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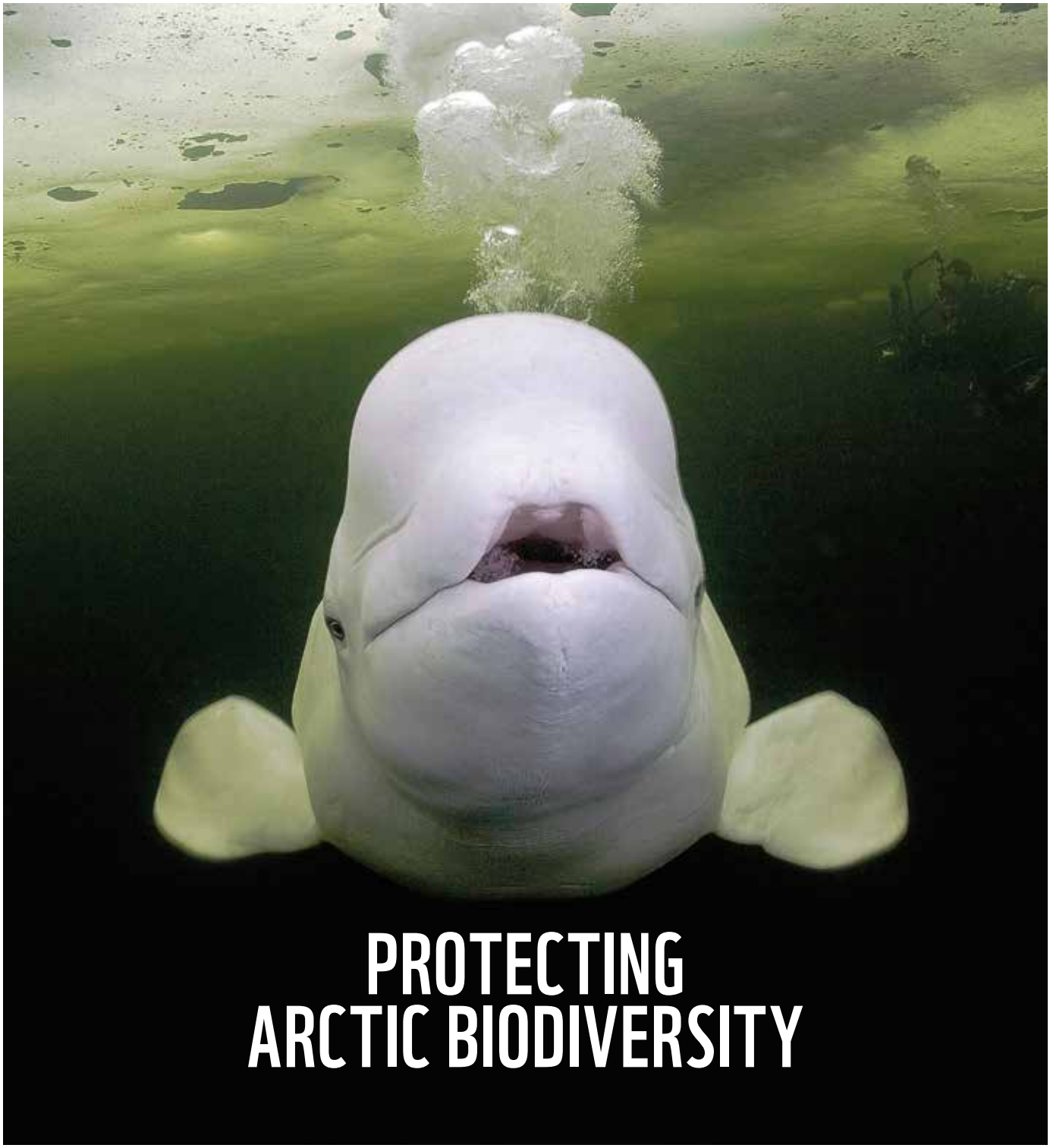

PROTECTING ARCTIC BIODIVERSITY

PUBLISHED BY THE WWF GLOBAL ARCTIC PROGRAMME

ARCTIC BIODIVERSITY

Contents

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■ WWF thanks the Conservation of Arctic Flora and Fauna working group for its help in creating this edition of *The Circle*, and particularly thanks Courtney Price for her assistance.

COVER: Beluga whale, White Sea, Russia.
Photo: Franco Banfi

ABOVE: Eider.
Photo: Uri Golman, Visit Greenland.

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A new beginning for nature conservation in the Arctic

NO MATTER how often I travel to the Arctic, I am struck by the vast array of species that thrive in what appears to be a harsh, unforgiving and uninviting place to call home.

Yet polar bears, caribou and reindeer, Arctic fox, seals, sharks and whales are all uniquely equipped to live in the Arctic. But there are other species that appear to be less rugged, even delicate: the ethereal sea butterfly; the millions of migratory birds that breed in the Arctic then fly to every continent on earth; the tiny plants, lichens, fungal and microbial species that define Arctic biodiversity.

Then there are the Indigenous Peoples who live, work, hunt and daily demonstrate the relationship between humans and the more than 21,000 species in the polar region.

Last year the Arctic Council's working group on Conservation of Arctic Flora and Fauna (CAFF) published its most comprehensive analysis to date of status and trends in biodiversity.

The *Arctic Biodiversity Assessment* synthesizes the state of knowledge of biological diversity in the Arctic. It identifies the population size and distribution of Arctic species and ecosystems, and – where possible – presents projections into the future. Over 250 scientists contributed. The *Summary for Policy Makers* identifies nine key findings and 17 recommendations that were endorsed by the Ministers of the Arctic Council, May 2013.

THE ARCTIC BIODIVERSITY ASSESSMENT SYNTHESIZES THE STATE OF KNOWLEDGE OF BIOLOGICAL DIVERSITY IN THE ARCTIC. IT IDENTIFIES THE POPULATION SIZE AND DISTRIBUTION OF ARCTIC SPECIES AND ECOSYSTEMS, AND - WHERE POSSIBLE - PRESENTS PROJECTIONS

This edition of *The Circle* reflects on those key findings and recommendations. Climate change, and increased development which climate change may enable, are identified as the most serious pressures on biodiversity now and into the future.

Earl Evans reports on the need for protecting the range of migratory species such as the Beverly and Qamanirjuaq Caribou herd. Biologist and biogeographer Eric Hoberg takes us into that often ignored world of parasites, those "elegant animals" which help explain, predict and document catastrophic climate shift.

A major challenge to Arctic biodiversity in the past was overharvesting, and sustainable management of living resources continues to be an important tool in sustaining biodiversity. Courtney Price tells us numerous overharvesting issues have been alleviated through successful co-management programs.

You will also read about the need for including traditional ecological knowledge if we are to fully comprehend climate change, its impacts, and create relevant, effective policy. In addition, there is a thought-provoking analysis of the economics of biodiversity. Should we be putting a dollar value on Arctic biodiversity?

To safeguard Arctic biodiversity and the services we receive from it, three spatial levels of stressors must be addressed: global stressors such as climate change and long-range transport of contaminants by air and sea water; regional over-exploitation, range expansion of boreal and invasive alien species; and more 'localized' stressors such as mineral extraction, oil development and ship accidents.

The challenge now is to turn recommendations into concrete actions. The results and implementation of Arctic Biodiversity Assessment recommendations will be discussed at the Arctic Biodiversity Congress, Dec. 2-4 in Trondheim, Norway. This unique meeting will allow a dialogue among environmental groups, industry representatives, government policy makers and Indigenous people on key actions. ○

TOM BARRY is the Executive Secretary for the Conservation of Arctic Flora and Fauna (CAFF), the biodiversity working group of the Arctic Council.

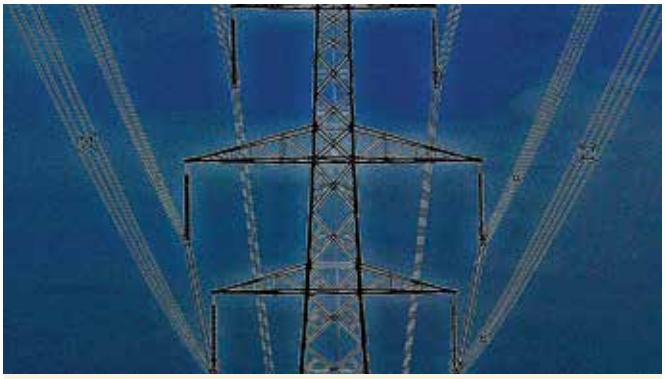


Photo: Tim Green

Animals see power lines as glowing, flashing bands

POWER LINES are seen as glowing and flashing bands across the sky by many animals, research has revealed. The discovery suggests pylons and wires stretching across many landscapes are having a worldwide impact on wildlife according to Dr Nicolas Tyler, an ecologist at the Arctic University of Norway.

"The loss and fragmentation of habitat by infrastructure is the principle global threat to biodiversity," he says. "Roads have always got particular attention but this will push power lines right up the list of offenders."

Avoiding power lines can interfere with migration routes, breeding grounds and grazing for animals and birds.

Scientists knew many creatures avoid power lines but couldn't figure out why since they are not impassable physical barriers. Now, a new understanding of just how many species can see the ultraviolet light – invisible to humans – has revealed the major visual impact of the power lines.

"It was a big surprise but we now think the majority of animals can see UV light," said Professor Glen Jeffery, a vision expert at University College London.

Noise chills whale romance

A NEW REPORT from WWF says increasingly noisy oceans are creating a range of problems for whales. Noisier oceans can create difficulties finding mates and food and drive whales away from prime habitat.

"We're finding evidence of increasing levels of noise in all of our oceans" says Aimee Leslie, Global Cetacean and Marine Turtle Manager for WWF. "Large ship traffic, offshore oil exploration and development, and military exercises are all contributing to a barrage of noise buffeting ocean life. This cacophony is hard on cetaceans that use sound for essential communication. We are particularly concerned about the impacts of sound in previously quiet oceans, such as the Arctic."

The report finds there are methods of both quietening the oceans, and reducing the impacts of noise on whales. See the report at: http://awsassets.panda.org/downloads/ocean_noise_report_web.pdf

Arctic states move toward high seas fishing agreement

REPRESENTATIVES of the five Arctic coastal states (Russia, Norway, United States, Denmark, and Canada) have agreed to pursue an agreement to manage fisheries in the part of the Arctic Ocean beyond national jurisdiction. No commercial fishing is taking place there now because the area is still covered with ice for most of the year. It is also uncertain how productive the area might be for a fishery.

To regulate fishing in the area, the states must persuade non-Arctic countries to be part of any agreement governing the area, as it is beyond the jurisdiction of the Arctic coastal states involved. WWF is also encouraging the coastal states to take similar actions on fishing in Arctic waters that are under their jurisdiction. The US, acting on the advice of local fishing interests, has already voluntarily placed a moratorium on fishing in previously ice-covered waters off Alaska pending better scientific information on fish stocks there.

Reindeer get fluorescent antlers

HERDERS ARE HOPING to stem the road deaths of thousands of roaming reindeer in the wilds of Finland by giving the rangifers a a glowing antler makeover.

Anne Ollila of the Finnish Reindeer Herder's Association says the antlers of 20 reindeer have been painted with various fluorescent dyes to see how the animals react and whether the paints are resistant to the harsh Arctic climate.

The Associated Press reports that if successful, animals with the glow-in-the-dark antlers will be free to roam Lapland – a vast, deserted area in northern Finland where herders tend to some 200,000 reindeer.

Ollila says reflectors and reflective tape have proven unsuccessful because the reindeer manage to tear them off, while road signs warning drivers of roaming reindeer often are stolen by tourists as souvenirs.

Cat parasite found in Beluga deemed infectious

SCIENTISTS at the University of British Columbia in Canada have found for the first time an infectious form of the cat parasite *Toxoplasma gondii* in western Arctic Beluga. The team is urging caution for Inuit people who eat whale meat.

"Belugas are an integral part of Inuit culture and folklore, and a major staple of the traditional diet. Hunters and community members are very concerned about food safety and security," says Stephen Raverty from UBC's Marine Mammal Research Unit.

The findings were presented at the 2014 Annual meeting of the American Association for the Advancement of Science. The scientists warn that the "big thaw" occurring in the Arctic is allowing never-before-seen movement of pathogens between the Arctic and the lower latitudes.

"Ice is a major eco-barrier for pathogens," says Michael Grigg, a molecular parasitologist with the U.S. National Institutes of Health. "What we're seeing with the big thaw is the liberation of pathogens gaining access to vulnerable new hosts and wreaking havoc."

Toxoplasmosis, also known as kitty litter disease, is the leading cause of infectious blindness in humans. It can be fatal to fetuses and to people and animals with compromised immune systems.

Insurers weigh in on Arctic shipping rules

Photo: by Mads Pihl

THE RECENT announcement that insurer Lloyds of London is adopting its own Arctic shipping guidelines highlights troubling gaps in shipping regulations, says Lars Erik Mangset, Climate and Sustainable Industries Advisor for WWF-Norway.

The Polar Code sets rules for ships operating in polar waters. It is being developed by the International Maritime Organization, a United Nations agency that specializes in shipping. The process of negotiating the code is nearly complete, but the current draft of the Code does not adequately address the risks of Arctic shipping, raising concerns from WWF and the insurers that assume those risks.

"Factors like a lack of infrastructure, challenging communication environments, a lack of reliable ice and iceberg data and the ability to predict the presence of old-ice inclusions in first-year sea ice are not addressed by the Polar Code, even though they provide significant risks to ships and thus to their insurers," Mangset says.

Ice Caps melting Faster, data show

GLACIER MONITORING conducted by the federal government in Canada's High Arctic shows the shrinking of ice caps that started in the late 1980s "has accelerated rapidly since 2005" and is part of a "strongly negative trend," according to internal government documents.

The data raise a number of questions about climate change and what the melting ice caps mean for Canada's future economy and environment.

The data were obtained through Natural Resources Canada's Climate Change Geoscience Program, which monitors annual glacier mass fluctuations and sea level changes at sites across the Canadian High Arctic.

Canada's federal government maintains glacier monitoring sites in the Canadian High Arctic for four ice caps: Devon, Meighen, Melville and Agassiz.

"Glacier monitoring conducted by the Earth Sciences Sector in Canada's High Arctic indicates that shrinking of ice caps started in the late 1980s, and has accelerated rapidly since 2005," the memo says.

David Burgess, research scientist and glaciologist with Natural Resources Canada, explained that since 2005 there has been a persistent high-pressure system over Greenland, which has acted to draw in more warm air from southerly latitudes and contributed to a warming High Arctic.

The main consequence of shrinking Arctic ice caps is increasing sea levels which can impact Canadian coastlines depending on their resiliency to erosion and inundation.

Traditional ecological knowledge

In a rapidly changing Arctic, traditional ecological knowledge (TEK) is essential to understanding climate change, its impacts and in creating relevant, effective policy. MARY-ANN FIDEL says TEK contributes unique information that can't be replicated by instrument data and often incorporates beliefs and values.

ARCTIC PEOPLES have thrived in this harsh environment for millennia by acquiring a vast wealth of knowledge about the land, waters and species of the far north. This traditional knowledge is increasingly recognized as critical to understanding and conserving Arctic biodiversity. Traditional ecological knowledge may be integrated with modern scientific data, or used separately to build a better foundation of the best available knowledge used to inform decision making. Observations about the changing environment are frequently accompanied by information about effects on well-being and contribute local information that enhances understanding of the environment. TEK can also be used to ensure management strategies are culturally appropriate and relevant to those most affected, which increases our collective ability to accomplish management goals.

MARYANN FIDEL is the CONAS Project Manager at the Aleut International Association, a permanent participant of the Arctic Council.

Culturally appropriate management strategies are more likely to preserve biodiversity and support Indigenous ways of life. This is illustrated by two historic examples.

OUR UNDERSTANDING OF BOWHEAD POPULATIONS WAS ENHANCED BECAUSE TRADITIONAL ECOLOGICAL KNOWLEDGE GUIDED THE SCIENCE

In 1978 the International Whaling Commission banned the hunting of bowhead whales by Alaskan Inuit based on a population survey from near-shore observations. This decision was made without meaningful tribal involvement. Residents living in the area had long understood that bowheads are capable of traveling great distances under the ice, and often migrate far off-shore, but no one had asked for their input when designing the survey even though the resulting decision affected very deeply held cultural practices. After some conflict, survey methods were altered to reflect Inuit knowledge of bowhead whales. The repeat survey found four times as many whales as was originally estimated. Hunting was reinstated, traditional practices were sustained and our understanding of bowhead popula-

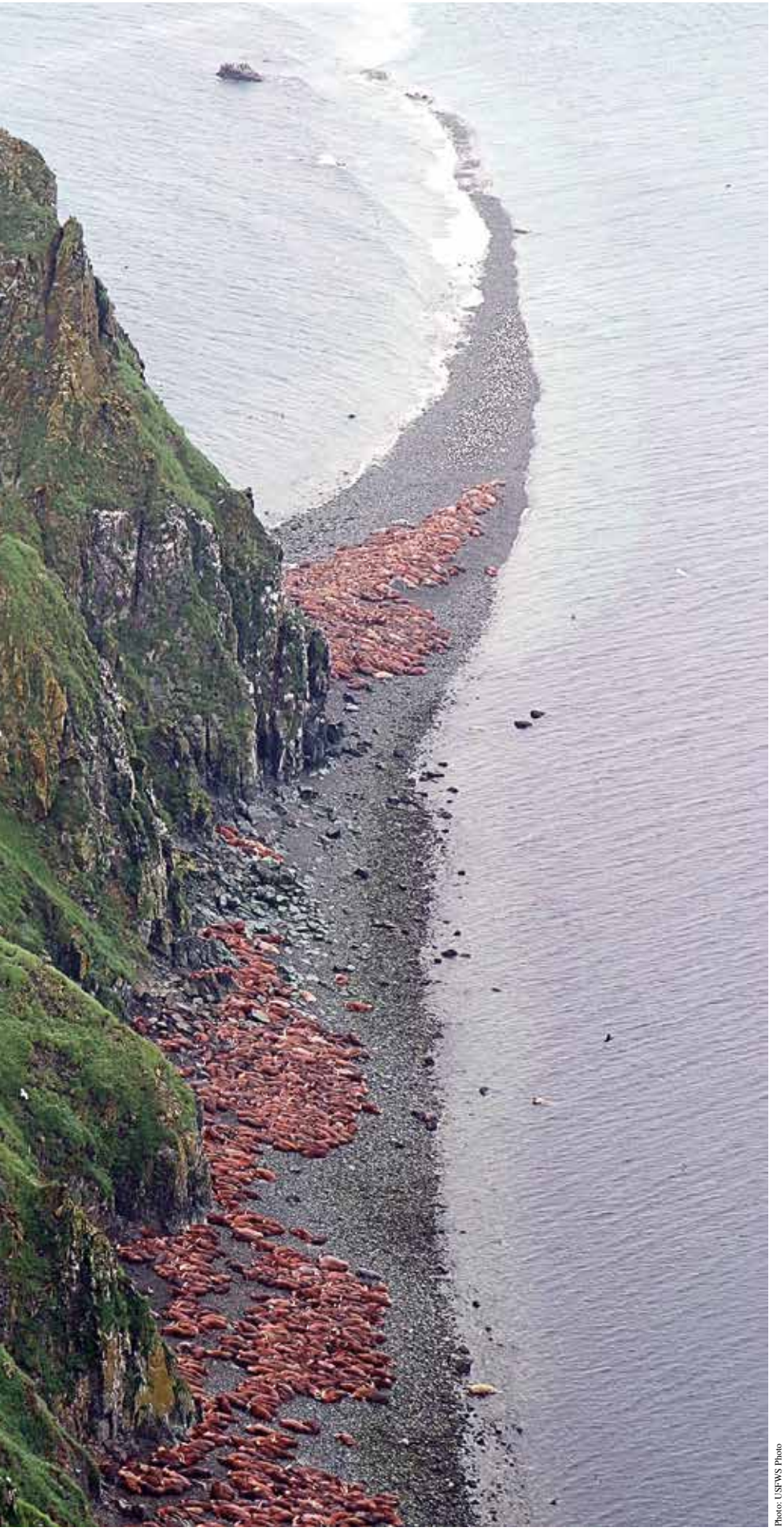


Photo: USFWS Photo

Walrus hauled out on a gravel beach on Qayassiq (Round Island), Alaska.

tions was enhanced because traditional ecological knowledge guided the science.

Qayassiq (or Round Island) is a jewel in Bristol Bay, Alaska with one of the largest and most consistently used walrus haul-outs. Evidence of human use here dates back at least 3,000 years. In fact, the Yup'ik word Qayassiq means 'place to go in a kayak'. In 1960, Qayassiq and surrounding islands were designated as the Walrus Islands State Game Sanctuary. A few years later, as residents were returning from a successful walrus hunt on Qayassiq, they were charged with poaching. They said they had no knowledge of the new regulations, and certainly weren't consulted in the formation of the Game Sanctuary. "Our elders started asking us younger people about it," one resident said. "They never did understand why they couldn't go out there any more. That island was the place they went to hunt." The community lamented the loss of this important hunting area, with some hunting at more distant haul-outs, or resorting to hunting walrus at sea, which one elder called, "hunting by accident." "This is just not true hunting," he said. "Many times the kill is not even retrieved" because many walrus shot at sea sink out of reach of the hunter.

In a challenge to the state's attempt to restrict their hunting rights, an elderly couple harvested walrus in plain view of biologists at Qayassiq in the early 90s. It was a bold act that provided the impetus for discussions with the management authority. By 1995, the Cooperative Agreement Governing Subsistence Walrus Hunting on Qayassiq was signed creating one of the first co-managed hunts in Alaska. Two decades later, there appears to be satisfaction with this agreement: it incorporates traditional knowledge of walrus; involves hunters who provide biological samples to scientists; reflects the traditional timing of the fall hunt; and allows sufficient num-

ber of walrus to be harvested for community use. The agreement also makes space for a cultural tradition enhancing human connectedness to walrus, which is an inspiring force in the conservation of species. By incorporating traditional values into co-management, wildlife managers were able to decrease the amount of walrus wasted through hunting at sea and reduce conflict in maintaining healthy walrus populations.

In addition to co-management agreements, many scientific research programs are underway that document traditional ecological knowledge. The Community Observation Network for Adaptation and Security (CONAS), funded by the National Science Foundation, is an evolution of the long-standing Bering Sea Sub-Network. CONAS partners with Indigenous communities bordering the Bering Sea in Alaska and Russia to co-produce useful data products such as subsistence-use maps. The maps are created from interviews conducted by community members with community members and are being used, for example, to inform decisions regarding shipping activity in the Bering Strait. These efforts also serve to communicate traditional knowledge to decision makers to develop effective, culturally appropriate management strategies, as well as improve our understanding of changes occurring at the local level. CONAS is also exploring the development of early warning systems for communities on the ground, to anticipate undesired changes long before they happen. ○

Arctic Biodiversity Assessment: Report for Policy Makers

Recommendation 14

■ Recognize the value of traditional ecological knowledge and work to further integrate it into the assessment, planning and management of Arctic biodiversity. This includes involving Arctic peoples and their knowledge in the survey, monitoring and analysis of Arctic biodiversity.

CAFF

Managing harvests

Until the second half of the 20th century, overharvest was the primary threat to a number of Arctic mammals, birds and fishes. Some, such as the Steller's sea cow, disappeared altogether while others retreated to ever more remote locations. COURTNEY PRICE says a range of conservation and management actions have helped manage harvest to the point that many populations are recovering. However, pressures on others persist.

EVEN THOUGH overharvest has historically been one of the most common pressures on Arctic wildlife, it is also the most manageable. The threat of overharvest has been greatly reduced in the Arctic for many species such as bowhead whale, muskox, common eider, some fish stocks and many migratory birds in part because sufficient knowledge exists to develop effective conservation measures and to build support for those actions. In most areas, hunting and fishing are regulated, at least for species of conservation concern. Indeed, the pressure from overharvest has been largely removed as a major conservation concern for most species due to improved management

Red knot breeding in high Arctic tundra during snow-storm in Great Arctic Reserve, Russia.

Photo: Peter Prokosch, http://www.grida.no

and conservation actions such as shortened seasons, regulated takes, improved reserve networks, better reporting, joint management and limitations to harvest technology. Continued and improved data collection is vital to achieve and maintain these results.

These actions are based on greater understanding of the potential for harm to species and ecosystems, better regulation and enforcement, and in many cases greater engagement with Arctic peoples. The incorporation of traditional values, practices and knowledge can help improve both management and enforcement. Local community observations and data collection are both key to affecting changes in management regimes.

There are many documented examples of Arctic peoples describing the changes they witness related to climate change, diminishing sea ice and especially to harvested wildlife species. There is a pressing need for more community-based monitoring that can detect change, interpret and integrate results, and lead to prompt decision-making. This will help tackle environmental challenges at operational levels of resource management.

Greenland's effort to increase community-based monitoring to inform management is one of the success stories that are becoming more common in the Arctic. In addition to other existing local monitoring efforts, the Greenlandic government is piloting a natural resource monitoring system called Piniakkanik sumiiffinni nalunaarsuineq (*Opening Doors to Native Knowledge*), whereby local people and local authority staff are directly involved in data collection, interpretation and resource management.

Photo: Visit Greenland

Musk ox, Greenland.

THE INCORPORATION OF TRADITIONAL VALUES, PRACTICES AND KNOWLEDGE CAN HELP IMPROVE BOTH MANAGEMENT AND ENFORCEMENT.

The increased need for information and the necessity of promoting locally relevant knowledge and management actions suggest that there are substantial prospects in the coming decades for more community-based monitoring around the Arctic. This will also contribute to effective local conservation actions.

Overharvest remains a high concern for many migratory species once they leave the Arctic to follow their migration routes south. The Eskimo curlew is thought to be extinct as a result of hunting on its migration areas. The critically

COURTNEY PRICE works with the Conservation of Arctic Flora & Fauna (CAFF) secretariat which recently published the Arctic Biodiversity Assessment

About the Conservation of Arctic Flora and Fauna (CAFF)

■ CAFF is the biodiversity working group of the Arctic Council and consists of National Representatives assigned by each of the eight Arctic Council Member States, representatives of Indigenous Peoples' organizations that are Permanent Participants to the Council, and Arctic Council observer countries and organizations. CAFF´s mandate is to address the conservation of Arctic biodiversity, and to communicate its findings to the governments and residents of the Arctic, helping to promote practices which ensure the sustainability of the Arctic's living resources.

endangered spoon-billed sandpiper faces extinction due to habitat loss and overharvest on its wintering areas in Southeast Asia. Overharvest is a factor in the drastic decline of the Siberian crane. Some birds, such as the red knot have declined in part because their food source (horseshoe crab) is overharvested, leaving less food available to them during migration. Greater engagement amongst Arctic and non-Arctic actors is necessary to reduce stressors on Arctic migratory species across their entire range.

Overharvest is but one threat to Arctic wildlife, acting in combination with other stressors such as habitat loss and changing climate. A comprehensive and integrated approach is needed to address the interconnected and complex challenges facing biodiversity and to ensure informed policy decisions are taken in a changing Arctic. The threat of overharvest has declined dramatically in recent decades across the Arctic, and working with harvesters has been central to better conservation. Arctic nations and peoples can achieve much more for biodiversity when they work together to ensure that unique environments and species exist for the benefit of future generations.

For more information see "Stressors and their alleviation" and "Conservation through community involvement" in the Arctic Biodiversity Assessment. ○

Arctic Biodiversity Assessment: Report for Policy Makers

Recommendation 10 (a)

■ Improve circumpolar cooperation in data gathering and assessment of populations and harvest and in the development of improved harvest methods, planning, and management. This includes improving the use and integration of traditional ecological knowledge and science in managing harvests and in improving the development and use of community-based monitoring as an important information source.

CARIBOU VS. MINING

Roaming room

Migratory animals such as caribou and reindeer require vast tracts of undisturbed land for calving grounds, grazing and staging areas. EARL EVANS says protected areas in Canada's Nunavut region are critical to the survival of these herds. He spoke with editor Becky Rynor.

NUNAVUT USED TO BE the last stronghold for caribou but it is now pretty promining. There was a lot of virgin territory that caribou could go where there was no disturbance, a place to have their calves. It was kind of like sacred ground. That's no longer the case. Permits have been issued on the calving grounds and there's no place for them to go right now where they have some sanctuary. We have to look at historical ranges, not just current calving grounds, but the historical range of the caribou and implement some kind of measures to protect these lands for the caribou.

How can protected areas be created?

We have to look at the overall picture to see how we can protect these areas. We also need migration corridors for caribou to pass through. That's one of the biggest obstacles. The diamond roads, for example, represent a linear structure that is a real impediment for caribou. They'll hit this road and they'll follow it for miles because they don't like to cross a linear structure. It impedes their movements and could delay their migration by a week or more. When calving is coming up that's pretty critical. If they get stuck somewhere, that could mean the loss of a lot of calves. But they see that diamond road and they change their migratory route. It's very important that they travel to the calving grounds. They leave predators like wolves and grizzly bears behind and they are able to have their calves safely up there. But over the past six years or so, even that is changing. The wolves and the grizzly bears are following them and the wolves are having their pups there now and it's raising hell with the calves. One wolf can kill 10 or 15 calves in one spot.

EARL EVANS is a Metis hunter, trapper, teacher and Chair of the Beverly and Qamanirjuaq Caribou Management Board in Fort Smith, Northwest Territories.

We definitely need protected areas that are accessible. The caribou have to be able to go to and from these areas free of harassment and hunters, a protected corridor where they can move

Caribou, Nunavut.

Photos: Rich Durant

freely back and forth with no breaks in it. There has to be free movement where they don't have to cross obstacles like roads or mining development.

Are there some industrial activities that are more tolerated by caribou, and some that are less tolerated?
Some activities like uranium mining in Saskatchewan are a pretty big issue. You're hauling raw contaminents between mine sites and processing plants and the material isn't covered and the wind is blowing contaminants over the landscape. Depending on the prevailing winds, it could be carried several hundred miles and contaminate large areas. No one has done any real studies on how much vegetation is affected by this kind of movement. A diamond mine is not as bad. The biggest problem with a diamond mine is the several thousand trucks that move in there every year to re-supply it. The actual diamond mine footprint is not that bad. It is an impediment but it's not as bad as other development.

How do we balance the needs of northerners to have paying jobs while trying to protect the caribou?
We have to ensure that local people who need and rely on the jobs have employment and can still pursue their traditional lifestyles. We suggest scaling down the development of the mines. A lot of these diamond mines in Yellowknife, the jet lands there from Edmonton or it goes straight to Newfoundland. These people don't even touch the ground in the Northwest Territories except at the mining site. So the territory itself is not benefitting from those people coming in to do this work. We've got to scale down the mine so that all the people that are living in the Northwest Territories have employment and not have to go outside. All of this is turning into temporary foreign workers coming in to these sites. We don't need that scale of development in the north. We have to look after the people in the north and the animals so we have to somehow strike that fine balance and scale the operations down so that the benefits of these mines are for the people of the north. If we keep going at the current scale, the whole territory is going to be taken up by development and we're not going to have the protection for the animals that we need.

What hope do you have for the future of the Beverly and Qamanirjuaq herds
If the scale of development continues at this rate, the caribou are going to be in serious peril, no matter what herd it is. These caribou that once were migratory animals are eventually going to become sedentary animals because they aren't going to have freedom of movement. That seems to be the case already with some of the herds north of the Baffin Islands. No matter where they go, there is development all around them. Some-

Diamond mine, Nose Lake, Nunavut.

how we have to create these corridors, implement them so that the animals can move freely, and look at the big picture to see what food is available to them. Development is coming, but let's place these mines or other industry strategically in a way that won't interfere with migratory routes, so that they can have access to their calving grounds. It's very, very important. ○

Arctic Biodiversity Assessment: Report for Policy Makers
Recommendation 5 (b)
■ Build upon existing networks of terrestrial protected areas, rare or unique habitats, particularly productive areas such as large river deltas, biodiversity hotspots, and areas with large aggregations of animals such as bird breeding colonies, seal whelping areas, and caribou calving grounds.

Fishing for the unknown

The Arctic seas are under tremendous pressure from climate change and expanding human activity of unprecedented scale. JØRGEN SCHOU CHRISTIANSEN says our biological understanding of Arctic marine fishes is virtually absent, and strict precautionary actions are imperative.

THE NEWLY RELEASED report on Arctic biodiversity presents the first comprehensive assessment of about 635 marine fish species across the Arctic Ocean and adjacent seas (AOAS). The most important outcome of this exercise is that we have finally structured our ignorance and identified some of our knowledge gaps. In short, our biological understanding of Arctic marine fishes is practically absent. Scientific uncertainty is difficult to broadcast and hard to sell, but it is nonetheless essential as it calls for strict precautionary approaches towards Arctic resources.

JØRGEN S. CHRISTIANSEN is a professor of fish ecology at the Arctic University of Norway, Tromsø, Norway, and guest professor at Åbo Akademi University, Turku, Finland.

A few years ago, headlines in the media gave the misleading impression of Arctic fishes being overexploited. Subsistence fisheries along the Arctic coasts have been going on for centuries and the reconstructed catch records for a range of fishes such as whitefishes (Coregonidae) and salmonids (Salmonidae) accumulated to about 950 thousand tonnes in 57 years (1950-2006). This is absolutely minuscule compared with, for example, annual landings of more than 1 million tonnes from a single stock of herring (*Clupea harengus*) in the Northeast Atlantic. What is most disturbing, though, is the emerging full scale exploitation of petroleum and living resources in hitherto pristine parts of the Arctic seas.

The daubed shanny Leptoclinus maculatus (Fries, 1838) – a little studied bycatch species in arctic industrial fisheries.
Photo: Arve Lynghammar.

BAN BOTTOM TRAWLING ON THE ARCTIC SHELVES

Among the 635 AOAS fishes, only 60 (fewer than 10%) are classified as being true Arctic. The remaining fishes belong to sub-arctic and southerly seas. The widely used phrase "Arctic fisheries" is false from a biological standpoint. Within the AOAS, industrial fisheries target about 60 species of which only three (5%) are Arctic: the codfishes polar cod (*Boreogadus saida*) and navaga (*Eleginus nawaga*), and the Arctic flounder (*Liopsetta glacialis*).

BOTTOM TRAWLS ARE BY FAR THE MOST USED AND MOST DESTRUCTIVE GEAR IN GROUNDFISH FISHERIES

Databases covering the Arctic Ocean and adjacent seas hold a wealth of valuable information for the commercial species. But it is also a fact that data on non-target fishes are notoriously poor – bycatch species are either misidentified or lumped into categories of little biological meaning. This is particularly true for cartilaginous fishes such as sharks and skates, and species-rich fish families such as sculpins (Cottidae), snailfishes (Liparidae) and eelpouts (Zoar-

cidae). So, to keep up a precautionary view: better to be data deficient ("we haven't got a clue!") than misinformed ("our databases may show...").

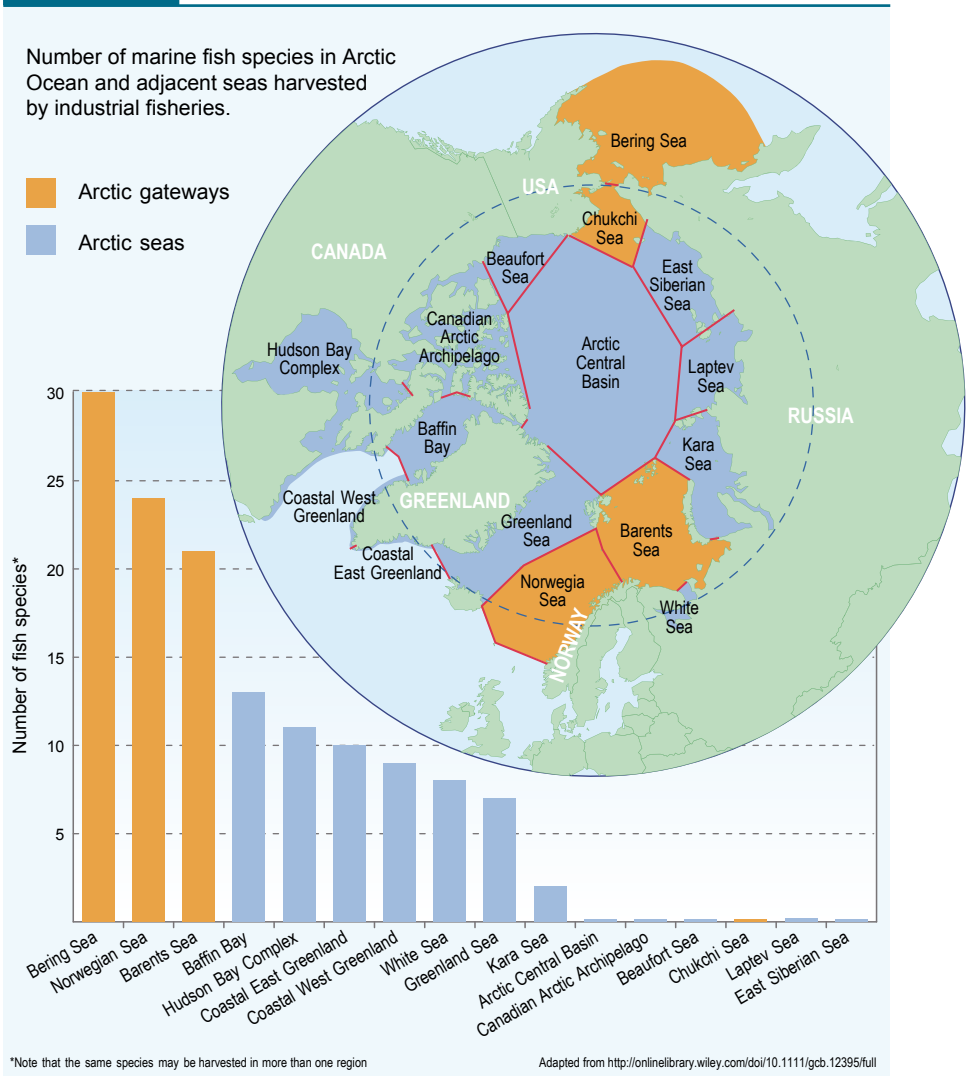
In light of ocean warming, targeted fishes spread rapidly into yet unfished parts of the arctic seas and marine top-predators, in the shape of industrial fishing fleets, obviously follow. For example, Atlantic cod (*Gadus morhua*) is now common on the arctic shelves around Svalbard archipelago at latitude 80°N. Bottom trawls are by far the most used and most destructive gear in groundfish fisheries. The vast majority of Arctic fishes live at or near the bottom and do not migrate. Therefore, they are particularly vulnerable to conventional bottom trawling as they are lost to bycatch and destroyed seabeds. Although of no direct commercial value, bycatch species make arctic ecosystems work by feeding seabirds and marine mammals – wildlife that forms the livelihood of Arctic peoples. In contrast to the Southern Ocean, the Arctic is neither an outpost nor a frontier but homeland to Arctic peoples. They are the first to feel the pressures of climate change, big business and reckless actions from some environmental activists.

The detection of valid species and how they work in context of ecosystems is at the heart of biodiversity assessments based on scientific credibility and legitimate conservation and management actions based on societal values. Several Arctic fishes are controversial and difficult to identify and basic questions remain unanswered: how do fishes interact as prey and predator; how do they grow and reproduce; how old do they get and how do they cope with heat and pollutants?

We clearly need to integrate traditional/community knowledge held by Arctic peoples and the natural sciences for legitimate conservation and management actions. This is indeed a huge, but not unsolvable, task. It must be based on mutual respect for the perception and rights of Arctic peoples to wildlife and habitat, and the methodological needs and rigor of science. Traditional ecological knowledge may provide valuable information to science on species distribution and abundance, shifts in biological events and changes in species occurrences and habitats**.** On the other hand, science may give useful advice on pollutant loads in wildlife and forecast potential consequences of climate change. Science needs traditional knowledge and traditional knowledge needs science. In the end, we all fall victim to failed conservation and management policies.

Read more on this in a recent Open Access paper in Global Change Biology (http://onlinelibrary.wiley.com/doi/10.1111/gcb.12395/full). ○

Arctic fisheries



*Note that the same species may be harvested in more than one region

Adapted from http://onlinelibrary.wiley.com/doi/10.1111/gcb.12395/full

Arctic Biodiversity Assessment: Report for Policy Makers

Recommendation 10 (c)

■ Support efforts to plan and manage commercial fisheries in international waters under common international objectives that ensure long-term sustainability of species and ecosystems. Encourage precautionary, science-based management of fisheries in areas beyond national jurisdiction in accordance with international law to ensure the long-term sustainability of species and ecosystems.

Big concerns about little life forms

While not visible to the naked eye, single-celled micro-organisms are the most numerous life forms on the planet. They form complex communities even in habitats that appear devoid of life, occurring in Arctic waters, soils and sediments. Some microbes may have global distributions, while others appear to be found only in the Arctic which means genetic diversity could be lost in the event of major climate change. As sea-ice retreat and thawing permafrost transform Arctic environments, MARY THALER and CONNIE LOVEJOY warn that changes in microbial communities could affect many basic ecosystem functions, with repercussions for larger life-forms.

MICRO-ORGANISMS are at the base of aquatic food webs. The best studied are phytoplankton that are responsible for nearly all photosynthesis in oceans and lakes. Less well known are microbes that eat other free-living single-celled organisms or take up organic material. The distinction between these types of microbes is not as clear-cut as it is for terrestrial plants and animals. Many groups are able to do both. These micro-organisms interact to form complex microbial food webs, which include protists, Bacteria and Archaea. Archaea and some Bacteria can use sources of carbon and other nutrients that are otherwise inaccessible to larger organisms. Other Bacteria and Archaea use chemical reactions to take up carbon dioxide without photosynthesis. The microbial food web is so efficient at recycling carbon and energy within itself that only a fraction of its biomass is ever consumed by animals. Nevertheless in the Arctic Ocean, for example, this fraction is enough to support all the zooplankton, and, ultimately, fish, birds, and marine mammals.

The Arctic Ocean is ice-covered for much of the year, and a specialized community of micro-organisms lives within brine channels and attached to the bottom of sea-ice. These microorganisms provide food for small crustaceans and even fish, whose life cycles are timed to the rhythm of sea ice expansion and retreat over the year. Along the shallow shelves, the ice community is released suddenly into the water column when the ice melts and continues to feed benthic invertebrates – organisms that live in or on the bottom sediments of oceans – and fish. However, as sea-ice retreats earlier in the season across the Arctic, the microbial community does not have time to develop and this pulse of food for benthic organisms may disappear.

Another consequence of ice break-up is increased light for photosynthesis, and production of biomass in spring. Multicellular animals appear to synchronize their life cycles to take advantage of this spring bloom, but this synchronicity may be disrupted with early spring blooms.

Micro-organisms in freshwater environments are also affected by climate change. For example, thawing permafrost creates new ponds that are colonized by microbes including some

AS SEA-ICE RETREATS EARLIER IN THE SEASON ACROSS THE ARCTIC, THE MICROBIAL COMMUNITY DOES NOT HAVE TIME TO DEVELOP AND THIS PULSE OF FOOD FOR BENTHIC ORGANISMS MAY DISAPPEAR.

CONNIE LOVEJOY is a professor at Laval University in Quebec. She has been working on aquatic microbes in the high Arctic for the past 15 years.

MARY THALER has a PhD in Oceanography at Laval University. After five field missions in the Arctic, she wrote her dissertation on the diversity of heterotrophic microbes in the Arctic Ocean.

■ The Arctic is home to more than 21,000 species of often highly cold-adapted mammals, birds, fish, invertebrates, plants and fungi (including lichens) – together with large numbers of undescribed endoparasites and microbes.

Arctic Biodiversity Assessment 2013

Archaea that convert ancient carbon formerly stored in the frozen soil to methane, a powerful greenhouse gas. Some bacteria in these ponds are able to use the methane for energy and thus prevent its release into the atmosphere. These methane-using bacteria (methanotrophs) need oxygen produced by photosynthesizers in multi-species microbial mats that grow on the sediments in well-established ponds. In new, rapidly formed ponds where conditions are not favourable for mats to form, the methanotrophs cannot grow and a potentially powerful feedback loop for climate change may be created by methane release into the atmosphere.

Micro-organisms are incredibly diverse. In order to understand the fate of carbon in food webs, and how this will be affected by climate change, it's important to know what species are present. Before we can ask ourselves how the community is changing, we first need to ask what is normal. New techniques have made it possible to analyze and compare many samples at a time, but the Arctic is already in a state of flux, and their ability to reproduce rapidly allows microbial communities to respond to environmental change at near-instantaneous speed. Already we find ourselves playing catch-up to describe microbial communities before this unique environment is changed forever. ○

Arctic Biodiversity Assessment: Report for Policy Makers

Recommendation 13

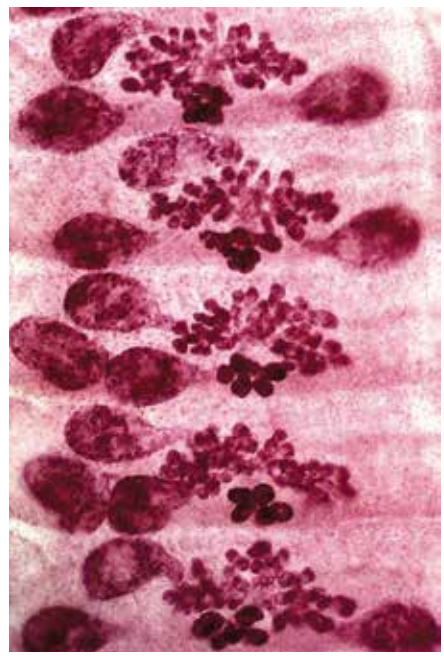
■ Increase and focus inventory, long-term monitoring and research efforts to address key gaps in scientific knowledge identified in this assessment to better facilitate the development and implementation of conservation and management strategies. Areas of particular concern identified through the ABA include components critical to ecosystem functions including important characteristics of invertebrates, microbes, parasites and pathogens.

Providing context in a changing world

Parasites are among the most common organisms on the planet. They represent 40-50% of all animals on Earth and inhabit animal and plant hosts from the equatorial regions, to the poles and the ocean depths. As ERIC HOBERG tells us, we explore the world of parasites because these elegant animals can predict how people, food resources and wildlife will be affected by unprecedented environmental shifts such as climate change.

PARASITES TIE communities together. They tell stories about critical connections established by a history of evolution and ecology such as food habits, foraging behavior and interactions among host species. Parasites reveal patterns of geographic distribution for host populations, species, ecosystems and regional faunas that constitute the biosphere. These often cryptic organisms tell us about range shifts, geographic colonization, climate variation, and episodic shifts in climate over the past 3 million years. This parasitic history has determined the patterns of diversity in the world around us including all that we observe today in high latitude ecosystems.

Vertebrate and invertebrate animals support complex assemblages of macroparasites (worms and arthropods) and microparasites (protozoans, fungi, bacteria and viruses) that collectively inhabit every part of their hosts. More than 100 years of field-based explorations across arctic and subarctic latitudes of North America and Eurasia estimate that more than 7100 species of worms infect fishes, amphibians, birds and mammals. These range from the



Strobila and multiple segments of Arostrilepis tenuicirrosa, a tapeworm in a red backed vole (Myodes rutilus) from along the Omolon River in northeastern Siberia.

remarkable meter-long lung nematode (roundworm) of muskoxen in tundra systems of the central Canadian Arctic, *Umingmakstrongylus,* described for

Chewing lice of the genus Quadraceps characteristic of alcid seabirds across the North Pacific and Bering Sea.

the first time only in 1994, to the nearly microscopic flukes (flatworms) that inhabit intestines of shorebirds and sea ducks around the polar basin of the Arctic Ocean. Parasites are integral parts of a global puzzle that can help us understand why the world looks as it does.

DR. ERIC P. HOBERG is Chief Curator and Zoologist at the US National Parasite Collection, among the largest archives of specimens and information documenting global parasite biodiversity.

Parasites are not simply indicators of disease and debilitated hosts. They also denote stability and connectivity among the intricate mosaic of myriad species of invertebrates and vertebrates that are the cornerstones of robust ecosystems from landscape to regional scales. The broad geographic and biological occurrence of these diverse parasite faunas indicates general health and resilience in marine, freshwater and terrestrial environments. Dependent on historically conservative and predictable connections for transmission and persistence within and across foodwebs, parasite diversity demonstrates important evolutionary and ecological principles, revealing hidden aspects of the structure of our biosphere in space and time. Though humble and often poorly known, parasites tell us about general responses in the biosphere to perturbation and the role of shifting ranges and biological invasions, providing a pathway to recognize and anticipate outcomes of broadening disturbance especially in a regime of accelerated climate and environmental change.

Parasites help us document and understand the impacts associated with parasitic infections and disease for people, food resources and wildlife species. Parasites have subtle to severe effects on individual hosts or on host populations that may cascade through ecosystems. Parasitic diseases influence sustainability for species and populations of invertebrates, fishes, birds and mammals, secondarily affecting food security, quality and availability for people. Further, some parasites of animals can infect and cause disease in people (termed zoonoses) and are a primary issue for food safety, security, sustainability and human health especially where access to 'country foods' is of concern at northern latitudes for people maintaining a strong reliance on wildlife species.

WE EXPLORE THE WORLD OF PARASITES BECAUSE THESE ELEGANT ANIMALS TELL US ABOUT OUR PLACE IN THE BIOSPHERE

We lack baseline and long-term data to establish trends for parasite biodiversity even for the best known Arctic host species. Understanding parasite diversity relies on a synergy. Field-based inventories with local traditional knowledge, archival specimens, and data resources must be linked to modeling efforts in exploring the distribution of organisms and disease in space and time. Baselines emerging from these synergistic activities will be essential tools for assessing environmental change. This is a critical need because the occurrence of particular parasite species and faunas is predicted to change under accelerating climate warming in northern systems. We can predict with confidence that changes in geographic ranges and switching of parasites among host species and within ecosystems with attendant emergence of disease are consequences of climate and environmental perturbation in high latitude systems. These responses will lead to breakdowns in mechanisms for ecological isolation related to where and how host animals spend time in the environment. For example, alteration in the timing and extent of migration, and developing mismatches in the arrival time for shorebirds and waterfowl and

OCCURRENCE OF PARTICULAR PARASITE SPECIES AND FAUNAS IS PREDICTED TO CHANGE UNDER ACCELERATING CLIMATE WARMING IN NORTHERN SYSTEMS

the availability of seasonally defined food resources such as aquatic insects may drive substantial changes in the distribution of some parasites. Further, northward expansion of fishes and mammals, respectively, tracking habitat changes are predicted to result in new zones of contact for aquatic and terrestrial faunas and shifts in the distribution of parasites. All these factors influence how parasites circulate in the environment, and their possible impacts relative to free-ranging species and downstream in determining environmental and food-based exposures for northern people. Each is a facet essential for predicting future shifts in ecosystem structure over time, allowing us to adapt in ways that mitigate or prevent disease outbreaks among human and wildlife populations. ○

■ The common eider is dependent on benthic organisms in shallow marine waters for food throughout the year, making them a potential indicator of the health of marine coastal environments.

Arctic Biodiversity Assessment 2013

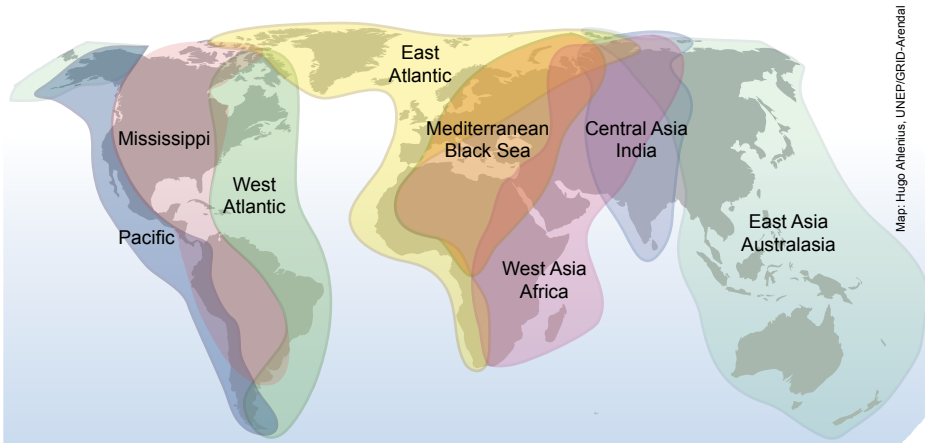
Phenomenal flyers in serious decline

For those who have experienced nine months of frigid weather surrounded by an unrelieved white landscape and covered by polar night, there is no need to explain what it means to hear the first distant call of geese or the first song of a snow bunting on the roof of your ice-bound hut. These are signals of spring and the promise of a flourishing summer. But those sounds are becoming less common as Arctic birds are in decline. EVGENY SYROECHKOVSKIY explains why so many of these amazing migratory birds are not making it back from southern countries.

THE ARCTIC is seasonally populated by roughly 200 species of birds. These are very special birds, many of them charismatic and phenomenally adapted to life in the far north. They are arguably the most visible Arctic wildlife in summer months and a crucial source of protein for subsistence hunters. Arctic birds also hold important cultural value for Indigenous peoples and are a crucial part of the ecosystem. But birds are declining faster than any other species in the Arctic due to climate change, harvest and development pressures and other threats encountered during long global migrations.

There are several "truly Arctic" groups of birds – geese, eiders, divers, waders (shorebirds) and the cliff-nesting Alcides with their colorful breeding

Major global bird migration routes to the Arctic



Map: Hugo Ahlenius, UNEP/GRID-Arendal

Photo: Peter Prokosch, www.grida.no

The Arctic Tern has the longest world seasonal migration – travelling from Arctic to Antarctic waters and back.

Photo: USFWS

A flock of migrating shearwaters fills the sky at Maritime National Wildlife Refuge.

plumages. Arctic birds also have the most phenomenal migration systems in the world. For most migratory birds, the Arctic is only warm enough for 2-3 months. The rest of their life is constant travel, interrupted by no more than 6-7 weeks in far southern areas and then northward migration again. The Arctic Tern has the longest world seasonal migration, travelling across the globe from coastal spits in the Arctic Ocean to Antarctic waters and back. Waders are probably even more remarkable migrants, covering up to 12,000 km/year one way, straight line. This small bird of only 30-100 grams has to rapidly adapt from incubating a clutch of eggs on permafrost in freezing weather, then migrating to 40 degrees Celsius, sun with no shade and not a drop of fresh water on the Australian or African coasts. The Bar-tailed Godwit flies non-stop from the Alaska Peninsula to New Zealand across the Pacific Ocean, a migration not to be believed if not proven by satellite tracking.

Both sides of the Bering Strait are particularly rich in Arctic bird species. But this is also the area of particularly serious threats to migrating birds. During their annual travels, Arctic migrants flying along Asian coasts have to visit the most densely populated countries with the most quickly-developing economies where conservation issues are often not the highest priority on national development agendas. The result is a 70 per cent decline in Arctic Geese in the second half of the twentieth century and only a few thousand remaining Siberian Cranes. The charismatic Spoon-billed Sandpiper has lost over 90 per cent of its numbers with only 100 pairs left and still declining. Formerly common Red and Great Knots, Bar-tailed Godwits, Grey-tailed Tattler and many others are facing extinction within

DR. EVGENY SYROECHKOVSKIY is an Arctic ornithologist and bird conservationist with the Russian Institute for Nature Conservation. He leads the BirdsRussia project on Spoon-billed Sandpiper conservation

Yellow Sea, the flyway hub

Map: Riccardo Pravettoni, UNEP/GRID-Arendal

Unimak Pass on the Alaska

The Spoon-billed Sandpiper has only 100 pairs left and is still declining

decades, while serious declines are also taking place among various duck species, raptors and passerines.

The main threats to Arctic birds are habitat transformation, hunting/trapping, pollution, and depletion of food resources. Often illegal huge-scale unsustainable bird harvests on the coasts and wetlands of tropical countries take millions of birds every year through mist-netting and other forms of trapping and poisoning.

Fifty per cent of the wetlands and intertidal areas of the Yellow Sea – the biggest bottleneck for migrating Arctic birds – is already gone. About half of what is left is slated to be drained over the next 20 years. The East Asian intertidal is shrinking faster than the tropical forests. Yet, there are no plans to create a network of reserves in key sites in intertidal China and many other Asian countries. Pollution is increasing, food resources needed for migration are depleting and for many birds, there is simply no habitat left.

THE MAIN THREATS TO ARCTIC BIRDS ARE HABITAT TRANSFORMATION, HUNTING/TRAPPING, POLLUTION, AND DEPLETION OF FOOD RESOURCES

The declining numbers are not yet fully recognized by the general public or conservationists. The challenge is enormous. We urgently need to bring countries in each flyway to one table to agree on actions which will influence their consumptive behaviors and reduce their development plans.

For the first time in history, the Conservation of Arctic Flora and Fauna working group of the Arctic Council has launched a project that focuses outside the Arctic. The Arctic Migratory Bird Initiative (AMBI) will bring together circumpolar countries and Arctic Council observers such as Singapore, China, Japan, European countries and others to take serious steps towards decreasing the pressure on Arctic birds outside of the Arctic. We hope other partners will join this work to give Arctic birds a better chance for survival into the 21st century. ○

Arctic Biodiversity Assessment: Report for Policy Makers

Recommendation 8

■ Reduce stressors on migratory species range-wide, including habitat degradation and overharvesting on wintering and staging areas and along flyways and other migration routes..

Photo: Julie Skotte, Visit Greenland.

Humpback whale, Jacobshavn Icefjord

ECOSYSTEM SERVICES ARE THE BENEFITS THAT PEOPLE RECEIVE FROM NATURE.

Putting a price on biodiversity

Those of us who have experienced encounters with some of the fascinating animals of the Arctic – narwhal, polar bear, ivory gull or some other Northern species – will not easily forget that moment. Or perhaps you have enjoyed a fine meal of reindeer, caribou, or whitefish. In that case, MARK MARISSINK says you have partaken of some of the many ecosystem services that Arctic biodiversity provides. But do we need to put a dollar value on the fruits of biodiversity, to protect it?

NATURE, BIODIVERSITY, has a value. It has a value because we can enjoy a walk in the forest or the view of a birds' cliff or just by being there. Indeed this value has been recognized by almost every country in the world, as witnessed by the very first lines of the UN Convention on Biological Diversity which state we are "Conscious of the intrinsic value of biological diversity and of the ecological, genetic, social, economic, scientific, educational, cultural, recreational and aesthetic values of biological diversity and its components".

But in day-to-day decision making, nature is still often seen as a special interest for a few

people who like rare species, rather than something that is of importance to all of us. This is where the concept of ecosystem services comes into play.

Ecosystem services are the benefits that people receive from nature. Some of those benefits, such as food, firewood and timber, are obvious and are also regularly traded in markets. Others, such as flood control through forests or wetlands, or pollination of orchards by insects, can be less visible and are often taken for granted. That means they are usually overlooked when decisions are made that have an impact on nature, and we may suddenly find ourselves without the flood control we have always relied upon.

MARK MARISSINK is with the Nature And Biodiversity Research and Assessment unit, under the Swedish Environmental Protection Agency.

Ecosystem services are often divided into four categories: supporting, regulating, provisioning and cultural services. Supporting services are the basis for our survival on earth. They include photosynthesis, soil formation, nitrogen cycling, and they lay the foundation for the other ecosystem services. Regulating services can be the pollination and flood control of the previous example, but also local and global climate regulation by vegetation. Provisioning services provide us with products from nature for use as food, building materials, and fuel. Finally, cultural services constitute a diverse category that includes our enjoyment of nature, inspiration or the benefits to our health.

By looking at nature through the concept of ecosystem services, the idea is that it will be easier to convince those who do not believe that they are interested in nature that nature should be of interest to them. In order to make this even clearer, it could be useful to actually put a value to those ecosystem services. In that case, benefits of a decision, for instance to build a new road, could be compared to its costs to ecosystem services. In some cases, it is not too difficult to valuate changes in ecosystem services; sometimes this can even be done in direct monetary terms, for instance changes in timber production when trees have to be cut to build a road. More often, however, it is much more difficult and in many cases we will have to be content just to know that these values exist, without exactly knowing how large they are.

Photo: USFWS

Wild berries gathered at Innoko National Wildlife Refuge in Alaska make a colorful display.

MANY PEOPLE OBJECT TO THE CONCEPT OF ECOSYSTEM SERVICES AND ESPECIALLY TO THE IDEA OF PUTTING "A PRICE" ON NATURE

Many people object to the concept of ecosystem services, and especially to the idea of putting a value ("a price") on nature. They see it as too human-centred or disrespectful of nature's own value. Traditional knowledge often takes a completely different view of life, and also many environmentalists think it is inappropriate to disregard the intrinsic value of nature in this way. Others see ecosystem services as the only way to make nature count in decision making.

To date, the concept of ecosystem services has been studied to a limited extent in the Arctic, especially when compared with other regions of the earth. Studies of supporting and regulating services are largely absent. Providing and cultural services have been studied in more depth, and the chapter on ecosystem services in the *Arctic Biodiversity Assessment* describes examples of four provisioning services – reindeer herding; commercial fisheries; commercial

and subsistence hunting, gathering and small-scale fishing; and recreational and sport hunting – and two cultural services – tourism and non-market values. Since so much of the work on ecosystem services has been done in very different environments, ongoing studies, led by WWF, on how and where an assessment of the ecosystem services provided by Arctic biodiversity can take place will be of great importance. ○

Arctic Biodiversity Assessment: Report for Policy Makers

Recommendation 12

■ Evaluate the range of services provided by Arctic biodiversity in order to determine the costs associated with biodiversity loss and the value of effective conservation in order to assess change and support

ARCTIC BIODIVERSITY CONGRESS

TRONDHEIM, NORWAY, DEC. 2-4, 2014

ORGANIZED BY THE CONSERVATION OF ARCTIC FLORA AND FAUNA WORKING GROUP OF THE ARCTIC COUNCIL

FIRST CALL FOR PROGRAM CONTENT

The Conservation of Arctic Flora and Fauna (CAFF), the biodiversity Working Group of the Arctic Council, is seeking individuals and organizations to provide presentations, organize sessions and submit posters that will encourage a dialogue on Arctic biodiversity among scientists, indigenous peoples, policy makers, government officials, northerners and industry representatives at the Arctic Biodiversity Congress.

PLEASE SUBMIT PROPOSALS FOR SESSIONS, PRESENTATIONS OR POSTERS THAT ADDRESS AT LEAST ONE OF THE THREE THEMES BY APRIL 30, 2014

Thank you for your interest in participating in and contributing to the Arctic Biodiversity Congress!

Please contact caff@caff.is if you have any questions.

Return WWF Global Arctic Programme
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THE PICTURE

Hunted to extinction

THE GREAT AUK was a flightless bird that has been extinct since the mid-19th century. It was the only modern species stemming from the penguin family and was important to many Indigenous cultures symbolically and for food. Many Maritime Archaic peoples were buried with Auk bones. Agile in the water but clumsy on land,early European explorers saw the bird as a great convenience food and as fishing bait, which greatly reduced its numbers. Down from the Great Auk was also in high demand in Europe. The last two confirmed specimens were killed on Eldey, off the coast of Iceland on July 3, 1844.
Great Auks mated for life nesting in extremely dense social colonies, laying one egg on bare rock with both parents taking turns hatching the chick.

Illustration: John James Audubon, *Birds of America*

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.

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