrial development from threatening it. But the menace of climate change means the area is changing: spawn streams are warming, and changing river flows are putting eggs and fry at risk.

Now, salmon searching for cooler streams and better conditions may be more likely to find them farther north. For the first time, conservationists are being forced to consider that saving Pacific salmon in the climate-altered future may have less to do with today's Bristol Bay and more to do with where the best conditions for the salmon will be tomorrow.

"Really, for these species, it means anticipating salmon rivers where there are no salmon yet," explains Martin Sommerkorn, head of conservation with the WWF Arctic Programme. "So, at this point, we need to make sure these rivers have free access for spawning salmon and that there is no development at the mouths of the rivers, or development all along them, that could block those migrations."

IMAGINING THE FUTURE ARCTIC

The trick, in other words, is to take conservation steps now that envisage where and how biodiversity will live and thrive later—after climate warming has forced them to move or adapt. It's conservation as a moving target, and it's no mean feat.

Sommerkorn is one of the organizers behind WWF's new Arctic Conservation Forecast Initiative, a unique workshop series that offers some hope of meeting this extraordinary challenge. The project, which concludes this autumn, has been gathering international experts from climate science, oceanography, ecology and conservation to share knowledge from their distinct fields.

The aim is to look at the latest projections of what Arctic climate change will mean for temperatures, snow, sea ice, glacier melt and other physical ➤

PETER CHRISTIE is a science journalist and author who writes frequently about conservation, climate change and other pressing issues in environmental science. His most recent book is *Unnatural Companions: Rethinking Our Love of Pets in an Age of Wildlife Extinction*.

land and sea features in the future, and imagine how these changes will affect ecosystems, habitat and species, like the Pacific salmon.

"Obviously, the Arctic is going to change like crazy in the coming decades—we know this from all the projections of physical variables in global models," says Sommerkorn. "But our [current] view of conservation is quite static. We want to be prepared and figure out where to emphasize conservation in the future."

It is also about looking at how to emphasize conservation: while in some cases, this new view of proactive conservation will mean protecting species where they don't yet live (but likely will), it may also mean protecting suitable habitat "corridors," such as north-south mountain ranges, so species can easily shift their ranges and survive the altered climate. In other cases, it may mean focusing conservation efforts on existing ecological hotspots, where exceptional productivity and other life-supporting features are expected to continue and will become far more important to species, habitats and people as the Arctic heats up.

The trick, in other words, is to take conservation steps now that envisage where and how biodiversity will live and thrive later—after climate warming has forced them to move or adapt. It's conservation as a moving target.

SUPPORTING RESILIENCE

For some species, such as the migratory caribou found across the North, this future-thinking conservation means working to reduce non-climate-related threats—such as accelerating Arctic development—so that a species' natural resilience can help it cope with the stresses of climate change.

"There's huge stress involved in such an adaptation," says Sommerkorn. "We must make sure to take most or all of the other pressures off so they have a chance to adapt, and we must make sure they have the strength to do so."

Unfortunately, he says there will be an element of triage. "It won't be possible to save all Arctic life and all current Arctic places, given all the changes ahead, even with the best possible temperature increase outcome. So we want to make sure we invest wisely. And the changes may actually be coming quite quickly."

For Sommerkorn and other participants in the conservation forecasting workshops, this knowledge adds a sense of urgency to their work. As the Arctic warms ever more quickly, mining, shipping and other industries are accelerating across the region. The need for conservation to stay one step ahead means that the final report from the workshop series—expected later this autumn—will be vital in discussions with industries and marine and terrestrial planners and managers to ensure the protection of features that are necessary for the future of Arctic life.

"We have to make sure conservation is on the map," says Sommerkorn. "And we must take a future perspective so we can negotiate on behalf of life. That's proactive conservation." ○

Caribou, Bering Land Bridge National Preserve, Alaska.

Photo: Bering Land Bridge National Preserve, CC, Flickr

The science of sea ice

A disappearing world

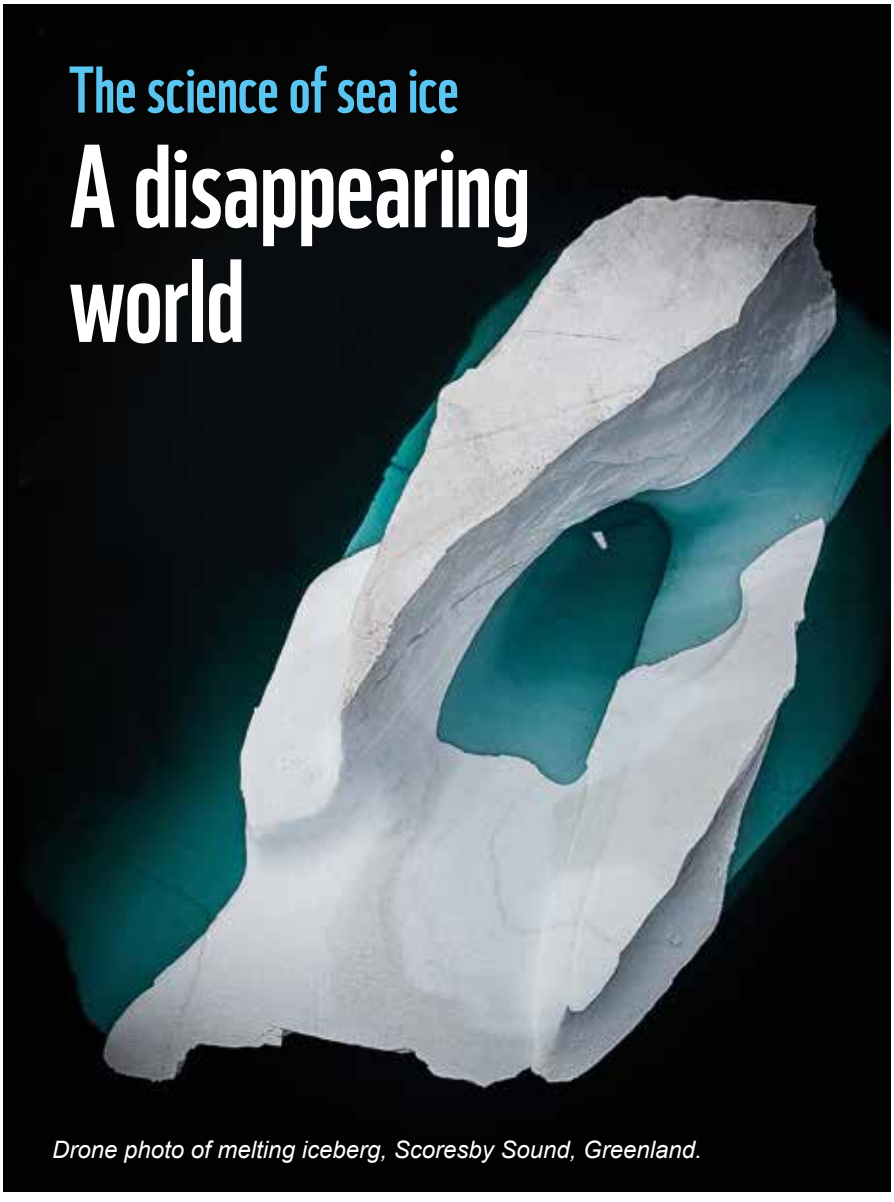


Photo by Annie Spratt on Unsplash

Drone photo of melting iceberg, Scoresby Sound, Greenland.

Seen from space, the Earth is a blue marble with a frosting of ice at either end. But closer up, the Arctic and Antarctic are very different worlds. DAVID MILLAR explains the history of sea ice and what the future may hold for it as the planet warms.

THE ANTARCTIC HAS a permanent ice sheet several kilometres deep, whereas the Arctic is an ocean covered by a thin layer of floating ice only a few metres thick. The critical consequence of this difference is that ice in the Arctic is far more fragile and dramatically more susceptible to the warming effects of the climate crisis. Also, unlike Antarctic land ice, Arctic sea ice varies with the seasons, growing each winter and shrinking each summer.

A BRIEF HISTORY OF ARCTIC SEA ICE

Both poles developed their current ice covers around 50 million years ago. By 13 million years ago, the Arctic sea ice had become perennial. However, it has varied over the years: two to three million years ago, it was considerably thicker than it is today—several hundred metres thick—although it has waxed and waned with the climate since then. As recently as 125,000 years ago, the area may have been almost ice-free, but for the last 5,500 years, there has been ice year-round.

However, the situation has changed dramatically over just the past few decades. Prior to the 1980s, at least half of the Arctic Ocean was ice-covered, even at the height of summer. But in recent years, the proportion has been as low as 28 per cent—and it is getting smaller every year. The ice is thinner, too, with very little "multi-year" ice—that is, ice thick enough not to melt completely in the summer and instead builds year over year.

Therefore, what is unique about the current situation is not so much the reduction in sea-ice extent, but the speed at which the ice has disappeared. We know there were big changes in the past, but they took thousands of years to occur. Today we are looking at an Arctic that will likely be completely ice-free in fewer than 50 years if we don't take immediate action. The speed of this change reflects the different causal mechanism—not slow-moving natural phenomena, as before, but the short, sharp shock of human-made change.

DAVID MILLAR is a research associate with the Arctic Institute of North America in Canada.

Although the ice of the Arctic Ocean is floating, its surrounding islands and land masses have year-round land-based ice. In some places, such as Ellesmere Island in Nunavut, Canada, it can reach thicknesses of hundreds of metres. But land ice is also melting. Some of the smaller ice caps have disappeared completely. (Fortunately, this generally has far less impact on ecosystems because fewer animals live or hunt on them.) Nonetheless, Greenland is currently melting at a rate of more than 200 cubic kilometres of ice per year, causing significant coastal erosion and ➤

We know there were big changes in the past, but they took thousands of years to occur. Today we are looking at an Arctic that will likely be completely ice-free in less than 50 years if we don't take immediate action.

reducing the salinity of the surrounding seas. Eventually, it may even have an impact on the Gulf Stream.

THE NEXT FEW DECADES

There is no question that anthropogenic climate change will affect the Arctic. It is already happening and is dramatically altering its ecosystems and the Inuit way of life. The questions scientists are thinking about now focus on how much worse it will get, how quickly, and how far beyond the Arctic the impact will be felt. In some scenarios, the Arctic could essentially be entirely ice-free in the summers within five to 10 years. Its fate depends on choices the world is making now: for example, if the global temperature increase can be held to 1.5°C, the Arctic may be able to retain some summer sea ice. But if we lose sight of that goal, summer ice will vanish within decades.

This will devastate polar bear populations, given that the bears need sea ice to hunt. How will it affect sea populations and fisheries? Warmer waters could well improve fisheries. The impact on people in the North will clearly be significant, but how, exactly?

Depending on one's perspective, some of the likely changes, such as increased tourism and shipping and easier mining, could be positive economic developments. But at what cost to local wildlife, traditional ways of life, and global efforts to contain carbon emissions? We don't have all the answers yet—but it may not be long before we experience the results of our choices. ○

Wildfires

Looking to Indigenous

As the climate warms, wildfires across the Arctic are surging. For example, extreme heat this summer in Russia led to more than 6 million hectares (15 million acres) of land being scorched in Siberia. The fires were so big that smoke reached Alaska.

The Gwich'in Council International (GCI) has been working with the Arctic Council to come up with ways in which Arctic nations can cooperate on their wildfire responses. One project run by the Council's Conservation of Arctic Flora and Fauna (CAFF) working group is looking at mapping wildland fires and sourcing best practices—including Indigenous knowledge—to better understand wildland fire ecology. A second project run by its Emergency Prevention, Preparedness, and Response (EPPR) working group is evaluating bilateral agreements between different states to look at cooperation and collaboration and form a new circumpolar agreement on wildfire response.

EDWARD ALEXANDER *is Gwich'yaa Gwich'in from Fort Yukon, Alaska. He is GCI's co-chair and head of its delegation to the Arctic Council's CAFF and EPPR working groups. He spoke to* The Circle *about the effect wildfires are having on Indigenous communities, and why it's important that the communities play a leadership role in these projects.*

How do these wildfires affect the communities that live near them?
One of the things we've seen is more evacuations. We've also seen wildfires in areas where they haven't traditionally occurred. For example, this year Iceland had its first experiences with wildland fires. Sweden had some significant wildland fires a few years ago when a heat dome was sitting above the country—but it hadn't had experience with wildland fire before. People are experiencing impacts like loss of economic activity and health effects from the smoke.

Indigenous knowledge doesn't need to be historical. If we can find and understand more examples of Indigenous knowledge about wildfire, I'm absolutely certain it will be useful to all of us in a circumpolar and global context as the fires become not only an effect of climate change, but a global driver of it.

communities for their knowledge

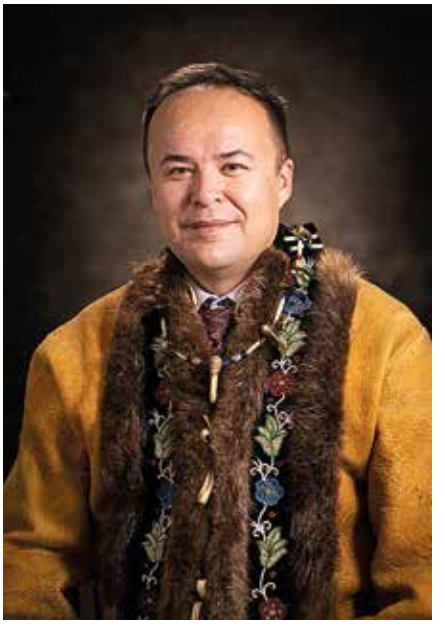
Here in Alaska, hunting areas and trap lines get burned, and those are productive areas that people rely on for food sources. So, it becomes a food security issue for people in the North.

Why do you think it's important that Indigenous People and organizations like yours take the lead in projects like these?

We're from this area, so we know what the history of wildfire has been here. We also know how we've managed the situation successfully in the past. I think it's important to have everyone involved for the health and safety of communities across the circumpolar North. A lot of those communities are Indigenous, so if we're going to have the best knowledge and local participants at the table, Indigenous People have to be included. It also means having scientists work together with Indigenous communities to better understand some of the practices we engage in and how they can be useful—not only in wildfire mitigation, but in managing global climate change.

Can you give an example of how Indigenous communities have managed fires in the past?

The examples I always give are the Gwich'in practices around fire. One involves burning meadows in the springtime. These are cultural burns, basically prescribed burning that Indigenous People here have engaged in for a long time. There are some key features that differ from the prescribed burning done by the Canadian Fire Service or the US Forest Service. For example, we only do our prescribed burns during



Edward Alexander.

a very particular time of year, when there's still snow on the ground and in the woods and the ground is still frozen. This protects the plants' root systems and makes wildland fires more containable so they don't spread through large grasslands and the taiga forest. Wildland fires weren't historically as large here because these meadows and lakes would basically serve as containment areas where the fire couldn't go through.

These cultural burns also improve the nutritional value of plants. Because these areas are burned in the springtime, the plants have higher nutritional value for the different species that depend on them, such as muskrats, waterfowl and other migratory birds. I've seen estimates that this practice increases nutritional value by 50 per cent for these animals. Maybe it's just burning off non-productive grass so that the land produces a wider variety of plant species that host more diverse animals and insects, thereby increasing the carrying capacity of the land and, in turn, food security for Native people.

But these practices don't need to be historical. Indigenous knowledge doesn't need to be historical. If we can find and understand more examples of Indigenous knowledge about wildfire, I'm absolutely certain it will be useful to all of us in a circumpolar and global context as the fires become not only an effect of climate change, but a global driver of it.

What are your long-term hopes for these wildfire projects?

Well, for the EPPR project, we hope it results in a binding agreement between all the states so they can work together on wildland fire operationally and establish a mechanism to gather and share their best knowledge. For the CAFF project, we hope it brings forward wildland fire ecology in the North so communities are better informed about wildland fire. We feel that if we can get operational folks, Indigenous communities and scientists to come forward and work together, we're going to get to a much better place as far as dealing with the impacts of wildfire in the North.

It's a big issue, and hopefully this is just the start, because we all have our part to play. I hope folks will get involved so they can understand how to make their communities more resilient against wildfire and so we can address global climate change together. ○

Permafrost

Let's keep it frozen

A warming climate is causing permafrost thawing and coastal erosion near the Laptev Sea.

Photo credit: Tom Arnbom

Thawing permafrost is already making things difficult for people and species in the Arctic. But as TOM ARNBOM writes, if thawing continues and causes the release of methane from the ground, the climate crisis will escalate dramatically and we will feel the effects globally.

THE CREAKING IRON gate slowly opened, revealing the way down to the underground museum. I had stepped thousands of years back in time: wherever I looked, there were boxes of ancient bones from mammoths, horses and seals—even a whole mammoth calf. I was encountering hidden treasures surrounded by permafrost underneath the town of Chatanga in Russian Siberia. Instead of wood or concrete, the museum's floors, walls and ceilings were made of permafrost.

TOM ARNBOM focuses on Arctic and marine issues as WWF-Sweden's senior advisor. He has almost 50 years' experience in the Arctic.

Permafrost consists of permanently frozen layers of ground, from the surface to depths of hundreds of metres. Very often, ice is part of it. Permafrost covers 24 per cent of the land masses in the northern hemisphere, and can also be found on the ocean floor. It is estimated that the world's permafrost contains up to 1,700 billion tonnes of carbon—almost double the amount of carbon that is currently found in the Earth's atmosphere.

WHY WE NEED THE PERMAFROST TO STAY FROZEN

Permafrost plays a key role in storing carbon, keeping it from being released into the air as greenhouse gases. But when permafrost thaws, we may be in real trouble: even if just a fraction of the carbon it contains is released quickly, the consequences will be severe, not only for the Arctic, but for the Earth's entire climate system. Permafrost is also vital for migrating reindeer, preventing

When permafrost thaws, even if just a fraction of the carbon it contains is released quickly, the consequences will be severe, not only for the Arctic, but for the Earth's entire climate system.

them from sinking into wetlands, especially during their spring migrations. It also keeps the ground solid, preventing erosion, supporting infrastructure and keeping nasty diseases, such as anthrax, frozen.

In many places, the surface layer of the permafrost thaws during the summer. Unfortunately, these areas have been growing in size for several reasons. The most obvious is the climate crisis, which is causing higher surface temperatures. Other causes include the clear-cutting of forests, the construction of new infrastructure, and the growing prevalence of large forest fires.

Degradation of permafrost has several negative consequences. The most visible is that buildings, pipelines and airstrips tilt when the Earth becomes unstable. Think of it like the steel frame that holds up a house: if you remove it, the house will collapse. More than 40 per cent of the buildings in the Russian Arctic have been damaged due to thawing permafrost. In 2020, a catastrophic industrial spill in the town of Norilsk caused more than 21,000 tonnes of diesel to spill into several rivers and lakes. The culprit: thawing permafrost and poor maintenance. The company was fined US$2 billion. But money cannot undo the damage.

The Arctic has long been seen as a carbon sink, but new research suggests it is now emitting more carbon than it is absorbing. Permafrost has vital global importance. We must cut greenhouse gas emissions sharply and immediately to avoid a world-changing meltdown. ○

Adaptation and infrastructure

Plans are just the start: Sub-Arctic communities need a whole-of-society approach to carry them out

Nearly three years ago, the Town of Churchill, a municipality in northern Manitoba, Canada, lost its only land connection to southern Canada when record flooding washed out portions of the 400 kilometre railway track leading to Hudson Bay. Infrastructure-damaging events like this are becoming more frequent and intense. As TREVOR DONALD explains, communities in northern Canada cannot be expected to live with the continued impacts of thawing permafrost. And they need more than just adaptation plans: they need an integrated approach to implement them so events like this don't happen in the future.

IN NORTHERN CANADIAN communities, extreme weather events are forcing people to find innovative ways to adapt to the climate crisis and boost their resilience in the face of multiple simultaneous challenges. Churchill and many similar communities are trying to do this while pushing Canada to address the lingering disparities that stem from the legacy of residential schools, forced relocations and the side-lining of Indigenous traditional knowledge.

Churchill's adaptation story to date is the product of a collaborative initiative by the Government of Canada and the Federation of Canadian Municipalities to help Canadian communities adapt. In 2020, the town created a climate change ➤

Photo credit: Trevor Donald

Shown in the distance, the port of Churchill, Manitoba does not connect directly to a road system. All goods shipped to and from the port must travel by rail.

adaptation plan to cope with the impacts of the accelerating climate crisis. The plan was designed to help the town take advantage of federal and provincial funding opportunities for core services and adaptation. The town also hopes the plan will bring the government's attention to other communities that, like itself, sit on permafrost, yet are often excluded from policies, funding streams and programmes that address climate change. But with plan in hand, what's next?

THE NEED FOR COMMUNITY ENGAGEMENT

To address issues like those faced by Churchill, Canada is now working on a national adaptation strategy. However, if the government is to meaningfully address the impacts of climate change in the North, it must go further and engage with communities like Churchill. In fact, it must go beyond Churchill and involve a wide range of communities over the large geographic expanse of Canada's North. This sentiment is backed by an International Institute for Sustainable Development report that recommends countries go well beyond consultations to invest in capacities for engagement and, once capacity is strengthened, co-designing processes and solutions.

In July 2021, the Government of Canada released a national infrastructure assessment. Informed by public engagement with more than 300 organizations and individuals, the report highlights recommendations that will guide the design of Canada's first national infrastructure assessment.

In 2017, the only train to Churchill, Manitoba was suspended for more than a year after catastrophic flooding damaged the tracks.

What's needed is an integrated, whole-of-society approach. This would bring together all levels of government, First Nations and Inuit organizations, and the private sector to address climate changes in the North.

This is a step in the right direction, but the report—and the national narrative around infrastructure—remains South-oriented, and this needs to change if we hope to address northern realities. As permafrost thaws, the ground becomes unstable, jeopardizing the structures that are built on top of it. But the national infrastructure assessment doesn't even mention permafrost.

Meanwhile, a recent IISD report found that Canada's "infrastructure deficit" is anywhere from CAD$150 billion to CAD$1 trillion, with the gap for

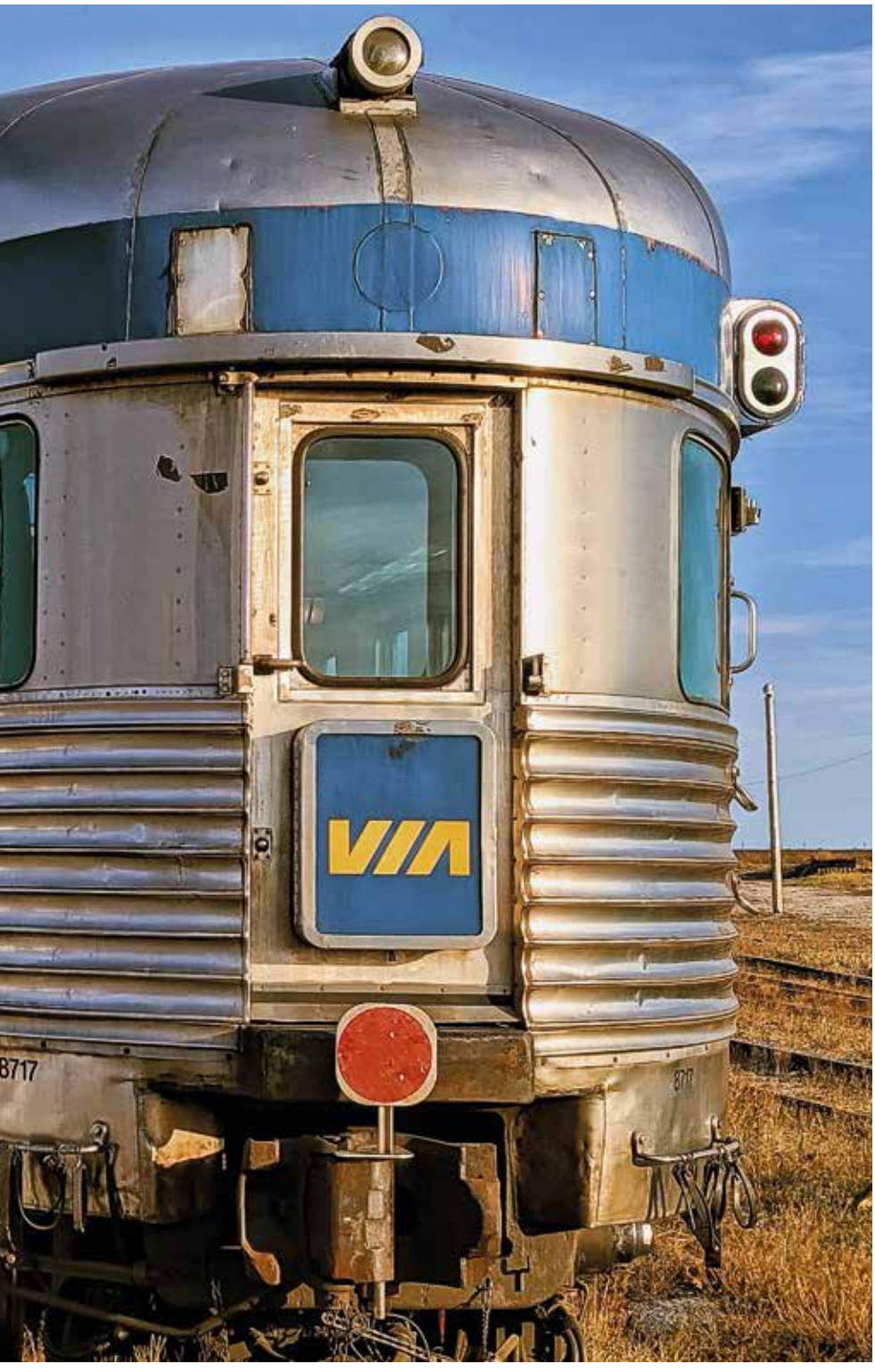


Photo credits: Trevor Donald

The national narrative around infrastructure—remains South-oriented, and this needs to change if we hope to address northern realities.

Indigenous infrastructure ranging from CAD$25 billion to CAD$30 billion.

Quality infrastructure in the North matters, especially given the numerous land-claims agreements and treaty lands in the area and the ever-increasing accessibility of natural resources and shipping routes.

LEADERSHIP AND VISION REQUIRED NOW

The Arctic Council Strategic Plan might be a template from which Canada can develop its northern strategy. The Council's strategic vision is that by 2030, "all Arctic people will have pathways for sustainable social and economic development while respecting the environment." Simply trying to fill an ever-widening infrastructure gap and relying on past climate forecasts to make decisions about the design, construction and maintenance of existing and new infrastructure doesn't work. What's needed is an integrated, whole-of-society approach. This would bring together all levels of government, First Nations and Inuit organizations, and the private sector to address climate changes in the North.

Fortunately, after Churchill's railway disaster, the town was able to build back better. But as disasters like this one stack up as the climate crisis accelerates, the repeated shocks will stretch scarce resources thin, force people to consider leaving for larger urban centres in the South, shrink the tax base and make it increasingly hard for municipalities to fund basic services, let alone build back.

TREVOR DONALD was the climate change adaptation coordinator with the Town of Churchill, Manitoba, Canada. He is now the climate change action coordinator with the Township of Georgian Bluffs in Ontario, Canada.

We must start recognizing that communities like Churchill are on the frontlines of climate change and support them accordingly. We cannot expect them to just live with the continued risks and impacts of climate change and thawing permafrost while adaptation plans sit on the shelf. These communities require bolder solutions to mitigate more frequent and intense weather disasters and build more resilient communities. ○

Photo: National Park Service via goodfreephotos.com

Ponds and marshes in the Kobuk River Region, Alaska.

Wetlands

Don't drain the swamp! Arctic wetlands threatened by climate change and human impacts

Effective stewardship of Arctic wetlands, including conservation and restoration efforts, has enormous potential to buy the world time by contributing to climate mitigation and adaptation. A new circumpolar report and recommendations adopted by the Arctic Council Ministerial in Reykjavik, Iceland, highlight the importance of Arctic wetlands. As MARCUS CARSON explains, the report also identifies actions to support the conservation and restoration of wetlands.

IF YOU'RE A regular reader of *The Circle*, you probably already know that wetlands, including Arctic wetlands, are incredibly important for bird migration, wildlife habitat and biodiversity generally, and for water-related ecosystems services and support of recreational activities and traditional livelihoods.

What's less widely known is that they store a stunning amount of carbon. Unfortunately, their role as a carbon sink is threatened by both the climate crisis and increasing human impacts in the Arctic. Peatlands, tundra and thawing permafrost all release carbon when they are dried,

damaged or thawing.

But actions can be taken to conserve and even restore these areas. In April 2021, the Arctic Council Ministerial in Reykjavik adopted a suite of recommendations and strategic priorities that could help expand and accelerate conservation and restoration.

WORKING TO PREVENT IRREVERSIBLE CHANGES

Many of the Earth's wetlands are found in the Arctic, but there are also large expanses of degraded wetlands in boreal zones, where they can be affected by drainage or peat mining. Climate change and permafrost thaw are causing irreversible changes to these ecosystems. While the only way to avoid large emissions of wetland greenhouse gases is to slow human emissions globally, restoring damaged and degraded wetlands can slow this process by substantially reducing current emissions.

For example, through nature-based interventions—such as the restoration, rewetting and establishment of wetlands—Sweden is emphasizing wetlands from 2021 to 2023 to help achieve its national goal of zero emissions by 2045. Finland, Norway and Iceland have similar initiatives underway.

The *Resilience and Management of Arctic Wetlands: Key Findings and Recommendations* report provides 13 key findings and a suite of 20 policy recommendations designed to maintain and strengthen the resilience of wetlands, all aimed at policy-makers and observers participating in the Arctic Council Ministerial meeting. The recommendations outline a variety of actions to strengthen cooperation, facilitate collaboration and accelerate efforts to restore and conserve Arctic wetland areas, including permafrost. The background report on which the recommendations were based shows quite clearly that we know enough about wetlands ecosystems to support ambitious action. The weak link is the adoption and implementation of policies that prioritize the conservation of wetlands.

Addressing the degradation of Arctic wetlands will be an important Arctic-specific contribution to curbing the global emissions that are driving climate change, and will provide insights and experience that reach beyond the Arctic region.

A BREAKTHROUGH FOR WETLANDS CONSERVATION

Many of the findings and recommendations in the report are also highly relevant outside the Arctic, and Arctic states have an important opportunity to act as role models for the sustainable use of wetlands. This is the first time the Arctic states have engaged in a pan-Arctic effort to conserve wetlands, and their actions could boost global efforts to curb climate change. The adoption of recommendations and strategic goals for wetlands represents a breakthrough, in part because the Arctic Council has previously steered away from engaging on climate change, taking the view that it is being addressed in other multilateral fora. This kind of action is possible, and especially important, given the change of administration in the United States. As part of the country's climate mitigation plans, the Biden government is prioritizing actions to restrain climate change, including the restoration and conservation of wetlands.

Addressing the degradation of Arctic wetlands will be an important Arctic-specific contribution to curbing the global emissions that are driving climate change, and will provide insights and experience that reach beyond the Arctic region.

MARCUS CARSON has worked on questions related to social-ecological systems in the Arctic for nearly a decade. He is an associate professor of sociology and a senior research fellow at Stockholm Environment Institute.

While the role of wetlands in climate change remains underappreciated, there are a few areas where ecosystem stewardship—restoration, conservation and wise use under changing conditions—can address many critical issues at once, including climate mitigation and adaptation, biodiversity protection and water-based ecosystem services. Clearly, there is no time to lose. ○

Developing *Resilience and Management of Arctic Wetlands: Key Findings and Recommendations*: a collaborative effort

The report's recommendations were a team effort, developed in collaboration and with input from international participants, including WWF. Contributions came from wetland experts, Indigenous Peoples, policymakers and NGO representatives across the Arctic. Researchers from Stockholm Environment Institute (SEI), the Swedish Environmental Protection Agency (Naturvårdsverket), Stockholm University and Conservation of Arctic Flora and Fauna (CAFF) led the work. The report was produced within the Resilience and Management of Arctic Wetlands initiative 2017–2021 and supported by an SEI-led international project funded through the Belmont Forum, a WWF partner.

Photo by Jessie Lindsay, NMFS MMPA Permit No. 19309.

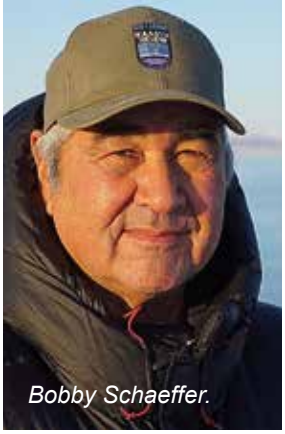
A bearded seal sits on the ice edge in Kotzebue Sound in the Chukchi Sea.

Bearded seals

Retreating sea ice threatens Indigenous way of life

Climate change is not only affecting the health of many Arctic species—it is also having an impact on the people and communities that depend on them to survive. A new study shows that a decline in sea ice has severely curtailed the length of the seal-hunting season in northern Alaska, threatening the communities that have depended on these marine mammals for food and clothing for generations.

The study was led by Indigenous hunters, the Native Village of Kotzebue, Alaska, and scientists at the University of Alaska Fairbanks. It found that over the past 17 years, the hunting season for bearded seals, called ugruk in Iñupiaq, shrank by one day each year. BOBBY SCHAEFFER is one of the Iñupiaq elders and hunters who co-authored the study. He spoke to *The Circle* about the changes he's seen in the seal population and what its decline might mean for his community.



Bobby Schaeffer.

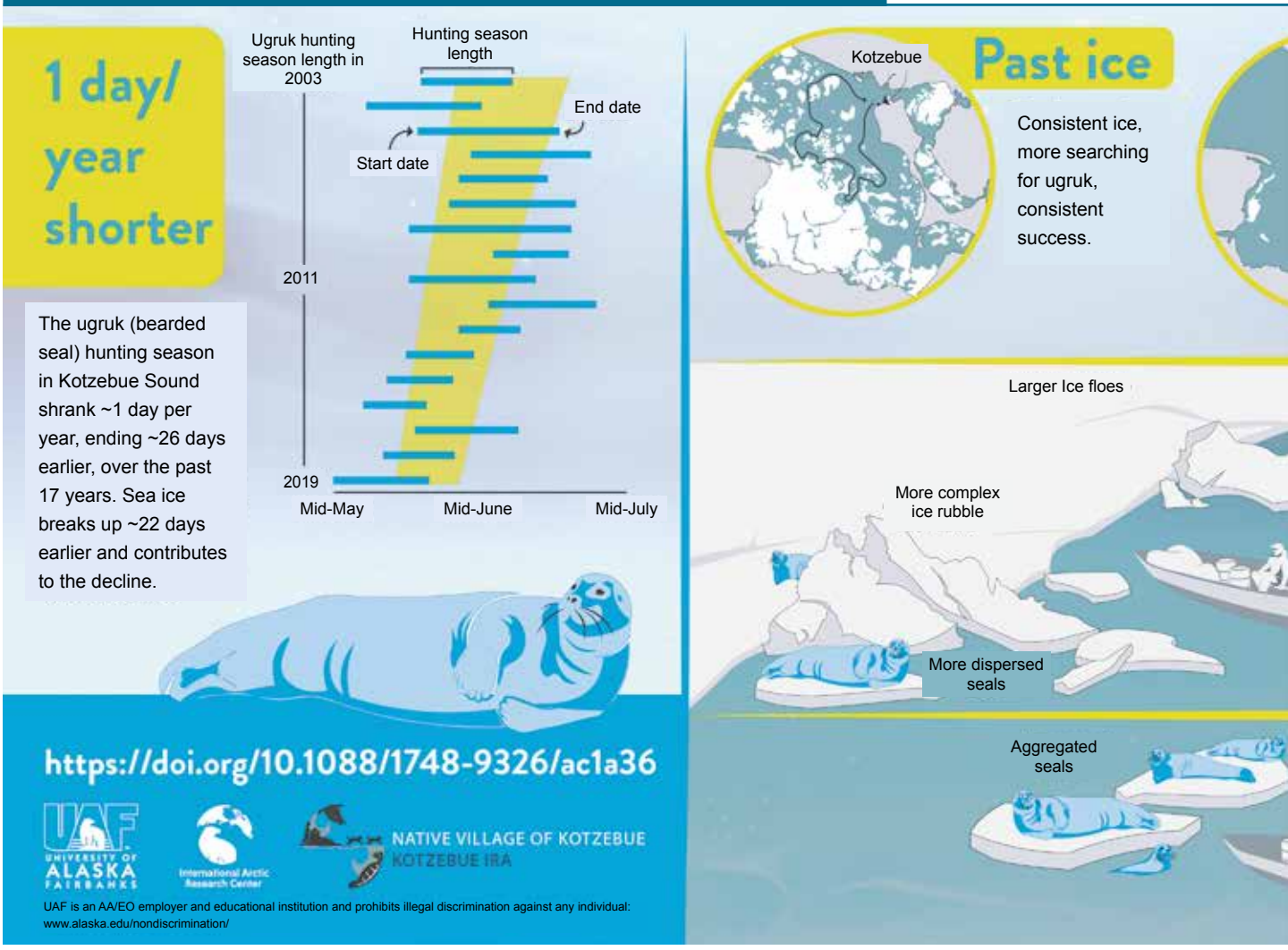
Photo from Sarah Betcher, Farthest North Films

"We used to get two to three inches of blubber out of our ugruk, or bearded seal, but the ones we got last year had only about an inch of fat."

What was your role in the study, and why did you get involved?
I took the scientists out on the ocean, and we studied the sea ice to try to determine what impacts the thinning of the ice was having on our seals. It was interesting to look at sea ice from a scientific perspective because I had never done that before—as a subsistence hunter, I've always looked at it from the animal perspective. I got involved in the study because we're feeling the effects of the climate crisis more than most places in the state, and in fact, most places in the world. It is affecting our subsistence resources, our animals in the oceans and our animals on the land.

What changes in the sea ice have you seen during your lifetime?
A huge difference, all for the worse. When I was growing up in the fifties, we had minus 40°C or minus 45°C, guaranteed, between December and January, our coldest months. The ice got to be more than two metres thick, and my dad was always out on the ocean hunting seal during the warmer periods after storms. That was a really important part of our diet. But as time went on, he started noticing the huge differences in the weather patterns and the thickness of the ice—and that was back in the early seventies.

Loss of Indigenous hunting opportunities in the face of Arctic climate change



https://doi.org/10.1088/1748-9326/ac1a36

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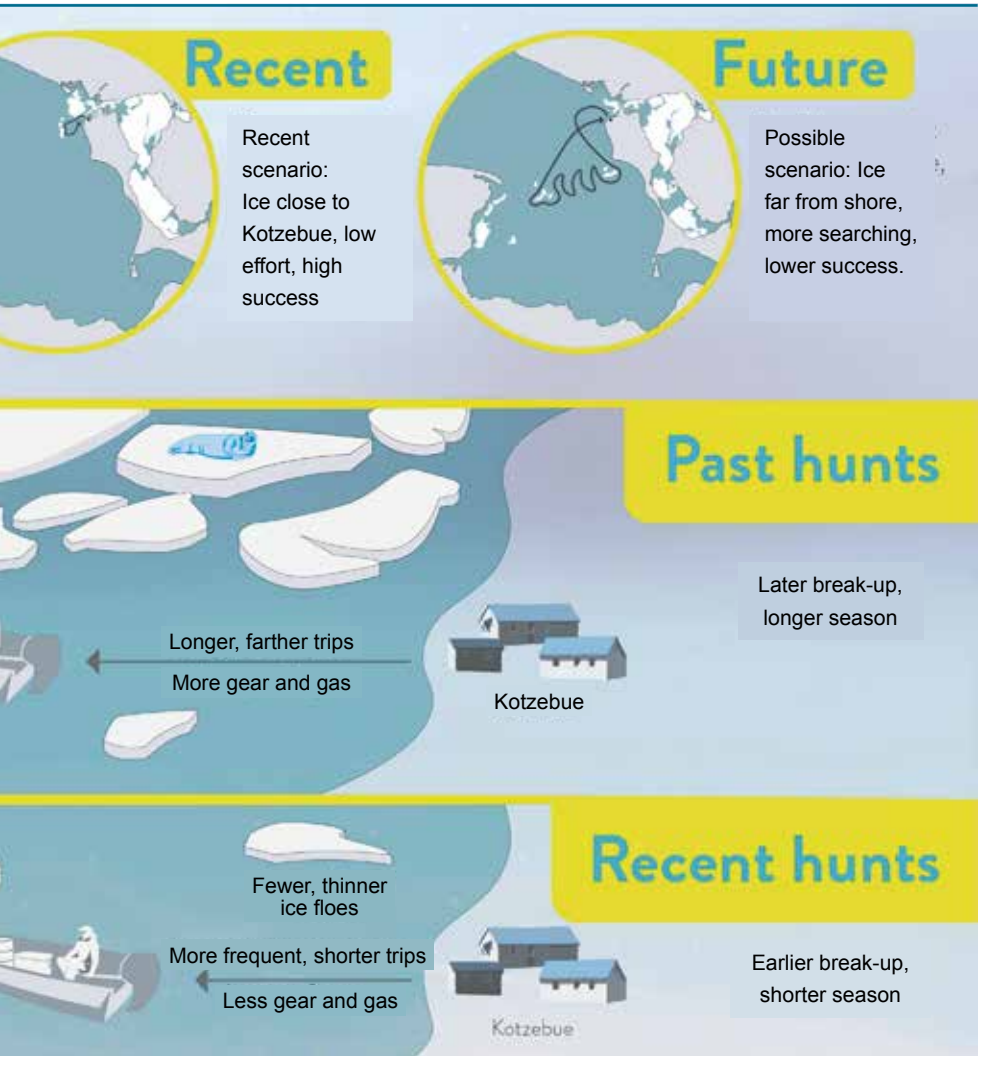
What about temperature changes?
My dad also talked about the differences in the lengths of our winters. Usually, we'd have four months of summer and eight months of winter, but that has changed rapidly. As our summers got hotter—it wasn't uncommon to see 27°C or 30°C degrees at our camp in the summertime—the waters started heating up tremendously. A lot of algae started to grow, and we started noticing a difference in the health of the fish. Around the same time, we noticed the ice getting thinner out where our seals live. That was back in the sixties. These changes really started to speed up in the seventies, and even more so in the eighties and nineties. By 2018 and 2019, Kotzebue Sound was ice-free all winter. And that had never happened before.

We are north of the Arctic Circle, and we are supposed to get our 40°C and 45°C below winters, but we never see these temperatures anymore. Never. Last year, for example, it never got cold until February. It stayed warm, a few degrees above or below zero, the entire time. So, the changes have been dramatic—traumatic, for that matter.

How has this affected the seals that you would traditionally hunt?
It has changed the seals' feeding habits—and our way of hunting—tremendously. For seals, ice is so important, especially the bearded seal, which we harvest in the springtime. They have to go to where the food is plentiful. And when they get done feeding, they normally rest on top of the ice to digest their food. But in 2018 and 2019, and even 2020 and 2021, the seals we were getting were healthy, but not fat. We used to get two to three inches of blubber out of our ugruk, or bearded seal, but the ones we got last year had only about an inch of fat.

What's happening is that when they go to the hotspots to feed on clams and shrimp, there is no ice, so they have to travel for 30 to 50 kilometres before they can start feeding. And when they get done, there is no place to rest and digest their food, so they have to swim all the way back to the edge of the ice. So, they are getting a lot more exercise. So, not only are we seeing animals that are a lot skinnier now, but we also have to travel further away to find them, because there is no ice out there.



What concerns do you have for the future of this seal population?
The ugruk, or bearded seal, is probably the most important sea mammal that we hunt. It has a lot of fat, and we render the blubber for seal oil. We store a lot of the dried meat products from that animal in seal oil to preserve it for long periods of time. The nutrition part is really important too.

We are also seeing a lot of dead seals on the beaches because there is no more ice to protect them during huge storms. After one storm we had in the spring, a number of seals drowned because there was no ice for them to haul out on. They don't like to go to the beach because the waves will hurt them, so they end up drowning out there. I don't know how many we lost.

How should people respond to the changes you've described?
It's important that people take notice, because we're already experiencing the effects of the climate crisis, especially when it comes to our sea mammals and their health. The most important part is that it is also going to affect the food chain.

What can we do to change this? It is up to the people of the world. We need to find an energy source other than fossil fuels. If we don't, we are doomed. The Earth is doomed. ○

Bridging the science gap

A conversation between Saami youth climate activist and Belgian royalty

Indigenous climate activist MARTINA FJÄLLBERG and Belgium's PRINCESS ESMERALDA may be from different countries, backgrounds and generations, but they have one thing in common: their passion for protecting the environment.

As a Saami reindeer herder from a village in northern Sweden, 22-year-old Martina Fjällberg has seen how climate change is threatening her community's way of life. To help put an end to the climate crisis and fight to protect her culture, she's studying biology and geoscience at Umeå University in northern Sweden. She is also vice-president in the Saami youth organisation Sáminuorr. She was the guest editor of The Circle's *recent* Youth in Action *issue.*

In addition to being a member of Belgium's royal family, Princess Esmeralda is a passionate campaigner for the environment and Indigenous rights, and has had a successful career as a journalist, writer and documentary maker.

As part of a recent episode of WWF International's podcast, Forces of Nature*, the two women spoke to each other about the challenges many Indigenous People face in getting their views on environmental matters heard. Here's part of that conversation.*

Esmeralda: What changes have you noticed as a result of climate change, especially in reindeer herding?

Martina: One of the changes my father says he has noticed the most is that you can't plan the reindeer herding as you used to. Back in the day, you could anticipate the weather. You could see that tomorrow is going to be like this, and the next week it's going to be like that. But now the weather is shifting so much because of climate change. We can't plan the same way we once did.

Esmeralda: Do you think Indigenous People—who are really on the ground and so much in contact with nature and with the animals' behaviours—have observations that would be different from those of non-Indigenous people?

Martina Yeah, I definitely think so, because it's real to us in a way that it isn't to a lot of other people—because our culture and our lives and everything are so deeply connected to nature. When nature changes, our culture also changes in some ways. As an example, in Saami culture, we have over 200 words for snow. But because of the changing climate, maybe 50 of these types of snow don't exist anymore. Without them, we are also losing the words for them. In that way, we are losing language because of climate change. And we then lose culture. So, it's so much more than just losing ice. And reindeer herding is one of the big things that is really affected.

In Saami culture, we have over 200 words for snow. But because of the changing climate, maybe 50 of these types of snow don't exist anymore. Without them, we are also losing the words for them.

Esmeralda: Despite that, we might say that science has not recognized Indigenous knowledge. Did you feel that you had to go to university to become, let's say, legitimate in your actions to protect nature and stop climate change?

Martina: In Sweden, at least, it seems like you have to be a professor or a researcher or scientist to be able to say, "this is a fact" or "this is something that's changing." As Indigenous People in Sweden, I don't feel we are taken as seriously as scientists or professors because we are not educated in the same formal way. I chose to go to university and get a degree so I can be more respected in Sweden—so that when I

Martina Fjällberg taking part in the recording of Forces of Nature.

Princess Esmeralda during the recording of the podcast.

say, "I see this change in our culture, I see this change in reindeer herding, and this is real," I will be taken seriously.

Esmeralda: Do you think getting a degree will change your perspective or your voice?
Martina: I think it will help me connect my background as a reindeer herder and Indigenous person with the more science-based world. I can be like a bridge between those two worlds in Sweden so that more people understand the link between Indigenous knowledge of nature and some things that are actually more scientific. Indigenous People have known these things for centuries because when you live with nature, you understand it in a different way. And that knowledge is something that really should be taken seriously and considered in all these different reports and studies.

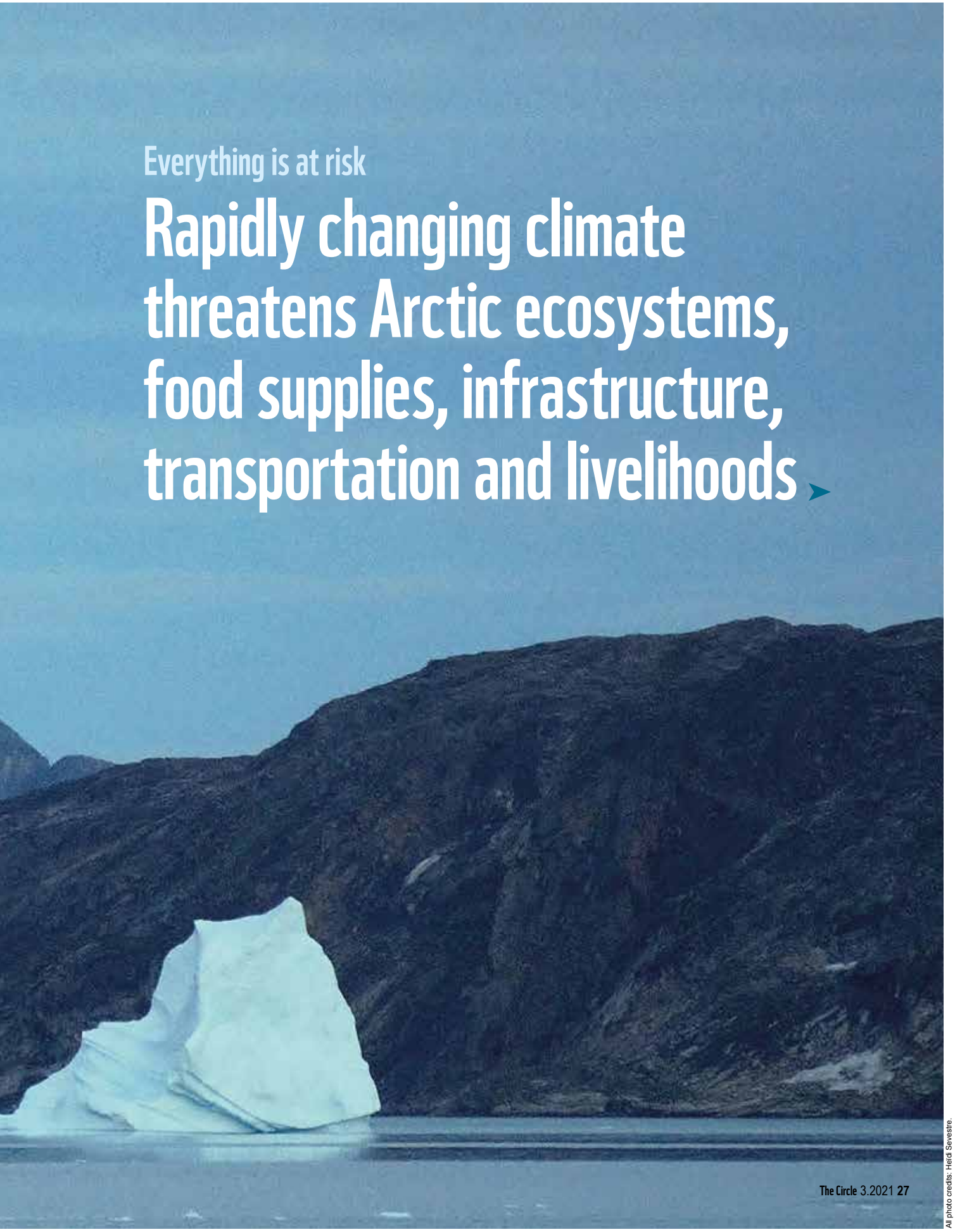
Esmeralda: Conservation has not always worked (together) with Indigenous People, and sometimes there has been confrontation. I would like to know what your point of view is. What do you think is the best way to work on conservation projects?
Martina: I think the biggest thing when doing conservation work in an area is to include the Indigenous People who live there. They are the ones who should be leading the work, in a way, because they are the ones who know nature the best. Include the Indigenous People in a way that isn't just about listening, but also letting us lead and make decisions. Otherwise, we're still left on the side. ○

As WWF turns 60, it's hosting a series of candid conversations between some of the biggest names in the environmental movement. Through these conservation conversations, we'll hear how action to save our planet has changed over the past six decades and what the next generation can learn from legendary trailblazers. You can subscribe to the podcast and join the conversation on social media using ***#ForcesofNature****.*

A full moon shines over the Bear Islands in Scoresby Sound during a calm autumn evening in Greenland.

Everything is at risk

Rapidly changing climate threatens Arctic ecosystems, food supplies, infrastructure, transportation and livelihoods



All photo credits: Heidi Sevestre.

As WWF has frequently documented in its reports and web content in recent years, the Arctic is warming more quickly than any other region on Earth—and Indigenous People are experiencing major impacts from the many climate-related changes that continue to occur there. JANET PAWLAK highlights the findings of a recent report by the Arctic Monitoring and Assessment Programme (AMAP). Spoiler alert: No aspect of life in this region is unaffected by increasing temperatures and their impacts on ice, snow, permafrost and ecosystems.

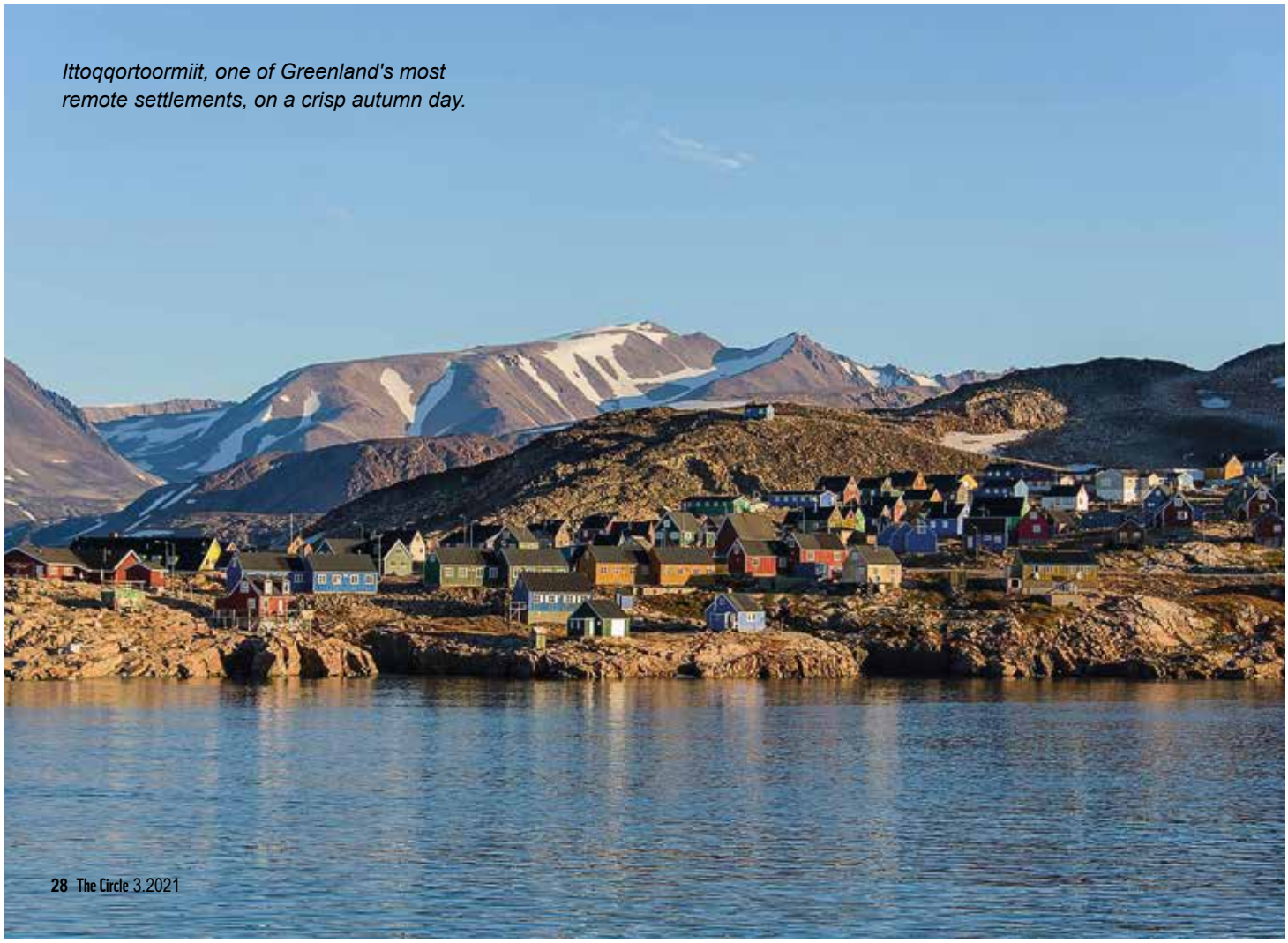
FOR PEOPLE AND animals living in the Arctic, climate change is not a distant threat—it is the driving force in many of the environmental, economic and societal transitions in the region today. These impacts are especially hard on Indigenous communities.

AMAP recently updated past assessments in a report titled Arctic Climate Change Update 2021: Key Trends and Impacts. This report shows that climate change is affecting virtually every aspect of life for people in the Arctic—particularly Indigenous communities—because of its effects on ecosystems, especially with regard to the productivity, seasonality, distribution and interactions of species in Arctic terrestrial, coastal and marine environments. Extreme weather events are increasing in intensity and frequency.

THREATENING THE TRADITIONAL ARCTIC WAY OF LIFE

Changes in sea ice, precipitation, snow regimes, temperatures and tundra productivity are affecting the availability of traditional foods, such as whales, walrus, seabirds, seals, caribou and even berries. In some areas, tundra greening is changing the ranges of the wildlife species that are important to hunters. For example, reindeer herders in Fennoscandia and Russia have experienced major losses in their herds due to extreme snowfall and rain-on-snow events (when rain falls on snow and freezes, creating an impenetrable layer of ice that prevents the animals from getting to their food).

Although the trend toward warmer



Ittoqqortoormiit, one of Greenland's most remote settlements, on a crisp autumn day.

Photo: Heidi Sevestre

springs and the earlier greening of pastures can have positive impacts on reindeer production, these are offset by challenges like increasing wildfire events, industrialization and greater numbers of predators. The safety of food stored in ice cellars has also been affected in some areas by permafrost thaw and higher temperatures. There is a greater occurrence of toxic algal blooms, which pose risks to food security and health. Periods of heavy rainfall and rapid snowmelt can also help pathogens to travel, posing risks to the safety of drinking water.

The warming climate has also affected how residents travel in many parts of the Arctic. For hunters in northwest Greenland, the period when travel by dogsled on sea ice is possible has decreased to three months from five months. Changes in sea-ice cover can also make transportation over ice dangerous. In addition, permafrost degradation and more frequent rain events are making local travel by all-terrain vehicles more difficult in remote settlements in Canada and Russia.

PUTTING NORTHERN COMMUNITIES AT RISK

More than 66 per cent of Arctic settlements are located on ice-rich permafrost—and buildings, roads and other forms of infrastructure are suffering damage as the permafrost thaws in many regions. In fact, the stability of the permafrost has been declining in Arctic Russia since the 1970s, affecting nearly all infrastructure in most settlements on the Taimyr Peninsula. Permafrost slumping (during thawing) also poses risks to transportation infrastructure. Coastal erosion rates in the Arctic are among the world's highest, with impacts to communities, property, infrastructure and livelihoods.

Extreme climate events—including wildfires, inland and coastal flooding, and extreme temperature and precipitation events—are having major socioeconomic impacts in the Arctic, and are only expected to become more frequent and severe in the years ahead.

Photo: Heidi Sevestre

The elusive Arctic hare in its white coat, ready for the harsh winter months in Greenland.

More than 85 per cent of Native villages in Alaska currently experience some level of flooding and erosion. Severe floods pose particular risks for remote communities where search and rescue operations may be limited or unavailable. Heavy snowfall and rainstorms bringing high winds have induced avalanches, slush flows and landslides on the Svalbard archipelago over the past decade.

The incidence of wildfire has increased in Alaska and Siberia. Wildfire destroys ecosystems, puts lives and property at risk, causes economic costs related to fire suppression efforts and damage recovery, and creates health impacts from smoke and related toxins, public anxiety and personal stress.

Traditional ways of life as well as species and ecosystems may disappear forever if the world does not take swift, decisive measures to reduce the greenhouse gas emissions that are driving up temperatures.

THE TIME TO ACT IS NOW

Rapid climate change in the Arctic is seriously affecting the lives and livelihoods of Arctic residents. Traditional ways of life as well as species and ecosystems may disappear forever if the world does not take swift, decisive measures to reduce the greenhouse gas emissions that are driving up temperatures. Although the effects of climate change are being felt now and most strongly in the Arctic, the long-term impacts will be felt far beyond the region.

JANET PAWLAK is deputy executive secretary of the Arctic Monitoring and Assessment Programme (AMAP) Secretariat.

Arctic states, Permanent Participants (Arctic Indigenous Peoples organizations) and observers to the Arctic Council should individually and collectively lead sustained, ambitious and global efforts to reduce these emissions and fully implement the Paris Agreement. Climate change is a global problem—and if we don't act now, there will be no second chance. ○

Harnessing the power of ocean-climate solutions

From melting sea ice and thawing permafrost to coastal erosion, the devastating consequences of climate change are playing out in marine ecosystems and coastal communities across the Arctic. But as PETER WINSOR writes, the Arctic Ocean can play a key role in addressing these consequences, not only by moderating the global climate, but by providing food, livelihoods and cultural identities for many people along with options for ecosystem-based adaptation. Conserving ecosystems in an ocean affected by rapid climate change will not only safeguard Arctic biodiversity, but support the resilience of the people who depend on these ecosystems.

OUR OCEAN and coastal habitats hold vast potential to help us mitigate, adapt and build resilience to the impacts of climate change. For example, climate-smart marine protected area networks can help ensure plentiful fish stocks for current and future harvest. Measures like these—linked to ecosystem-based adaptation—can contribute to the resilience of communities and livelihoods and are a critical part of the solution for the Arctic.

But the ocean also offers opportunities for carbon sequestration. In some places, coastal "blue carbon" ecosystems, such as seagrass beds, kelp forests and, to some extent, saltmarshes, can sequester as much carbon per hectare as terrestrial ecosystems, or more. In addition, like coral reefs, they can act as blue infrastructure, offering protection from storms and other impacts of climate disruption.

To meet the Paris Agreement's goal of limiting the global temperature rise to no more than 1.5°C, we need to use every tool at our disposal, and that means tapping into the power of the ocean. The ocean provides enormous opportunities and solutions to mitigate the impacts of greenhouse gas emissions, yet few countries have even begun to capture this potential to respond to climate change in their plans—particularly in their nationally determined contributions, or NDCs.

It's also vital that national adaptation plans include ocean-related measures. WWF's *Blueprint for a Living Planet* outlines four principles for integrated ocean-climate action that we expect will guide discussions going into the crucial UN climate conference in Glasgow in November 2021.

Blueprint for a Living Planet is about expanding options and opportunities to meet the objectives laid out in the Paris Agreement and the Convention on Biological Diversity, among others. The blueprint rejects the false premise that "ocean solutions" would be created at the expense of "climate solutions," and embraces the expanded possibilities found in fully integrated ocean-climate strategies. It asks government and business to:

- **Be more ambitious and urgently deliver stronger and sustained mitigation and adaptation actions**
- **Make nature a key part of the solution**
- **Put people at the centre**
- **Join up the climate and ocean finance agendas**

DRAWING ON INDIGENOUS KNOWLEDGE

A healthy, resilient ocean sustains people everywhere, even those who live

Fishing boat between icebergs in Disco Bay, Greenland.

Photo: Peter Prokosch, www.grida.no/resources/4188

The ocean provides enormous opportunities and solutions to mitigate the impacts of greenhouse gas emissions, yet few countries have even begun to capture this potential to respond to climate change.

far from shorelines. But coastal communities have an especially important role to play in designing and delivering successful conservation efforts. An inclusive, equitable and transparent approach that includes Indigenous and local knowledge is critical. Whether it's managing marine protected areas as part of a pan-Arctic network or providing key knowledge about managing important species, communities must lead and own conservation strategies if those strategies are to be effective. Putting people at the centre isn't just the right thing to do—it has the power to unleash the transformative change we need.

Countries have grasped the idea that strategies like planting trees and restoring soils are part of the solution to both climate change and the wider nature crisis—but we're nowhere close to making the most of such nature-based solutions when it comes to our ocean and coastlines. Based on systematic blue accounting assessments, seagrass meadows in Arctic coastal lagoon systems (along with salt marshes, kelp forests, mussel beds and other marine ecosystems) have incredible carbon sequestration power even in cold Arctic waters, but are threatened by surging coastal development expected in many parts of the region. With proper protection and management informed by community needs and aspirations, these ecosystems can pay their way, delivering food security, livelihoods and climate benefits.

THOUGHTFUL INVESTING

Climate finance also still falls far short of what's needed—and only a tiny fraction of it goes to nature-positive, ocean-based solutions. We have to invest more and we have to invest smarter to get more impact from every dollar. Ocean-climate solutions provide incredible value for money: when we restore seagrass beds, for example, we're drawing down carbon, protecting biodiversity and coastlines, and building food security and community resilience. That's an impressive triple-bottom-line return.

As outlined in WWF's Arctic Blue Economy report, the Arctic region faces specific challenges and opportunities. Fully integrating Arctic research and Indigenous knowledge in decision-making processes is a good place to start.

Investors can also do their part by carefully considering and prioritizing climate change risks when choosing where to put their money. They should consider only projects that will benefit the Arctic's long-term sustainability and prosperity. That means prioritizing responsible investments that develop renewable resources—since these have the potential to reduce greenhouse gas emissions and create strong and resilient Arctic economies—and backing only projects that prepare for and anticipate the impacts of climate change and minimize the carbon footprint.

PETER WINDSOR is the director of WWF's Arctic Programme.

Sometimes conservation entails tough choices and trade-offs. But there is no need to choose between ocean solutions and climate solutions—they are one and the same. If we want to protect and restore our ocean, we must work together urgently to tackle the climate crisis before it is too late. ○

THE PICTURE

Keep 1.5 Alive

Sea ice is a critical component of the Arctic marine ecosystem, but it is projected to almost disappear by the summer of 2030. WWF has partnered with NOMINT, a UK animation company, to develop a short stop-motion animated film that is built entirely with ice, an almost impossible feat. It is a stark reminder that once the Arctic ice melts, we will not be able to get it back. We can't negotiate the melting point of ice.

WWF

Why we are here
To stop the degradation of the planet's natural environment and to build a future in which humans live in harmony with nature.

www.panda.org/arctic