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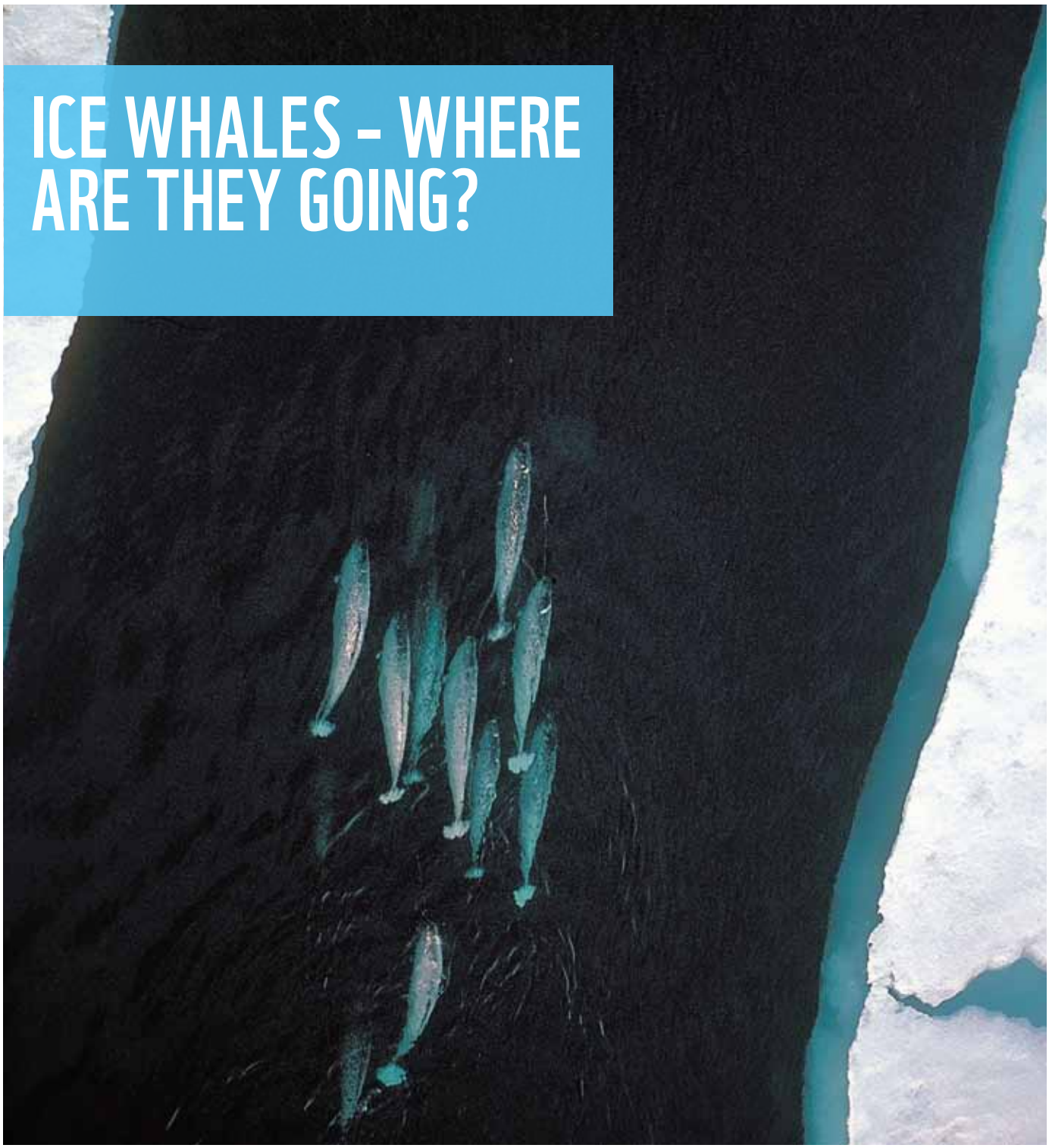
THE CIRCLE

ICE WHALES – WHERE ARE THEY GOING?



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Contents

ICE WHALES – WHERE ARE THEY GOING?

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COVER: Aerial view of narwhal (Monodon monoceros) group migrating, Lancaster Sound, Canadian Arctic
© naturepl.com / Doug Allan / WWF-Canon

ABOVE: Bowhead whale at Isabella Bay, also known as Niginganiq, Nunavut, Canada.

The Arctic: a land of challenges and opportunities for cetaceans

THIS EDITION of *The Circle* is dedicated to the Arctic's ice whales: the bowhead, the largest whale in polar waters and the longest-lived mammal species on Earth; the narwhal, whose long tusk has mystified humans for years; and the beautiful white beluga, a sentinel of the Arctic Ocean's health.

In September 2012, it became clear that the arctic sea ice extent was a record low this year. In this issue, we are looking at the dramatic changes that are currently taking place, and the impact that these developments may have on arctic cetaceans. Kristin Laidre points out that climate change and sea ice loss are opening up new physical habitat for cetaceans, resulting in possible distribution changes as species move into new areas. Similarly, Mads Peter Heide-Jørgensen alerts that the seismic exploration used for oil and gas development may cause changes in migration patterns and ultimately affect the survival and reproduction of narwhals. Impacts of shipping will increase threats such as collisions, noise and oil pollution, as Dustin Street highlights in his article.

THE TIME TO IMPLEMENT EFFECTIVE CLIMATE CHANGE ADAPTATION MEASURES IS NOW.

Yet of cumulative impacts on cetaceans are still poorly understood.

Randy Reeves points out three major research gaps that need to be addressed: baseline data, information on effects, and understanding the effectiveness of mitigation measures. Fortunately, today short-term or narrowly scoped studies are being replaced with monitoring programs that are more intensive, holistic and integrated. This is helping to understand the structure, function and health of the ecosystem, explains Lisa Loseto.

In this edition of *The Circle* you will also find examples of ways to move forward. As highlighted by Bruno Tremblay, Pierre Richard and Stephanie Pfirman, climate models are essential to understand how the ice whales' habitats will change and help inform decision-making. On a local level, one concrete example is the Western Gray Whale Advisory Panel (WGWAP) that oversees the interests of gray whales off Sakhalin Island in Russia. As Reeves puts it, loan conditions and company reputational risks are key factors in pulling the extractives industry in the right direction. In addition, Cheryl Rosa stresses the importance of management measures both at the local and international level. Achievements have been made to date, but there are growing challenges in the rapidly changing future conditions.

Parallel to this, cooperation between scientists and local communities is vital to ensure the integration of local perspectives and knowledge into research. As mentioned by Loseto, Inuvialuit hunters have helped compile one of the largest data sets for a marine mammal in the Canadian Arctic by providing over 20 years of samples and regular local observations. The last two decades have also been revolutionary in terms of generating knowledge of arctic cetacean habitat use through remote sensing and satellite based technology; which Heide-Jørgensen rightly points out as crucial for the modern management of whale populations.

As extractive industries are increasing activities in the Arctic, the observed summer-time melting of arctic sea ice has already far exceeded the worst-case projections from climate models of the Inter-governmental Panel on Climate Change (IPCC). The time to implement effective climate change adaptation measures is now. We need to strengthen the linkages between policy makers, scientists, local communities, and industry, to be able to mitigate the quickly increasing threats faced by arctic cetaceans and the people that depend on them. ○

AIMÉE LESLIE is the Global Cetacean and Marine Turtle Manager at WWF International, leading WWF's Cetaceans Species Action Plan (2012-2020) with projects in 10 marine priority places, including the Arctic; and a particular focus on 25 cetacean species around the world, including whales, dolphins and porpoises.

Ice floes with considerable open water near the edge of the sea ice. Taken near the 2012 record minimum low sea ice extent north of Svalbard, Norway.

Record arctic ice low drives urgent global action

SEPTEMBER'S ANNOUNCEMENT of a record low for arctic sea ice extent highlights the need for urgent local and global actions, said WWF experts. According to satellite monitoring, the low of 3.41 million square kilometres was reached on September 16.

"This is a critical loss of habitat for a whole sea ice dependent ecosystem and the unique animals that rely on that system," said Martin Sommerkorn of WWF's Global Arctic Programme. "We know the ice is on a continuing downward trajectory. What's shocking is just how quickly it is happening. We need to plan now for an Arctic where the ice is virtually gone for the summer, as that is the situation we will soon be facing – this means conserving the critical habitat that remains."

The sea ice loss should be a gigantic wakeup call for all of us on climate change, said Samantha Smith of WWF's Global Climate and Energy Initiative. "Climate change won't stop at the Arctic Circle. Scientists tell us that the rapid loss of arctic sea ice is linked to wet summers, severe winters and extreme weather events in the northern hemisphere. And other global climate impacts we're seeing are at least as serious, such as this year's record droughts with their impacts on food production, food prices and hunger." ○

Greenland: collaborating for sustainability

THE PUBLIC DEBATE on sustainable development in Greenland should be strengthened, with a particular focus on the many proposed large-scale projects and what they mean for Greenlandic society and the environment. That's the aim of a new collaboration between the Inuit Circumpolar Council (ICC) and WWF, which was launched in Nuuk in September.

Greenland is experiencing a growing interest from foreign companies who want to extract the wealth hidden underground. The number of prospecting licenses for oil exploration has increased from five to 47 since 2002.

"The ICC and WWF recognize the need to create new revenue and new jobs in Greenland. But the speed with which projects are put on the drawing board seems overwhelming for many," said Aqqaluk Lynge, president of the ICC. "The success criterion should be what Greenlandic society gets out of these projects." ○

In press

NARWHALS and seismic exploration: Is seismic noise increasing the risk of ice entrapments? This is the pertinent title of an upcoming article in *Biological Conservation*, scheduled to be published in 2013 and written by arctic experts Mads Peter Heide-Jørgensen, Rikke Guldborg Hansen, Kristin Westdal, Randall R. Reeves and Anders Mosbech.

The warming Arctic holds an estimated 25 per cent of the earth's known remaining petroleum reserves and commercial activity is expected to increase further as the area becomes more accessible and oil prices climb. One of the main methods of locating and assessing these resources is seismic survey which involves the use of airguns that introduce high-energy noise which whales are known to be particularly sensitive to. The authors express a concern that three large recent ice entrapments of these whales may have been causally linked to seismic survey activities, and conclude that studies of the direct effects of seismic surveys on narwhals are urgently needed and should precede further seismic surveys in narwhal habitats.

In Canada, seven oil companies hold 56 licenses to do exploratory drilling in the Beaufort Sea, overlapping with 75 per cent of the ecologically and biologically significant areas (EBSAs) there. And on the Canadian continental shelf of Baffin Bay, extensive five year seismic approvals are now sought by oil-gas companies in areas that are major migration and wintering areas for bowheads and narwhal especially. ○

US government video shows changing world of walrus

A VIDEO PRODUCED by the United States Geological Survey in November highlights the challenges faced by walruses as a result of climate change. In recent years, ice loss along the Alaskan and Russian coasts has forced thousands of walruses ashore, resulting in deaths as they sometimes stampede and trample each other. Land is not a good place for the walrus to be – sea ice is their preferred platform for resting and feeding. But this year, as in four of the five previous years, ice is hard to come by. As a result, female and young walruses in need of a resting spot are again heading to shore to haul out, huddling together in abnormally large numbers. These mass congregations are dangerous and can lead to violent stampedes that are often deadly, especially to young walruses. ○

Walrus haulout. Ryrkaypiu, Chukotka, Russia, 2007.

© Tom Arnbom

Stronger safeguards for arctic drilling needed: UK MPs

A REPORT PUBLISHED in September by the Environmental Audit Committee of the United Kingdom House of Commons calls for a halt on oil and gas drilling in the Arctic until stronger safeguards are put in place.

"With this report, we've seen politicians from all sides working together to consult scientists, stakeholders and civil society," said WWF's Rod Downie. "Now the UK government, and governments and industries across the world, need to heed the warning signs from the Arctic and act with urgency and ambition to tackle climate change."

While the UK is a non-arctic nation, its ties to the region are significant – it is a seat for oil and gas interests (Cairn Energy, Shell and BP have major offices there), globally relevant and influential polar science, and maritime insurance and finance. The Polar Code, which deals with arctic shipping, is under negotiation at the International Maritime Organization (IMO) in London. ○

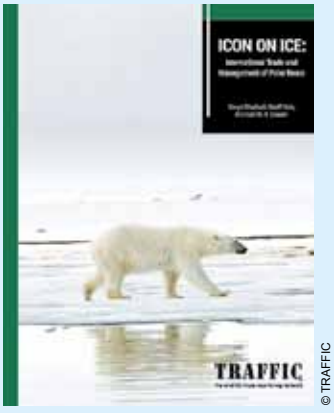
Arctic a hot topic at global climate talks

THE ARCTIC was a hot topic at the global climate talks in Doha in November. The World Meteorological Organization issued a "Provisional Statement on the State of Global Climate in 2012" highlighting the record crash of arctic sea ice this year. WMO Secretary-General Michel Jarraud said "The alarming rate of its melt this year highlighted the far-reaching changes taking place on Earth's oceans and biosphere. Climate change is taking place before our eyes and will continue to do so as a result of the concentrations of greenhouse gases in the atmosphere, which have risen constantly and again reached new records."

While the WMO noted present arctic impacts, the United Nations Environment Programme was looking ahead at the potential for thawing arctic permafrost to release large amounts of warming gases into the atmosphere, speeding up global climate change. WWF was at the climate meetings offering solutions and pushing nations at the talks to take up those solutions. ○

Primary threat to polar bears

A REPORT published by the wildlife trade monitoring organization TRAFFIC in October concludes that the major threat to polar bears is not international commercial trade, but habitat loss due the rapid melting of their preferred sea ice habitat. *Icon on Ice: International Trade and Management of Polar Bears* gathers the best available information on the legal market for polar bear skins and other parts, and has been peer reviewed by international experts. ○



Cover of Icon on Ice.

© TRAFFIC

Who are the ice whales?

By CHESLEY SANGER

GENERAL CHARACTERISTICS:

- The bowhead is the only exclusively arctic great whale *(Balaena mysticetus),* up to 18 metres and 100 tonnes.
- Narwhals (*Monodon monoceros*), which can measure up to 4-5 metres and 1-1.5 tonnes and belugas (*Delphinapterus leucas),* up to 4-5 metres and two tonnes, are closely related. The principal differentiating features are the narwhals' "tusks" (a canine tooth protrusion up to two metres, found mostly in males) and migration/range variations .
- Besides differences in ranges, seasonal movements and ecology, the fact that narwhals and belugas are toothed whales also distinguish them from the bowhead which is a baleen or "filter" feeder.
- All three are circumarctic.
- The range of the beluga includes some subpopulations persisting in more southerly regions, including in the Gulf of St. Lawrence, Cook Inlet, Okhotsk Sea and the White Sea. Of the three species, belugas have the most generalist diet.
- As with all whales, migrations/ranges are determined primarily by the need to seasonally find food and suitable breeding and birthing environments.
- All three ice whales have contributed to the evolution and survival of coastal people in the Arctic, with their bones, blubber, meat and other material all being used for multiple purposes in Inuit culture especially.

(Continued on p. 8)

CHESLEY SANGER, Professor emeritus, Department of Geography, Memorial University of Newfoundland.

Climate cha

nge impacts on arctic cetaceans

Pod of narwhals in Melville Bay, West Greenland, August 2012.

Photo: Kristin Laidre

The loss of sea ice is creating dramatic changes in the Arctic. But for arctic cetaceans, many of the impacts of these changes are still unknown, says KRISTIN LAIDRE.

THREE SPECIES of cetaceans inhabit the arctic marine biome exclusively and are adapted to this dynamic and extreme environment: the beluga whale, the narwhal, and the bowhead whale. These species are often associated with sea ice and their life history events and feeding behaviour are closely linked to seasonal dynamics of light, temperature, and annual ice cover. With some exceptions, these species range widely and undertake large seasonal migrations, covering thousands of kilometres in a single year. All three species are also important cultural and food resources for Indigenous peoples throughout the Arctic.

KRISTIN LAIDRE is a marine ecologist at the University of Washington, Seattle. Her research is field-based, largely empirical, and focuses on using quantitative data to answer questions about the ecology and management of arctic marine mammals.

Dramatic loss of arctic sea ice has been well documented since 2000. The latest projections indicate the Arctic could be ice-free during summer as early as 2030. Thus, habitat loss and habitat degradation for all ice-associated arctic marine mammals, evident in some locations now, can be expected to continue. While the impacts of sea ice

THREATS:

- As arctic sea ice cover decreases, the whales are facing a situation where major changes in prey and predator relationships are occurring, and their preferred habitats are increasingly open to industrial development and possible associated impacts.
- In particular, the increased presence of the oil-gas industry and commercial shipping may pose distinct threats caused by oil pollution and acoustic disruptions in the arctic marine environment.
- Bowheads suffered from severe overexploitation during commercial whaling in the Arctic and populations are still slowly recovering.
- Northward expansion of commercial fisheries may also pose challenges for the food supply of these whales in terms of potential impact at different trophic levels.

HUNTING (NATIVE SUBSISTENCE):

- Narwhals, belugas and to a lesser extent bowheads have been hunted by Indigenous peoples for thousands of years.
- While all body parts at the subsistence level were "essential", whale oil for lighting, heating and food preparation was particularly important. Similarly, the tusk of the narwhal had a particular significance, hence "value", especially as contact with European/American whalers/traders increased.
- Harpoons and lances were people's principal killing "utensils", using kayaks or the ice as the main hunting platforms.
- While the bowhead was a significantly more important target in terms of yields (including, additionally, baleen and larger bones that could be used in the construction of shelters, sleds, etc.), its capture was a more lengthy and immeasurably more dangerous process than narwhal and beluga hunting.

COMMERCIAL WHALING:

The bowhead was the only great whale species regularly encountered by arctic Indigenous people each year. Fortuitously, however, it was one of the two "right" whales that - due to the fact that they are timid and slow swimmers, and float when dead - led to the development of commercial (or so-called "traditional") whaling, first by the Basque in the Bay of Biscay during the Middle Ages and then spreading in rough order to southern Labrador, Spitsbergen, offshore Greenland

Two narwhal (Monodon monoceros) surfacing to breathe in Admiralty Inlet, Lancaster Sound, Nunavut, Canada.

Beluga whales trap Arctic. June 1999

loss on ice-obligate species (e.g., polar bears or walrus) are clear, it is less obvious what the impacts will be on arctic cetaceans.

NEW PHYSICAL HABITATS

Fundamentally, sea ice loss opens up new physical habitat for cetaceans and may result in changes in distribution as species move into new areas. For example, in Baffin Bay, belugas shift their distribution westward (offshore) with the receding annual sea ice edge when the banks off West Greenland open up earlier in spring. In other areas, geographic barriers (such as heavy sea ice in narrow

Bowhead whale (Balaena Mysticetus) just under ice.

© naturepl.com / Sue Flood / WWF-Canon

ped at ice hole (Delphinapterus leucas) too far away to reach open sea, Canadian High

straits) that have separated some cetacean populations are disappearing. For example, two satellite-tagged bowhead whales, one from West Greenland and one from north of Alaska, entered the Northwest Passage from opposite directions and spent approximately 10 days in the same area in 2010 (see map on page 17). This is the first time geographical overlap between these populations has been documented. These populations were likely connected for periods during the Pleistocene epoch, but since then have been assumed to be separated by the sea ice plug in the Northwest Passage. Reductions in summer ice may now be facilitating exchanges between these, and possibly other, cetacean populations or species.

INDIRECT CHANGES IN THE ECOSYSTEM THAT OCCUR WITH THE LOSS OR RETREAT OF SEA ICE MAY INCLUDE INCREASED PREDATION BY KILLER WHALES OR EXPOSURE TO DISEASE AND COMPETITION FROM TEMPERATE SPECIES EXTENDING THEIR RANGE INTO HIGH LATITUDES.

Changes in spring sea ice breakup may also shift the duration or extent of the arctic production season. The spring bloom of algae (primary production) provides the main food source for the zooplankton (secondary production), which plays a critical role in the transfer of energy between primary producers and secondary consumers like forage fish. Any changes in timing of the optimal feeding window may have negative impacts on populations of arctic cetaceans. However, it may also allow for improved or longer foraging opportunities for sub-arctic baleen and toothed whale species that move into the Arctic in ice-free months.

(Continued on p. 10)

Sea, Davis Strait/Baffin Bay, North and South Atlantic, Pacific and eventually the western Arctic before giving way in the 1860s to "modern" whaling with engined chasers, exploding projectiles, harpoon guns and winches able to retrieve whales that sank when dead. This, in turn, permitted the harvesting of all other great whales previously immune to attack, such as blue, fin, humpback, minke and sei.

IMPACT ON NATIVE POPULATIONS:

- European/American commercial whalers had little impact on Indigenous polar people in terms of the narwhal and beluga, although there were instances towards the end of the 19th century following the decimation of the western North Atlantic bowhead stock where individual crews took belugas in the eastern Arctic by driving them ashore when concentrated in large numbers. Oil yields were meagre, however, and the characteristics of the "drive" so unpleasant, that masters were seldom able to get their men to participate. Stocks, then, were not seriously threatened and the beluga and narwhal hunts (and produce) initially did not promote significant interaction between whalers and Indigenous people.
- The bowhead, on the other hand, attracted and encouraged wide-scale and intimate contact between commercial whalers and arctic Indigenous peoples, especially in the eastern Canadian Arctic (and west Greenland to a lesser degree) and the western Canadian Arctic/Alaska.
- Overhunting led to the dramatic decline of all bowhead populations (hunted almost to extinction by the beginning of the 20th century, and the first protected internationally), but none more so than the eastern North American Arctic. Indigenous peoples, then, found it increasingly difficult to harvest bowheads as part of their subsistence economies.
- By the 1860s, American and British (primarily Scottish) whalers, motivated by severely reduced catches and profits, began to overwinter and establish shorestations primarily in Cumberland Gulf and other southern parts of Baffin Island that increasingly relied on natives. Their Indigenous cultures and economies, consequently, were significantly impacted. A little later towards the turn of the century western arctic groups followed the same pattern with similar results. ○

Photo: Kristin Laidre

Bowhead whale in Disko Bay, West Greenland.

INDIRECT ECOSYSTEM CHANGES

Trends in population abundance of arctic cetaceans are largely unknown because obtaining abundance information in sequential years requires extensive and expensive surveys conducted in remote regions. In some areas, stocks of belugas and narwhals are monitored regularly due to the need for harvest advice, while in other areas, almost nothing is known about abundance. In areas where subpopulation trends of bowhead whales are monitored (Bering-Chukchi-Beaufort and West Greenland), they are increasing at 3-5 per cent per year. However, heavy commercial harvesting reduced bowhead whales to very low numbers and contracted ranges, therefore, the population increases are likely due to population recovery from extremely depleted levels, and cannot be attributed solely to climate change.

Indirect changes in the ecosystem that occur with the loss or retreat of sea ice may include increased predation by killer whales or exposure to disease and competition from temperate species extending their range into high latitudes. Additionally, irregular sea ice freeze-up patterns may have negative effects for belugas and narwhals, which are susceptible to sea ice entrapments if ice conditions change rapidly. Increasing frequency and intensity of storm events might also have greater impacts on arctic cetaceans if they no longer have ice available for refuge.

The decrease in sea ice has been accompanied by increasing human activities which may have direct (e.g. collision) or indirect impacts on arctic cetaceans. As seen elsewhere in this edition, these include industrial activities such as offshore oil and gas exploration and development (seismic exploration, drilling), commercial shipping and increased tourism, northward expansion of fisheries (with possible implications for bycatch, competition and resource depletion (e.g., narwhal and Greenland halibut), incidental mortality and serious injury caused by entanglement in fishing gear and ship strikes (e.g., bowhead whales), hydroelectric development (e.g., beluga whales in Hudson Bay), concomitant increases in underwater noise, and industrial and urban pollution. ○

Red-listed

■ The three ice whales are on IUCN's (International Union for the Conservation of Nature) Red List. Overall narwhal and belugas are listed as 'Near Threatened' and the bowhead as 'Lower Risk', but some regional populations, especially towards the edges of the range, are 'Endangered' or 'Critically Endangered'.

ICE MODELLING

Understanding

The ice whales' habitats are evolving rapidly together with the sea ice that they depend on. Climate models are essential to understand the coming changes and help inform decision-making, say BRUNO TREMBLAY, PIERRE RICHARD and STEPHANIE PFIRMAN.

IN THE LAST DECADE, the Arctic has witnessed large changes in sea ice extent and thickness. In the past, the seasonal cycle in arctic sea ice extent ranged from 15 million square kilometres (roughly the size of Russia) in March to seven million square kilometres (roughly the size of Australia) in September. Contrast this with the seasonal cycle for 2012: 14 million square kilometres in winter but only 3.4 million square kilometres at the end of the summer. This means that the minimum ice extent this year was approximately half of the 1980s average September value. In fact, in the last decade, four record sea minimum ice extents occured, in 2002, 2005, 2007 and 2012.

Unlike sea ice on a lake or smaller body of water, arctic sea ice is in constant motion, mainly under the action of surface winds. During periods when the winds are calm, ocean currents also play a role. The dominant wind pattern over the central Arctic blows sea ice forming off the coast of Eurasia toward North America. As multi year ice – which survives summer melting – drifts, it thickens, both due to ice formation on the underside of floes in winter, and also because the ice is deformed into ridges.

the future

FRAGILE ICE COVER

Anomalous wind patterns in the late 80's and early 90's exported larger than normal quantities of thick multi year ice from the central Arctic out through the Fram Strait. Now the wind pattern has returned to normal, and yet the sea ice cover has continued its decline. Thinner pack ice will have larger areas of open water forming within the pack during the summer where solar radiation is absorbed causing further sea ice melt.

A number of Global Climate Models have been developed to try to understand these changes, using quantitative methods to simulate the interactions of the atmosphere, oceans, land surface and ice. More than 20 climate modelling groups exist worldwide, and much of this work is coordinated through a Coupled Model Intercomparison Project (CMIP5) which provides a multi-model context for experiments.

Despite variations and different weaknesses and strengths between the models, the simulated pattern of summer sea ice retreat is consistent among all models and observations: sea ice retreat occurs both in the Pacific and Atlantic sectors of the Arctic, starts from the Eurasian coastline and migrates towards the Canadian coastline. However, the timing of the simulated retreat lags when compared with observations, with simulations of a seasonally nearly ice-free Arctic ranging between ca. 2030 and 2080.

WILL THEY ADAPT TO CHANGES OF THE FOOD CHAIN THAT ARE LIKELY TO OCCUR WITH WARMING SEAS AND THINNING ICE?

ACCURATE PREDICTION OF FUTURE SEA ICE COVER IS IMPORTANT FOR A WIDE RANGE OF STAKEHOLDERS.

IMPORTANT PREDICTIONS

Accurate prediction of future sea ice cover is important for a wide range of stakeholders including local populations, fisheries, commercial shipping, the tourist industry, national security, the research community – and for the conservation of arctic natural resources.

Among the species that are likely to be affected by sea ice loss are the whales of the Arctic: the belugas, narwhals and bowhead whales. Those species are ice-associated a large portion of the year and their distribution is influenced by the quality and quantity of sea ice. They are limited by the extent of fast ice and migrate out of areas where it forms in winter. If they do not, they risk becoming entrapped when pack ice is consolidated. When trapped for long periods of time, whales slowly become emaciated from lack of food and they often suffer predation from polar bears. The ice also keeps their main predator, killer whales or orcas, away during the winter months. Narwhals and belugas feed on Arctic cod under the pack ice, or such prey as squid and Greenland Halibut near the bottom of ice-covered seas. With pack ice disappearing earlier in spring and forming later in the fall, killer whales have access to arctic hunting grounds earlier and for a longer period. With summer ice extent dwindling, they also have access to wider areas which include these three ice whale species.

FUTURE CHALLENGES

As arctic whales lose their ice refuge, will they change their habits and seek more northern areas with remnant pack ice to avoid predation? Will they adapt to changes in the food chain that are likely to occur with warming seas and thinning ice? Our present understanding of the ecology of these animals is that they appear to be philopatric, i.e., they prefer to migrate to and from the same places every year. It is unclear if and how they will adapt to a very rapidly changig Arctic.

Furthermore, other modelling challenges remain. With less sea ice there will be more light available in the surface waters and therefore more productivity, but the surface ocean will also be more stratified because of the increased river runoff and melting of sea ice. This makes vertical mixing (which recycles nutrients back up in the photic zone) less efficient. Those are all small scale effects that are difficult to simulate using large scale models which still have relatively low resolution. There is therefore a two-fold challenge for future models: ensuring correct modelling of the timing and spatial distribution of a retreating sea ice cover, while also simulating the effect on the ecosystem of these changes. ○

BRUNO TREMBLAY is Associate Professor in the Department of Atmospheric and Oceanic Sciences at McGill University. **PIERRE RICHARD** is a retired marine mammal research scientist, formerly with Fisheries and Oceans Canada. **STEPHANIE PFIRMAN** is Professor and Chair of Environmental Science at Barnard College of Columbia University.

Cultural value of subsistence hunting

The bowhead whale is a primary food source for Alaskan Natives. In addition, the communal nature of the subsistence hunt makes it a critical activity for passing important social and survival skills and cultural practices along to younger generations, says GEORGE NOONGWOOK.

ALASKAN NATIVES of the high Arctic (Iñupiat) and Bering Straits Region (Siberian Yupik) have relied on bowhead whales, from the Bering-Chukchi-Beaufort Seas (BCBS) stock of bowhead whales, as a primary food source for the past 2,000 years. Today, bowhead whales remain a key nutritional resource for the 11 bowhead whale subsistence hunting communities of the Alaska Eskimo Whaling Commission (AEWC). The villages of Kaktovik, near the Canadian border on the Beaufort Sea coast; Nuiqsut, in the Colville River Delta; Barrow, at the junction of the Beaufort and Chukchi Seas; Wainwright, Pt. Lay, Pt. Hope, and Kivalina, on the Chukchi Sea coast; and Wales, Little Diomede, Gambell, and Savoonga in the Bering Straits Region, all participate in the annual subsistence hunt of bowhead whales. It is estimated that this hunt can account for as much as 900,000 pounds per year of highly nutritious meat and *muktuq* (skin and a thin layer of epidermal fat), which is shared within the villages and with a large network of family and friends in the subsistence sharing network relied upon by many Alaskan Natives.

In addition to its importance as a source of nutrition, the communal nature of the bowhead whale subsistence hunt makes it a critical activity for passing important social and survival skills and cultural practices along to younger generations. Whaling captains are highly respected for their traditional knowledge of ice, weather, and whale behaviour, which is necessary to hunt successfully, for their generosity in supporting their whaling crews, and for their stewardship of the Native traditions of sharing and distributing meat and *muktuq* throughout the communities. Of all subsistence activities in these communities, the bowhead whale hunt represents one of the greatest con-

Inuit narwhal hunter Mamarut Kristiansen throwing his harpoon from his kayak, Qaanaaq, Greenland.

© Staffan Widstrand / WWF

centrations of community-wide effort and provides ongoing reinforcement of the traditional social structure. With all of this, the bowhead whale subsistence hunt is a key part, not only of the cultural traditions of northern Alaska's Native communities, but also of their modern cultural identity.

QUOTA REGIME

The BCBS bowhead whale stock migrates every spring from its wintering grounds in the northern Bering Sea, through openings in the ice along the Chukchi Sea coast of Alaska, past Pt. Barrow and west to summering grounds

THE BOWHEAD WHALE HUNT REPRESENTS ONE OF THE GREATEST CONCENTRATIONS OF COMMUNITY-WIDE EFFORT AND PROVIDES ONGOING REINFORCEMENT OF THE TRADITIONAL SOCIAL STRUCTURE.

in the Canadian Beaufort Sea. During this spring migration, all of the AEWC villages, with the exception of Nuiqsut and Kaktovik hunt for whales from the edge of the spring shorefast ice. Crews hunting in the spring prefer to use traditional wood-frame *umiaqs* covered in walrus or *ugaruk* (bearded seal) skin, as they are lightweight and glide quietly in ice-choked spring waters. Beginning in late August, bowhead whales summering in the Canadian Beaufort Sea begin to migrate westward along the Alaskan Beaufort Sea coast before heading south through the Bering Strait and into the northern Bering Sea. During the fall migration, the villages of Nuiqsut and Kaktovik conduct their annual whale hunt, along with Barrow, which hunts during both the spring and fall migrations. The fall bowhead whale subsistence hunt is conducted in open water, primarily from motorized skiffs.

Since 1977, the bowhead whale subsistence hunt has been managed under a quota regime set up by the International Whaling Commission (IWC). The IWC quota is implemented domestically by the National Oceanic and Atmospheric Administration (NOAA), and managed locally by the AEWC under a cooperative agreement with NOAA. The AEWC was formed by the whaling captains of the bowhead whale subsistence hunting villages in 1980 to represent the interests of the villages under the newly-imposed IWC quota regime.

OIL AND GAS MITIGATION

As stated in its bylaws, the purposes of the AEWC are to "enhance the marine resource of the bowhead whale, including protection of its habitat; to protect Eskimo subsistence bowhead whaling; to protect and enhance Eskimo culture, traditions, and activities associated with bowhead whales and bowhead whaling; and to undertake research and educational activities related to bowhead whales." In keeping with these purposes, along with managing the subsistence hunt, the AEWC works with its whaling captains on measures to improve the efficiency of the hunt and on a program to upgrade the traditional weapons used by the hunters. The AEWC and its whaling captains also cooperate with wildlife scientists at the North Slope Borough Department of Wildlife Management on research into bowhead whale biology and genetics.

Also in keeping with its purposes, since 1986, the AEWC has worked to develop procedures for mitigating adverse impacts to bowhead whales, their habitat, and bowhead whale subsistence hunting from offshore oil and gas development. This work is undertaken through the AEWC's Open Water Season Conflict Avoidance Agreement (CAA) Process, an annual series of communications and meetings between whaling captains and offshore oil and gas operators, focused on developing measures to manage planned offshore operations so as to minimize environmental impacts and impacts to hunting opportunities. ○

GEORGE NOONGWOOK is the Chairman for Alaska Eskimo Whaling Commission (AEWC). He is Yup'ik Eskimo and has resided in Savoonga, Alaska his entire life. He began whaling at an early age and is now one of 31 whaling captains in his village. Savoonga is located on the northern coast of St. Lawrence Island in the Bering Sea. Because of its isolation and remoteness, Savoonga is heavily reliant on the subsistence hunt of the bowhead whale to feed the village.

Getting to know belugas through community-based monitoring

In the Beaufort Sea, cooperation between scientists and local communities ensures inclusion of local perspectives and knowledge into the research on beluga whales, and improves the access to samples, explains LISA LOSETO.

SINCE THE 1970s, Inuvialuit communities in the western Arctic have been collaborating with researchers, including scientists from Fisheries and Oceans Canada (DFO), to monitor beluga whales that roam the waters of the Beaufort Sea. Inuvialuit hunters, for example, have been involved in collecting samples from harvested whales during traditional subsistence hunts for more than two decades. This has led to the compilation of one of the longest datasets for a marine mammal in the Canadian Arctic.

LISA LOSETO leads the Ecosystem Impacts Team at the Freshwater Institute of Fisheries and Oceans Canada in Winnipeg. Her research on beluga health focuses on diet, contaminant exposure and the linkage to ecosystem health and ecosystem stressors. The programs she leads are carried out in close partnership with communities and co-management boards of the Western Canadian Arctic.

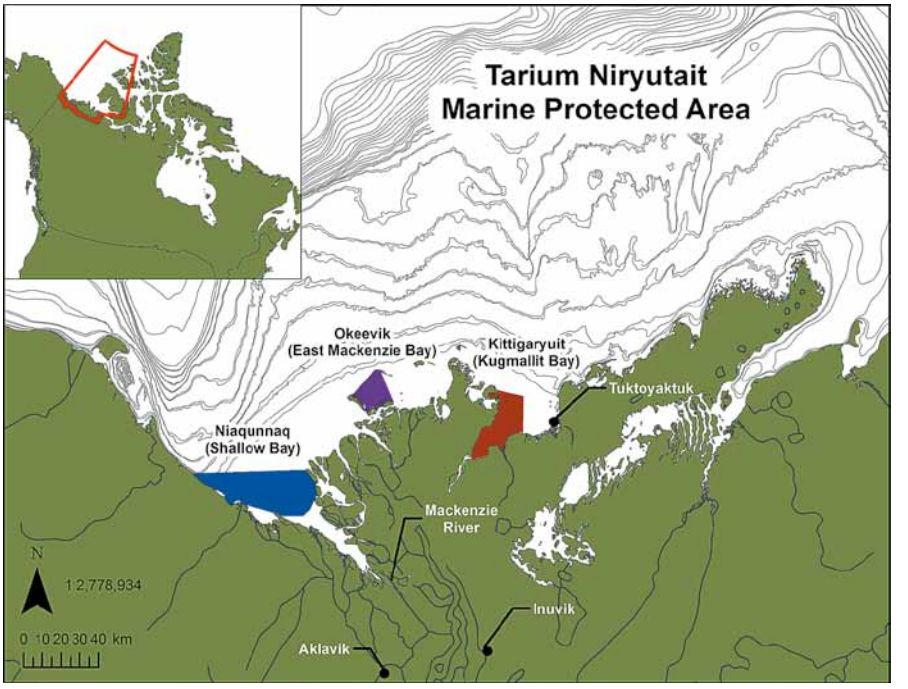
Monitoring is carried out in close partnership with DFO, which manages the resources in collaboration with the co-management boards that ensure the interests of local communities are included. Ultimately, the information gathered will inform decision-making related to the management of resources in the region and the Tarium Niryutait Marine Protected Area (MPA), which was mainly established for belugas, as well as environmental assessments and regulatory processes (see Figure 1).

IDEAL SPECIES TO STUDY

One of the longest and most successful community-based monitoring programs in the region is the beluga program at Hendrickson Island, situated within the MPA near Tuktoyaktuk. Belugas are an ideal species to study for logistical, cultural and scientific reasons. They are traditionally hunted in many places, making it possible to collect samples from a broad range of sites. For scientists, belugas serve as a sentinel species because of their position near the top of the food chain, which enables them to integrate signals and information from the food web and the ecosystem as a whole.

The success of the monitoring program at Hendrickson Island is due in large part to the involvement of Frank Pokiak and his wife Nellie. For more than a decade, the Pokiaks have been assisting in scientific research by taking samples of beluga *muktuq* (blubber/skin), muscle, organs, blood and other tissues from each of the whales that lo-

Figure 1



cal hunters from Tuktoyaktuk share for sampling in order to measure and monitor beluga health. Along with traditional knowledge, tissue sampling techniques have also been passed down to their children and grandchildren. Over the past six years, more than 10 local youths have also participated in the program.

Given their long history of observing the movement, behaviour and anatomy of whales, the invaluable knowledge accumulated by the Pokiaks and other community members is critical to shaping the future direction of monitoring in the region and the Tarium Niryutait MPA, an area that has been traditionally used by the Inuvialuit people of the western Arctic.

Photo: Lisa Loseto

Frank Pokiak, Inuvialuit hunter and chair of the Inuvialuit Game Council (IGC) sampling harvested beluga for skin and muscle with Lisa Loseto, DFO, at the Hendrickson Island beluga camp, Canada.

INTEGRATED MONITORING

Over the past few years, Loseto and other scientists at the Freshwater Institute (DFO) have been collaborating with the six communities in the Inuvialuit Settlement Region – Aklavik, Inuvik, Paulatuk, Sachs Harbour, Tuktoyaktuk and Ulukhaktok – to enhance existing monitoring programs in the coastal waters of the western Arctic.

Studies that are short-term or narrow in scope are being replaced with monitoring programs that are more intensive, holistic and integrated, which will help develop a baseline understanding of the structure, function and health of the ecosystem. That means moving away from gathering information that simply tells us how many fish or beluga were taken in one year to information that will tell us how healthy they are and how that reflects ecosystem health.

For example, the programs are being designed to address questions such as whether climate change is having an impact on whales and whether that is being observed in both the scientific findings and by hunters. This enables observations made by community members to be built into the design of monitoring programs for the following year.

As part of the project, Inuvialuit college and university students are taking the lead on traditional ecological knowledge (TEK) studies. In the summer of 2012, a traditional knowledge study was carried out to collect information that will aid in the design of an enhanced beluga and fish monitoring program. The students interviewed local elders and hunters about changes being observed and asked what should be included in the design of the new program. The information is now being used to ensure the implementation of a holistic approach to monitoring.

COMMON INDICATORS

Although the species monitored vary by site, all of the monitoring programs started using the same set of indicators in 2011. This will enable researchers to pool the information being collected. The indicators fall into four main categories:

- diets and the food-web
- the impact of stressors
- morphometrics (age, sex and size of species)
- disease

The use of standardized indicators at all monitoring sites will provide scientists with more insight into the spatial and temporal variability of the ecosystem in both coastal and offshore waters, how species use various habitats, and improve understanding of the linkages between predators and prey.

Integrated monitoring programs will also make it possible to assess what impacts, if any, may take place in a future with less ice, more shipping and other activity in the Arctic and whether changes are within the ecosystem's normal, healthy range or not.

Each of the three areas that comprise the Tarium Niryutait MPA are distinct, but they are all interconnected and each can provide scientists with different information about the health of the beluga, from what they eat and how they respond to stressors, for example.

This cooperation with communities ensures partnership with experts who know the ecosystem and facilitates monitoring of a larger area. They can boat out to complicated areas, they know when the whales or certain fish species will be there, they know how to hunt and harvest them, and they can tell whether the condition of the whales and other species looks good or not.

Community-based monitoring also makes it possible to monitor a greater variety of species, which is essential for developing an effective ecosystem-based approach to resource management. This is even more critical in a rapidly changing Arctic.

Once researchers gain a better understanding of how the offshore and coastal systems work, the goal is to maintain the coastal community-based monitoring in the long term, which will benefit both science and communities. ○

Following the whales

By MADS PETER HEIDE-JØRGENSEN

Photo: Mads Peter Heide-Jørgensen

Captured narwhals are instrumented on the shore.

THE THREE ARCTIC WHALES – the beluga, the narwhal and the bowhead whale – spend most of the year in remote and inhospitable areas of the Arctic where darkness prevails for months and where sea ice conditions make it impossible to observe and follow these whales. The development of remote sensing and satellite based technology over the past 20 years has revolutionized our knowledge about how the arctic whales utilize their habitats. Record deep diving activity has been observed for narwhals during the darkest part of the winter and long range migrations into the multi-year polar ice has been monitored for bowhead whales and belugas. None of this would have been possible without the development of miniaturized satellite radio transmitters in parallel with experiments with techniques for safely capturing, handling and instrumenting arctic whales. Some of these devices have remained on the whales for almost 12 months, providing a vital insight into the entire annual cycle.

Photo: Mads Peter Heide-Jørgensen

Back-mounted satellite transmitter.

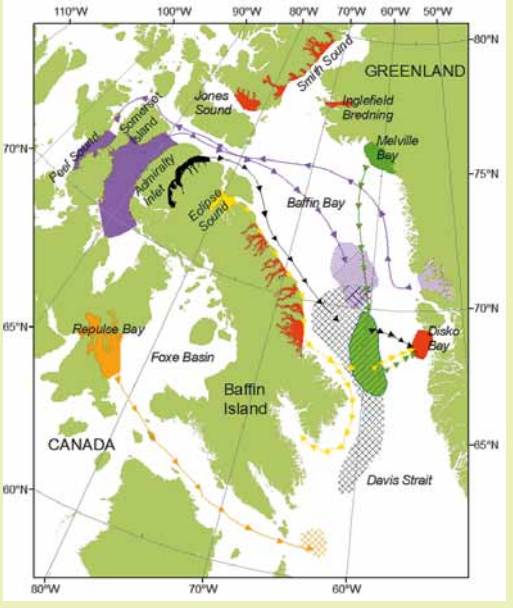
The effort and results from these research activities are not just for the fun of science but are crucial for the modern management of the whale populations. Movement data are used to identify key areas of use by different subpopulations that require specific levels of protection or that periodically overlap with industrial activities. Diving information is used for identifying important feeding areas where conflicts with fisheries might occur. The overall new insight into the secret life of arctic whales is used to assess their vulnerability to climate change, and the whales themselves are occasionally used for monitoring their own environment by instrumenting them with sensors that can provide temperature profiles in areas and seasons inaccessible to hydrographic vessels.

All three arctic whales are sensitive to underwater noise pollution and satellite tracking will be an important tool when assessing future effects of offshore hydrocarbon exploitation on arctic whales. Past trackings will document how the whales used the Arctic before oil exploration/development and sea ice recession, and new tracking studies will be a major source for demonstrating how the whales deal with changes in the pristine arctic environment. ○

Photo: Ado Isaksen

Tagging a bowhead whale in West Greenland.

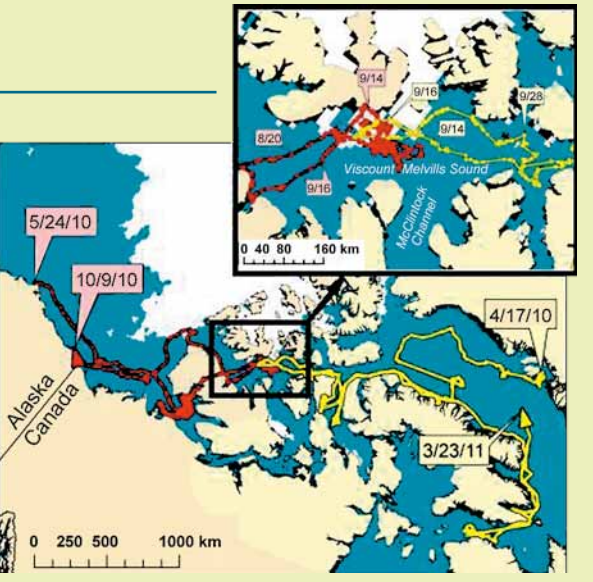
Narwhals



Narwhals have very low genetic diversity and have probably had low variability for millennia. Genetic studies have therefore provided little insight into the population structure of narwhals. Instead satellite tracking has during the past 20 years developed to become the most important method for studies of narwhal migrations, diving behaviour and population structure. Narwhals from the Melville Bay, the Eclipse Sound, the Somerset Island stock, the Admiralty Inlet and the Hudson Bay stocks (Repulse Bay) have been tracked by satellite and their late summer and autumn movements to four different wintering areas (crosshatched) are observed (from *Animal Conservation 2012 doi:10.1111/acv.12000*). Narwhals from the Uummannaq November aggregation have been tracked to the summering area of the Somerset Island stock. Other localities that have not yet been studied (marked in red) include; Disko Bay, Smith Sound and adjacent fjords, Jones Sound, Inglefield Bredning and fjords along the east coast of Baffin Island.

Bowhead whales

Bowhead whales were heavily hunted in the Atlantic sector of the Arctic for three centuries and are still severely reduced in abundance around Svalbard and East Greenland. The stocks in Alaska and in eastern Canada/West Greenland are recovering from past exploitation and they have been subject to an extensive tagging program where more than 200 whales have been instrumented over the past decade. The results have shown that bowhead whales travel extensively over large areas and are not as restricted to certain migratory corridors as narwhals and belugas. As mentioned on page 8, one of the more spectacular surprises was the entering of the otherwise inaccessible Northwest Passage in 2010 where bowhead whales tagged in Alaska and West Greenland passed each other in September in the central part of the Northwest Passage. This opens up for a whole new scenario where a biological connection between the Pacific and the Atlantic may become a reality with receding ice coverage (from *Biology Letters* doi:10.1098/rsbl.2011.0731).



Is seismic exploration an emerging threat

Oil and gas exploration involves seismic surveys which introduce considerable noise to the pristine arctic waters. This disturbance may cause changed migration patterns and ultimately affect the survival and reproduction of narwhals. Extreme caution should therefore be taken by actors involved in marine seismic surveys, says MADS PETER HEIDE-JØRGENSEN.

Narwhals in the ice in Greenland.

SOME OF THE LARGEST unexplored areas for hydrocarbon development are located offshore in the seasonally ice-covered parts of the Arctic. As the extent and thickness of the arctic sea ice continues to decline, these areas have become increasingly interesting to the oil and gas industry. The main method for locating oil and gas resources is through seismic surveys where powerful airgun arrays are towed behind research vessels introducing considerable noise levels to the pristine underwater acoustic environment in the Arctic.

Narwhals are primarily distributed in the High Arctic, and can during the winter be found in the very dense pack-ice of the Baffin Bay-Davis Strait and the Greenland Sea-Irminger Sea.

In West Greenland seismic surveys have been conducted with increasing intensity during the last five years and in East Greenland similar surveys are expected to begin in 2013. Narwhals are known to react at long distances to underwater noise from vessels and they are considered highly sensitive to human activities. However, so far no studies have addressed the question of direct effects of high-energy airgun pulses on these whales.

ENTRAPMENTS OF CONCERN

Reactions of narwhals to underwater noise pollution can be either short-term with brief behavioural interruptions or they can be more long-term with changes in migrations, body conditions

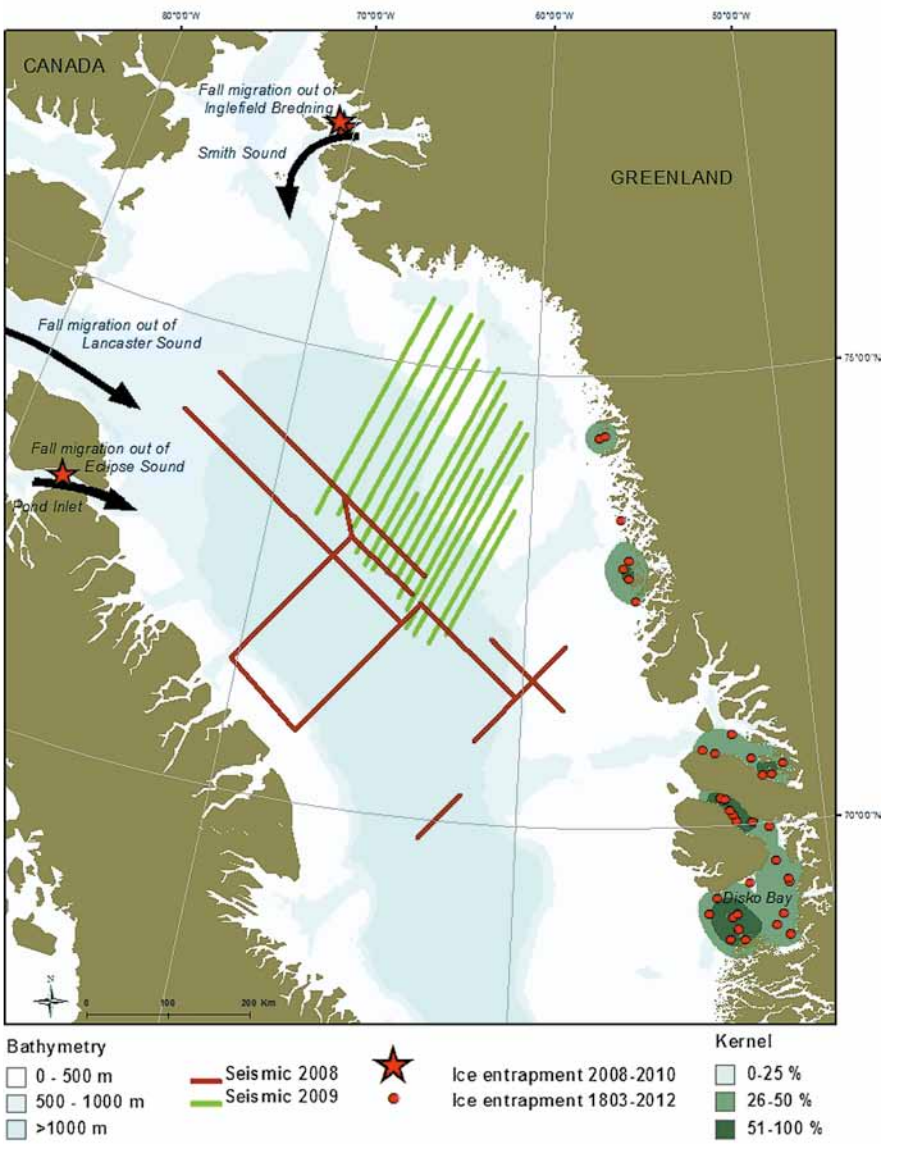
MADS PETER HEIDE-JØRGENSEN is a senior scientist at the Greenland Institute of Natural Resources. Working in the Arctic since 1982, his main research field is arctic marine mammals, especially cetaceans, where he has provided data for the International Whaling Commission and the North Atlantic Marine Mammal Commission. He has pioneered new techniques for tracking whales by satellite and for surveying marine mammal populations.

to narwhals?

Photo: Mads Peter Heide-Jørgensen

Figure 1

Recent ice entrapments Baffin Bay
Source: *Biological Conservation* 158 (2013) 50-54



and ultimately in survival and reproduction. Narwhals are characterized by low plasticity in their migratory patterns compared to most other whales and they are therefore expected to be particularly vulnerable during the migratory phases of their annual cycles.

Of special concerns are three recent large-scale ice entrapments of narwhals outside the usual localities where these events are known to occur. Ice entrapments are caused by a sudden freeze-up during periods of stable but high atmospheric pressure. In November 2008 thousands of narwhals were seen moving quickly through the freezing seas near the community of Pond Inlet (northern Baffin Island, Canada, see Figure 1). However, after the ice had frozen solid, local residents discovered about 1000 narwhals at breathing holes about 50 kilometres from open water. During late September and early October 2008, seismic surveys were underway in Baffin Bay at the time when narwhals would normally be moving out of Pond Inlet and Lancaster Sound and starting their southward migration in Baffin Bay. Narwhals that have spent the summer in and near Pond Inlet usually depart the fjord system in late September and head towards wintering grounds in central Baffin Bay.

Two other unusual, and similarly lethal, incidents occurred in November 2009 and February 2010 in Inglefield

Bredning, involving 30-100 and 50-100 narwhals, respectively. Similar to 2008, seismic activity was taking place in northern Baffin Bay in September-October 2009, i.e. at the time when narwhals would normally be moving out of their summering area in Inglefield Bredning.

NEED FOR CAUTION

The industrial seismic surveys conducted in Baffin Bay in 2008 and 2009 were in deep waters (500-2000 metres) and the airgun pulses would have affected most of the northern part of Baffin Bay during the early part of the narwhal fall migration. There is little doubt that the pulses were audible to narwhals. As highlighted in an upcoming edition of *Biological Conservation*, the general proximity in space and time of the seismic survey activity and the 2008 and 2009-2010 ice entrapments could indicate a causal connection, with the seismic surveys interrupting the migration of narwhals and prompting them to return to the summering grounds which would eventually be covered with fast ice.

Persistent disturbance of narwhals could cause the animals to change their migration patterns. As they leave the summering grounds, narwhals are heading towards winter feeding grounds, and disturbance could cause them either to return and risk ice entrapment or to move to wintering areas that are sub-optimal for feeding.

Extreme caution should be taken by companies and agencies involved in marine seismic surveys in areas near to narwhal summering grounds and migratory routes. There is also an urgent need for studies of the effects of airgun noise on behaviour and population parameters of narwhals and for monitoring the population trends of exposed narwhal populations. The fact that narwhals are mainly distributed in Canadian and Greenlandic territorial waters puts special responsibility on Canada and Greenland to address issues related to the long-term conservation of narwhals, including the implementation of measures to mitigate disturbances from human activities. ○

BUCKETHEAD CAMPAIGN

Protecting the acoustic environment

Arctic waters are getting noisier, and at a remarkable pace. This is serious business, says DAVE APLIN.

DAVE APLIN is Director of Outreach and Education with the WWF-US Arctic Program. Since 2005 he has worked from the Homer, Alaska Field Office to engage individuals and communities on a variety of important issues.

RECEDING SEA ICE and new technologies have opened the door for both governments and private companies to exploit new energy sources and transportation routes considered unreachable just a generation ago. For the foreseeable future the calls of arctic whales will be drowned out by the growl of ships plying new trans-arctic shipping routes and an increasing cacophony generated by offshore oil and gas development, seabed mining, and the construction of infrastructure required by the emerging industrialized Arctic.

This is serious business. Marine mammals and fish use sound to navigate, find food, locate mates, and simply live. And while scientists have clearly documented that human-produced underwater noise pollution can drive whales away from key areas, and cause confusion and physiological stress, the incidental and cumulative effects of this noise are poorly understood. More troubling still, attempts to regulate Arctic Ocean noise by national governments and international organizations is lagging behind the surging industrial growth in the Arctic.

In response to this growing problem, the WWF-US Arctic Program and conservation partners Natural Resource Defense Council and Ocean Conservation Research launched *Don't Be a Buckethead* in 2012. Don't Be a Buckethead is an initiative to raise the alert and stimulate action to protect arctic wildlife from the mounting threats caused by ocean noise. The first phase of the project, an interactive website, www.dontbeabuckethead.org, offers visitors an opportunity to learn how arctic species depend on sound for their survival and the threats posed by new sources of sound. Project partners are expanding the site to include additional opportunities to experience the Arctic Ocean's remarkable acoustic environment and to become a repository for the growing body of research into the complex world of ocean noise.

Ultimately, developers aim to use the *Don't Be a Buckethead* project as a platform for citizen science opportunities where people interested in arctic marine life and conservation can support ongoing research projects as scientists work to unlock the complex world of ocean noise. ○

The Arctic Marine Shipping Assessment (AMSA) report includes important recommendations for minimizing risks and impacts from increased shipping.

Future impacts of marine shipping in the changing Canadian Arctic

The decline of sea ice and the opening up of the Arctic will increase risks to whales from shipping, writes DUSTIN STREET.

SHIPPING in the Canadian Arctic today is limited. There is only a handful of companies who currently pass through this area, and in 2010, less than 100 ships were active in making trips in the Arctic. As some research suggests, shipping will slowly increase over the next decade, both in transport and tourism, with the major increase in destinational shipping to serve the growing mining industry. The overall impacts of this growth in shipping traffic are still to be determined, however it is anticipated that some of the key issues will be:

- **Increased vessel collisions with whales**: The Canadian Arctic is home to several cetacean species and at certain times of year whales often concentrate in large numbers in a few key areas to breed and feed. These locations could coincide with shipping lanes where vessel traffic could be very heavy. Vessel collisions can cause cetacean injury or death, and can be a major threat to particularly vulnerable cetacean populations. Additionally, with ice cover reduced and more areas of the Arctic accessible, year round shipping is probable which will bring new threats to wintering marine wildlife.
- **Increased noise pollution**: Low frequency noise from ships can mask the communication signals of marine mammals, interfere with their ability to navigate and communicate and result in increased levels of stress. The effects of shipping and other continuous noise on wildlife range from the interruption of vocalizing, changes in behavior, feeding, mating and the rearing of offspring. These combined changes may affect vital functions such as breeding and parenting, which could have long term population consequences. Cumulative stressors are at present difficult to ascertain and so there is a strong case for precautionary measures to prevent and minimize disturbance.
- **Polluted habitats**: Each year, several thousand barrels of oil or other pollutants are released into the oceans from ship operations (groundings, ship wrecks, accidents, oil spills etc). Impacts from the operational or accidental discharge of bilge water, ballast water, sewage, grey water, food waste, garbage and other pollutants can have harmful effects on numerous species and the marine environment. As ship traffic increases so does the possibility of these accidents occurring. In the Arctic there are generally minimal infrastructure and shore side reception facilities available for ships to properly dispose of wastes. This may challenge the capacity of some ships to dispose of harmful substances properly and could be especially difficult in the winter when ice and ice flows are at their heaviest. If a spill were to occur during this period, the oil could not only coat the underside of sea ice but could also form within, and/or over it. When the ice melts, the pollutants are likely to disperse. Such risks could extend clean ups by a considerable amount of time and make it very difficult to respond to the spill because of the ice and the geographical remoteness of the Arctic.
- **New and invasive species**: The discharge of a ship's ballast water can act as a conduit for the introduction of invasive aquatic species impacting both the environment and human health. The loss of native biological diversity is of particular concern as well as the introduction of alien species that become a human health issue. Additionally, chlorine systems to sterilize ballast water of unwanted organisms can lead to chlorine residues and in turn harmful effects on organisms throughout the foodweb.

We do know that the decline of sea ice and the opening up of the Arctic will increase risks, and the insurance industry will be expected to be ready to respond. To help mitigate the risks associated with marine shipping in the Canadian Arctic, Coast Underwriters, as part of the RSA Canada Group, is working in partnership with WWF to research and analyze the impact of climate change on the Canadian Arctic, map potential future routes that will help minimize impact on sensitive areas and species, and take the necessary steps to ensure both the shipping and insurance industries are responsible and doing what they can to reduce the detrimental impacts on whales. ○

DUSTIN STREET is Senior Marine Insurance Underwriter at Coast Underwriters, which forms part of the RSA Canada Group. WWF-Canada and RSA have been partners since 2009, focusing on preparing the industry for the impacts of climate change.

Limiting the consequences

Despite the significant interest and investments in industrial development in the Arctic, there are few examples where credible and sustained effort has been made by the industries to reduce the effects of their activities on cetaceans, says RANDALL REEVES.

WHEN IT COMES to cetaceans (and other marine mammals), there are three major gaps in most marine arctic industrial development scenarios: baseline data, effects data, and an understanding of the effectiveness of mitigation.

RANDALL REEVES chaired the Sakhalin independent scientific review panel (ISRP) and continues to chair the Western Gray Whale Advisory Panel (WGWAP). Based in Hudson, Quebec, Canada, he also chairs the Cetacean Specialist Group under IUCN's Species Survival Commission and serves on the US Marine Mammal Commission's Committee of Scientific Advisers.

The first of these is, at its simplest, an inventory of pre-development conditions: what species are present in the action area, in what numbers and when, and what resources (prey, habitat features, etc.) are required for populations to remain viable and continue to play their ecological roles?

The second concerns the need to understand cause-and-effect relationships. Except for obvious things like outright injury or death from ship strike, entanglement in fishing gear, or oil exposure, these are often dose-dependent and subtle, operating on health, reproduction or longevity. The effects question must extend to the difficult subject of cumulative effects. Although their importance is widely acknowledged in principle, how to define, assess, and manage cumulative effects remains elusive.

ALTHOUGH THEIR IMPORTANCE IS WIDELY ACKNOWLEDGED IN PRINCIPLE, HOW TO DEFINE, ASSESS, AND MANAGE CUMULATIVE EFFECTS REMAINS ELUSIVE.

Finally, there is a belief deeply held by many that if only enough resources are invested in mitigation, it should be possible for virtually any type of development to take place without major (or unacceptable) collateral environmental damage. Even if this were true, however, it would presuppose that we have full knowledge of how to prevent, or at least mitigate and manage, the unintended impacts of our activities on natural organisms, processes, and systems. Rarely is this the case.

I am aware of only two arctic or quasi-arctic examples where credible and sustained effort has been made by offshore oil and gas interests to address these three knowledge gaps with regard to whales (there may be other good examples, of course). One is the North Slope of Alaska. There industries, as well as government regulators, have invested substantial resources in monitoring and research on marine mammals, including whales, due to a combination of strong legislative mandates (Endangered Species Act, Marine Mammal Protection Act) and a politically influential Indigenous subsistence hunting constituency. Industrial interests are required to carry out extensive monitoring and mitigation to protect the habitat of bowhead whales and, to some extent, belugas. Any plans for seismic surveys, drilling operations, and platform or pipeline construction in Alaskan waters are subject to intense public scrutiny through formalized processes, and permits to proceed are invariably conditional on rigorous mitigation, monitoring, reporting, and reassessment. These strictures have slowed the pace of, but not stopped, offshore oil and gas development in northern Alaska.

LEARNING FROM SAKHALIN

The other example is Sakhalin Island in the Russian Far East where large-scale offshore oil and gas development is under way and much more is planned. Russian companies, and foreign companies involved in joint ventures, are bound first and foremost to meet national regulatory requirements. Some foreign companies have additional incentives to address and fill the data gaps and to achieve more precautionary environmental standards. These incentives notably include (a) loan conditions imposed by international financial institutions and (b) the desire of the companies to minimize reputational risks or, put another way, to enhance their image of environmental responsibility.

The Sakhalin-2 megaproject, operated by Sakhalin Energy Investment Company (currently majority-owned

Photo: Gazprom

Oil and gas platform, Sakhalin-2, Russia.

by Gazprom, with Shell, Mitsui, and Mitsubishi as junior partners) under a production sharing agreement with the Russian Federation, began producing and exporting oil in 1999. The project has expanded since then to involve three offshore platforms (a controversial fourth is in the decision and planning stages), subsea and on-land pipelines, a large liquefied natural gas (LNG) facility at the southern end of the island, and a tanker fleet to carry products to markets in Asia, North America, and elsewhere.

Two of Sakhalin Energy's existing platforms are located immediately offshore of prime seasonal feeding habitat of a critically endangered population of gray whales. The whales' feeding habitat near Piltun Lagoon is ice-bound for about half of the year. In view of conservation concerns, the company initiated an extensive gray whale monitoring program in the 1990s. This ongoing program has helped to make the Sakhalin gray whale population one of the most closely studied baleen whale populations in the world.

In 2004, under pressure from international lenders, Sakhalin Energy embarked on a novel arrangement with the International Union for Conservation of Nature (IUCN). An independent scientific review panel (ISRP) was created to evaluate the company's plans for construction of a second platform and for installation of an undersea pipeline that would replace the previous high-risk shuttle tanker system for moving oil from platform to shore. The ISRP report, delivered in early 2005, emphasized, among other things, the importance of minimizing construction noise and keeping vessel traffic away from near-shore waters where mother gray whales forage and wean their calves between June and October. It also recommended that the pipeline be routed in order to avoid crossing the whales' feeding habitat, and the company complied with this recommendation even though it meant a substantial increase in costs.

PUBLIC SCRUTINY

Given their favourable experience with the ISRP, project lenders decided to condition their loan agreements with Sakhalin Energy on the maintenance of a longer-term advisory panel to look after the interests of the gray whales. Thus Sakhalin Energy and IUCN agreed to establish a Western Gray Whale Advisory Panel, or WGWAP, for an initial five-year term beginning in 2006, and a second five-year term began in January 2012. I have chaired this group since its inception.

The WGWAP's main responsibilities are to review the company's scientific work on gray whales, evaluate the adequacy of mitigation efforts, provide advice on how these can be improved, and assist in regular assessments of the whale population (which has been steadily increasing over the past decade or so). The engagement has meant that Sakhalin Energy is subject to an extraordinary level of public scrutiny, in stark contrast to other companies operating on the Sakhalin shelf. Representatives of NGOs, lending institutions, and government agencies attend WGWAP meetings as observers, and all reports, recommendations, and formal statements of the panel are made public, as are most of the company documents that the panel reviews. The terms of reference require the company to either implement panel recommendations, or explain why it cannot or will not in a response posted on the WGWAP website (www.iucn.org/wgwap).

Unfortunately, we have not made nearly as much progress towards the goal of establishing meaningful engagement with other companies and with regulatory bodies as had been hoped. This seriously limits our effectiveness in protecting the whales and their habitat and impedes our ability to assess cumulative effects. I remain convinced, however, that the ISRP and WGWAP provide good models, and that similar independent advisory and oversight elements should be part of the planning and conduct of other large-scale industrial projects that carry the potential to harm cetaceans or degrade their habitat. ○

Arctic cetacean management at the international and local level

A formidable challenge: managing elusive species that occupy expansive underwater ranges in an often-harsh arctic environment. Much to the credit of those involved, there have been numerous successes in the management of bowhead whale, beluga and narwhal, especially in recent years. However, says CHERYL ROSA, the picture is not perfect.

TODAY THERE ARE two primary levels of management: one that operates at an international level (such as the International Whaling Commission, the North Atlantic Marine Mammal Commission, or multiple bi/multinational committees that exist between countries that share arctic cetacean stocks) and a second level that tends to be more locally co-managed, often in conjunction with the federal government of the country in question. The local co-management structure can take many forms, most of which attempt to take the needs of Indigenous groups that hunt these species for food into consideration. In the interest of space, I have focused on two main management groups: the IWC and Alaska's co-management structure.

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THE INTERNATIONAL WHALING COMMISSION (IWC)

The IWC is an assemblage of governments that come together on a regular basis to conserve whale stocks and manage whaling. Membership in the IWC is open to any country in the world that formally adheres to the 1946 International Convention for the Regulation of Whaling. They need not be whaling countries; indeed, some participants do not even have a coastline. Each member country is represented by a Commissioner, who is assisted by scientists who are experts in various fields of cetacean science. Of the eight arctic states, all countries, with the exception of Canada, are members of the IWC (Canada withdrew from the IWC in 1982 after decision-making on the 1986 moratorium on commercial whaling).

A major part of the IWC's efforts involves coordinating cetacean research through its Scientific Committee. It is this research that provides authorities with the information needed to make management decisions. Some of the most important work the IWC conducts involves the simulation of whale population growth, incorporating appropriate levels of uncertainty. These simulations are supported by "on the ground" abundance analyses and other forms of population assessment. The less that is known about a population, the greater the uncertainty and hence the more conservative the numbers produced related to removal/mortality. These simulations are incorporated into management models that produce total allowable harvests for the population in question. It is not only hunting that is considered in these calculations, but also other factors such as bycatch in fishing gear, ship strikes, gear entanglement, etc.

Optimally, the end result is the con-

WHALES, INCLUDING ARCTIC SPECIES, ARE MIGRATORY AND DO NOT RECOGNIZE POLITICAL BOUNDARIES.

Photo: Cheryl Rosa

Bowhead whale muktuq*, consisting of skin and blubber, is a highly nutritious part of a subsistence diet.*

Photo: Cheryl Rosa

Bowhead whale "shares" are divided after a successful spring hunt.

servation and effective management of the species in question. International management of whale stocks is important for many reasons, not the least of which relate to the fact that whales, including arctic species, are migratory and do not recognize political boundaries.

The IWC sets catch limits for stocks of large whales subject to Indigenous subsistence whaling. The International Whaling Commission recognizes several bowhead whale stocks: Bering-Chukchi-Beaufort Seas (BCBS); Nunavut; Svalbard-Barents Sea; and the Okhotsk Sea. Of these, the BCBS stock is showing the most impressive post-commercial whaling exploitation population rebound, though the species remains on the Endangered Species List and some other populations are not showing recovery similar to the BCBS.

The IWC also gives advice on small cetaceans. Currently, the IWC Scientific Committee has convened a Steering Group to formulate a "Global Review of Monodontids". This group is involved in planning a workshop scheduled for Fall 2013, which will bring together the Scientific Committee of the North Atlantic Marine Mammal Commission, the Canada-Greenland Joint Commission on Conservation and Management of Narwhal and Beluga, Alaska's North Slope Borough and other groups to discuss the population status of beluga and narwhal.

CO-MANAGEMENT, A US EXAMPLE

There are many examples of marine mammal co-management in practice throughout the world. In Canada, there are quota systems in place for the harvest of beluga and narwhal and Russia has adhered to a system of total allowable catches which follow regional guidelines. In the US, the Marine Mammal Protection Act (MMPA) strives to maintain stable and healthy marine ecosystems. In order to achieve this, the Act prohibits "take" of marine mammals with few exceptions, one of which relates to Alaska Native subsistence hunts. In 1994, an amendment added section 119 to the MMPA granting the National Marine Fisheries Service (NMFS) and the US Fish and Wildlife Service (USFWS) authority to enter into cooperative agreements with Alaska Native organizations. These agreements promote participation of local subsistence consumers and integration of their knowledge into the management of marine mammal stocks of importance

to their communities. It also allows the passage of federal funds to these groups for the purposes of data collection and harvest management.

The Indigenous People's Council for Marine Mammals (IPCOMM) is "a coalition of Tribal marine mammal commissions/councils and other Native organizations formed for the purpose of identifying and addressing marine mammal issues of common concern". There have been fourteen separate co-management agreements signed pertaining to the management of twelve marine mammal species (four of which are grouped together as "ice seals"). The member institution relevant to arctic cetaceans is the Alaska Beluga Whale Committee (ABWC). The Alaska Eskimo Whaling Commission (AEWC) maintains "observer" status in IPCOMM, but holds a distinctly independent spot in the Alaskan co-management structure, primarily related to its strong organization and high level support from both residents representing eleven Northern communities that hunt bowhead whales and the local municipalities. This relates strongly to the centrality of the bowhead whale in the culture of Northern Alaska.

The co-management process teams local knowledge and approaches with federal needs and funding. However, improvements are possible. Co-management groups lack capacity and need funds and training in order to have a presence and be effective at the local level.

A meeting held by the Marine Mammal Commission in 2008 made several recommendations for enhancements that could strengthen co-management. These include recommendations that would build trust and capacity, improve harvest management and conflict resolution, strengthen research and outreach efforts and increase stable funding available for all of the activities undertaken by co-management groups. Many of these 2008 recommendations have yet to be acted upon and, in this time of fiscal austerity, it remains to be seen if many of these improvements will come to pass. ○

WWF PERSPECTIVE

The ice whales: new conserv

***Now* is the time for decision-makers, resource planners, and corporate investors to address the main threats to the ice whales, says PETE EWINS. WWF recently identified the three ice whales as one of the highest global priorities for its conservation effort.**

HISTORY SHOWS US that when fundamental conditions change, our old approaches seldom work well. Today's Arctic is changing rapidly, both in climate and ecosystem function, but also in terms of human values, communications, lifestyles, infrastructure and economic developments. Usually everyone agrees that a top priority for the Arctic is to ensure a future that contains sustainably harvested wildlife, as well as decent human lifestyles and economic opportunities. However, the much-needed new approaches to long-term conservation and persistence of what society values in the changing Arctic have yet to be firmly adopted, prioritized or implemented by planners, regulators and decision-makers. Our human systems seem to be very slow in responding to the rapidly changing conditions. But – there are some promising signs of acceleration.

The good news is that human society already has sufficient knowledge, analyses, experiences, principles, models and tools available. We know what kind of Arctic people want to leave for their grandchildren – one with minimal risks and healthy ecosystems, including opportunities for sustainable harvesting of marine mammal species like bowhead, narwhal and beluga whales that have enabled Inuit in particular to survive over millennia.

SIGNIFICANT OPPORTUNITY

The concerning news is that these new tools and approaches – such as Strategic Environmental Assessment (SEA), resilience-building for Social-Ecological Systems (SES), and precautionary approaches – and principles of true sustainability have yet to be properly applied in ecosystem-based decision making for the long-term. Short-term frontier-type development paradigms still prevail in many arctic regions, with local wildlife and people usually left with the adverse consequences long after the petroleum, minerals and other natural resources have been sent hastily southwards.

There is still a globally significant opportunity to provide a well-balanced future for the arctic marine ecosystems, and valued species such as bowhead, narwhal and beluga, though time is running out quickly now. The Arctic Council produced the Arctic Marine Shipping Assessment (AMSA) Report in 2009, which made many recommendations along these lines, including identifying and elevating protection for Ecologically and Culturally Important Areas in the Arctic – before approved increased development pressures.

Now is the time for decision-makers, resource planners, and corporate investors to address and internalize the risks associated with the main threats to the ice whales and their very sensitive ecosystems: rapid climate change and sea ice retreat, more navigable marine regions, and associated increased shipping, mining, petroleum exploration and development, commercial fisheries, tourism, and military activities. Arctic

WWF's global cetaceans strategy.

vation approaches and priority work

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Beluga whale (Delphinaptherus leucas), White Sea, Russia, Kareliya.

residents, governments and industries cannot afford to ignore the consequences of not planning and acting to address major short-term and long-term risks under such circumstances, based on readily available facts and projections – we need to look no further than the lessons learned from the Exxon Valdez or Deepwater Horizon oil incidents, or commercial fisheries collapses, or long-term bioaccumulation of persistent toxins and nuclear waste.

HIGH PRIORITY

Persistence of the ice-adapted whale species depends on well-informed effective management of cumulative impacts from multiple human stresses across the large annual ranges and lifespans of these species. Scenarios-based Risk Assessments, anchored by current climate models, are essential if future ecological, social and economic costs are to be avoided across the Arctic. How many people today would really feel comfortable with their descendents referring back to them as a key part of this 2012 generation that consciously failed to use the available information, tools and new approaches?

Based on the tremendous conservation opportunity to plan and get things right in these largely natural arctic marine systems, WWF has identified the three ice whales as one of the highest global priorities for conservation effort. Framed by the global WWF Cetaceans Strategy to 2020, our Arctic Cetaceans Conservation Action Plan (CAP) will in 2013 set out specific actions WWF will support and help lead to secure major conservation results in key regions for bowhead, narwhal and beluga whales. It is expected that the resulting elevated conservation measures will benefit all other components of the marine systems in the Arctic, right to the base of the foodwebs, and including the human users of both renewable and non-renewable resources. ○

PETE EWINS is WWF-Canada's arctic species specialist and WWF's lead on arctic cetaceans. He joined the organization in 1996 and subsequently built WWF-Canada's Arctic Program. He now focuses on community-based field projects as well as conservation science-based analyses of what key arctic species and their habitats really need for the rapidly changing arctic future. In addition, he currently serves on Canada's Environment Minister's Species At Risk Advisory Committee.

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THE PICTURE

Remnants of the past

ANCIENT BOWHEAD WHALE (*Balaena mysticetus*) skeleton, from commercial whaling operations in the 17th and 18th centuries, Svalbard, Norway, taken during the 'Arctic Expedition for Climate' in July 2008.

Commercial bowhead whaling began in the 16th century, and in 1611 the first whaling expedition sailed to Svalbard. By mid-century, the populations there had practically been wiped out.

Although two of the four bowhead populations are increasing now, the other two populations are still red-listed by IUCN (International Union for the Conservation of Nature) as 'Endangered' or 'Critically Endangered'.

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.

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