AMAP ASSESSMENT 2018

BIOLOGICAL EFFECTS OF CONTAMINANTS ON ARCTIC WILDLIFE & FISH

SUMMARY FOR POLICY-MAKERS

AMAP

ARCTIC MONITORING AND ASSESSMENT PROGRAMME

INTRODUCTION

The Arctic and its inhabitants harbor elevated levels of environmental pollutants, most of which originate from the industrialized centers and agricultural regions of lower latitudes. Chemical pollutants transported via the atmosphere, oceans and rivers are deposited in Arctic ecosystems, where they bioaccumulate in organisms and biomagnify through food webs. Many of the chemicals found at elevated levels in the Arctic have also been associated with effects on animal and human health, therefore, wildlife and fish species endemic to the Arctic and the indigenous communities that rely on them as part of a traditional diet, remain vulnerable to the potential detrimental effects associated with these chemicals.

The following key messages are derived from the most recent AMAP report which updates previous assessments[2,3] on the biological effects of Arctic chemical pollution and summarizes the current state of the knowledge on the impacts of organohalogenated compounds (OHCs) and mercury (Hg) on Arctic biota. Newly acquired information indicates continued concern regarding the impacts of legacy chemicals – those substances whose presence in the environment is largely a consequence of past use. Additionally a greater understanding of the potential impacts of emerging chemicals of concern on the health of circumpolar wildlife and fish is needed, especially in light of a rapidly and increasingly changing Arctic.

FOOTNOTES:

[1] ***AMAP Assessment 2018:*** *Biological Effects of Contaminants on Arctic Wildlife and Fish. Arctic Monitoring and Assesment Programme (AMAP).*

[2] ***AMAP Assessment 2011:*** *Mercury in the Arctic. Arctic Monitoring and Assessment Programme (AMAP).*

[3] ***AMAP Assessment 2009:*** *Persistent Organic Pollutants (POPs) in the Arctic. Science of the Total Environment Special Issue. 408:2851-3051. Elsevier, 2010.*

[4] ***AMAP Assessment 2016:*** *Chemicals of Emerging Arctic Concern. Arctic Monitoring and Assessment Programme (AMAP).*

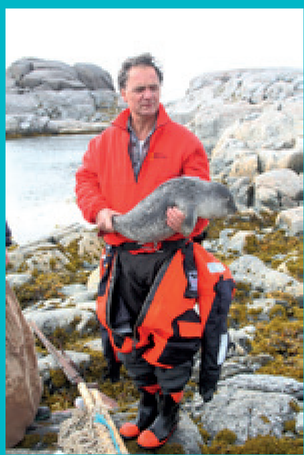
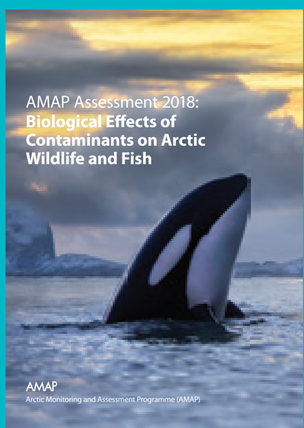


Photo: Aqqalu Rosing-Asvid



CONTAMINANT-MEDIATED BIOLOGICAL EFFECTS REPORTED IN ARCTIC WILDLIFE AND FISH

Several different biomarkers and endpoints of biological effects have been investigated in Arctic wildlife and fish to identify potential relationships with OHC or Hg levels.

- Hormone levels*
- Vitamin status*
- Immune function*
- Enzyme activity*
- Oxidative stress
- DNA damage
- Blood biochemistry
- Tissue pathology
- Bone density
- Neurological and behavioral effects
- Reproduction

*Endpoints most commonly and consistently included in Arctic wildlife and fish studies since 2010.

NEW AND LASTING IMPACTS OF CHEMICAL EXPOSURES IN ARCTIC WILDLIFE AND FISH

Photo: Paul Nicklen

Photo: Birgit Braune

Photo: Rune Dietz

KEY MESSAGE 1

Legacy chemicals and mercury continue to pose a significant concern for Arctic biota.

Despite global initiatives to restrict the production of legacy chemicals such as persistent organic pollutants (POPs) and mercury, levels in some Arctic top predator species remain elevated and may no longer be declining in response to restrictions in use. Risk estimations conducted as part of the new AMAP assessment[1] indicate that levels of mercury, and more importantly, polychlorinated biphenyls (PCBs), remain a significant exposure concern for many Arctic biota, including polar bears, killer whales, pilot whales, seals, and various seabird, shorebird, and birds-of-prey species. The levels of these chemicals put these species at higher risk of immune, reproductive and/or carcinogenic effects.

KEY MESSAGE 2

The suite of environmental contaminants found in many Arctic apex predators is expanding and may require new investigations of their potential biological effects.

As reported in the recent AMAP Assessment of Chemicals of Emerging Arctic Concern (CEACs)[4], a number of new chemicals previously undetected in the Arctic are now being found in circumpolar wildlife and fish and may contribute to adverse effects in these organisms. Yet, current research on biological effects in Arctic wildlife largely continues to focus on legacy chemicals and mercury. Although levels of these so-called 'chemicals of emerging concern' are currently low in comparison to POPs and mercury levels, lack of information on their effects precludes an evaluation of their potential for health and population impacts. Future research focused on the biological effects of CECs would improve the ability to estimate risks to Arctic biota.

WILDLIFE HEALTH IN A COMPLEX AND CHANGING ARCTIC

Photo: Andrew Sutton

KEY MESSAGE 3

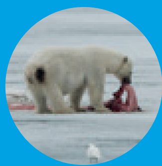
Improved predictions of contaminant-related risks to Arctic biota will require methods that account for the combined toxicity of real-world, complex, multi-chemical exposures.

Arctic wildlife and fish are exposed to a complex cocktail of environmental contaminants including legacy POPs, emerging chemicals of Arctic concern, mercury, and other pollutants that, in combination may act to increase the risk of biological effects. Yet, most of the data and methods currently used to predict potential health impacts to Arctic biota are based on single-chemical exposures. In order to improve the accuracy of risk evaluations, a better understanding of impacts of real-world, multi-chemical exposures is needed. New experimental approaches and targeted research involving complex contaminant exposures are required to address this need.

ARCTIC WILDLIFE AT RISK

Understanding the biological effects of chemical exposures to Arctic wildlife populations is challenging given the numerous other natural and anthropogenic stressors that can also influence health endpoints. However, the use of toxicity data acquired from laboratory animal studies combined with exposure data from wild populations can be used to estimate the potential for biological effects from contaminant exposure. Accordingly, as part of the newest AMAP assessment[1], risks of PCB and Hg health effects were estimated for geographically-widespread populations of Arctic mammals and birds. This analysis identified the following species as being at a particularly high risk of adverse health effects or population impacts:

POLAR BEARS



As apex predators of the Arctic, polar bears continue to exhibit levels of mercury that put them at a high to severe risk for reproductive and other adverse health effects. Additionally, being long-lived predators that produce few offspring, polar bears may be at greater risk of population declines through exposure to endocrine disrupting chemicals and are expected to be greatly impacted by the effects of climate change due to the projections of sea-ice loss, and decline in access to their main prey, the ringed seal.

KILLER WHALES

Having a reduced capacity to detoxify OHCs, killer whales are among the most highly PCB-contaminated species on Earth. Populations inhabiting the Arctic waters of the North Atlantic were found to have levels of PCBs placing them at a high risk for immune and endocrine effects. Moreover, population modelling indicates the impacts of PCB exposure could have severe consequences for the long-term sustainability of killer whale population numbers.

BIRDS

The Arctic is populated with numerous and diverse marine and terrestrial bird species, many of which serve as important subsistence foods for indigenous communities. Many different Arctic bird populations, spanning multiple species – including gulls, guillemots and murres at various locations were found to be at a high to severe risk for health impacts from either PCB or Hg exposure, prompting concern for both population viability and human health impacts.

Inset images from top: Frits Steenhuisen, Audun Rikardsen, Frits Steenhuisen

KEY MESSAGE 4

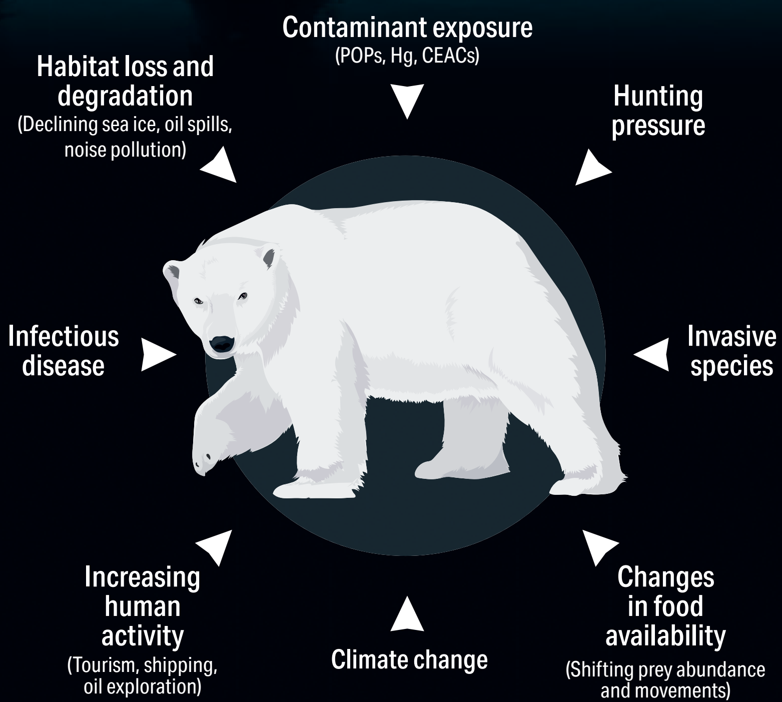
The impact of contaminant exposure in Arctic biota needs to be considered in combination with other natural and anthropogenic stressors.

In addition to being exposed to a complex mixture of environmental contaminants, Arctic biota are subject to numerous natural and anthropogenic stressors including, but not limited to, climate change, hunting pressure, invasive species, emerging pathogens, and changes in food web dynamics. The added influence of these environmental factors, on top of existing chemical exposures, may significantly increase the risk of health effects and population impacts. This observation highlights the need for cross-disciplinary studies that include observations of indigenous knowledge holders, environmental data, and the development of new tools, such as computer models, to integrate data collected from the field into a larger, holistic picture of Arctic wildlife health.

Photo: Frits Steenhuisen

THE IMPACT OF MULTIPLE STRESSORS IN A CHANGING ARCTIC

Risks to wildlife populations are often based on oversimplified scenarios where predicted impacts are estimated based on exposure to a single chemical or stressor. In reality, wildlife are exposed to a diverse and highly complex and interwoven series of natural and anthropogenic stressors that may act cumulatively to impact wildlife health. New approaches that approximate these 'real world' exposures as closely as possible would enable the ability to more accurately predict and anticipate population- and ecosystem-level effects in a rapidly changing Arctic environment.



INTERCONNECTIONS BETWEEN ARCTIC WILDLIFE, HUMAN, AND ECOSYSTEM HEALTH

Photo: Rune Dietz

KEY MESSAGE 5

The high contaminant levels observed in some Arctic wildlife could pose a concern for the health of indigenous communities reliant on subsistence harvests as part of a traditional diet.

Many indigenous communities of the Arctic rely on locally harvested fish, seabirds, and marine mammals as part of their traditional diets. The observation that some populations of these Arctic species contain levels of PCBs and mercury sufficient to place them at a higher risk of biological effects serve as a reminder that there may be a coincident human health risk to consider as well. Additional research into potential contaminant-mediated human health impacts is warranted. Sustained efforts to disseminate research findings and promote awareness of public health concerns will be also be crucial in supporting healthy communities.

KEY MESSAGE 6

Strengthened collaborations between research scientists, indigenous communities and knowledge holders, medical doctors and veterinarians are needed to facilitate a broader understanding the factors impacting wildlife and human health in a rapidly changing Arctic.

The interconnected nature of the environment, wildlife, and human health in the Arctic has long been recognized, but perhaps never so clearly as it is today in face of global climate change. Warming temperatures and other environmental changes are expected to promote the emergence of new pathogens and the northward spread of insects and other vectors of disease into the Arctic. Fish and wildlife, already compromised by chemical contaminants and other changing ecosystem dynamics, may be at heightened risk for infection and contribute to the spread of zoonotic diseases through the Arctic environment and to its human inhabitants. With so many complex and interwoven factors influencing wildlife and human health, cooperation between local communities, health professionals and environmental scientists will be essential for understanding future health threats. Integrating wildlife and human health assessments, as well as involving diverse stakeholders would improve the ability to anticipate and respond to health crises in an increasingly changing Arctic.

POLICY-RELEVANT **RECOMMENDATIONS**

The most recent AMAP assessments of trends in Arctic contaminants and their effects on wildlife and fish show that, while international and national pollution control activities have generally been effective at reducing the levels and ecosystem impacts of the chemicals they regulate, some contaminants including PCBs and mercury continue to pose a significant risk to some Arctic biota. In particular, top predators including polar bears, killer whales, pilot whales, seals and various species of birds are at continuing risk from exposure to these contaminants. In addition, as new chemicals of Arctic concern enter use in society, the suite of environmental contaminants found in Arctic top predators is expanding.

Key existing measures to address PCB- and mercury-related pollution include the Stockholm Convention on Persistent Organic Pollutants and the Minamata Convention on Mercury. The Stockholm Convention calls for Parties to the Convention to take action to eliminate the use of PCBs by 2025, and make determined efforts to ensure environmentally-sound management of PCB-containing waste as soon as possible and no later than 2028.[1] The Minamata Convention, which entered into force in 2017, has the goal to protect human health and the environment from anthropogenic emissions and releases of mercury and mercury compounds.

In order to address an urgent crisis in maintaining viable populations of killer whales and other top predators in the Arctic, in which PCB- and mercury-contamination are contributing factors, and protect species at risk from environmental contaminants, **AMAP recommends that:**

- Arctic States and all Parties to the Stockholm Convention strengthen and accelerate measures to eliminate their domestic use of PCBs, where needed.
- Arctic States and all Parties to the Stockholm Convention increase efforts to ensure environmentally-sound management of PCB-containing waste and remove stockpiles, and if they have not already done so, identify and clean up PCB hot-spot source areas in their Arctic and non-Arctic territories.
- Arctic States and other Parties to the Minamata Convention fully implement the Convention to reduce emissions and releases of mercury globally.
- Arctic States continue support for monitoring and research to evaluate the effectiveness of mercury emission and release mitigation measures for the Arctic region, and that effectiveness evaluation under the Minamata Convention[2] takes into account AMAP's data and information products on mercury.
- Arctic States consider possible actions to manage and reduce other sources of stress associated with human activities that have the potential to affect Arctic wildlife and fish, such as anthropogenic underwater noise and commercial hunting/harvesting pressure, to mitigate combined effects of multiple stressors on Arctic wildlife and fish. Such consideration should involve relevant local, regional, national and international regulatory authorities and, as appropriate, in consultation with indigenous peoples.
- Arctic States and Observer States are encouraged to also take action to address new chemicals of emerging Arctic concern (CEAC) and undertake needed research to investigate the levels of persistent CEACs on Arctic species.

[1]Annex A, Part II and UNEP/POPS/COP.9/6 (15 December 2018) (http://www.pops.int/TheConvention/ConferenceoftheParties/Meetings/COP9/tabid/7521/Default.aspx).

[2]Currently under development.

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This document presents the Summary for Policy-makers of the *AMAP Assessment 2018: Biological Effects of Contaminants on Arctic Wildlife & Fish*. More detailed information on the results of the assessment can be found in the scientific background report. For more information, contact the AMAP Secretariat.

AMAP, established in 1991 under the eight-country Arctic Environmental Protection Strategy, monitors and assesses the status of the Arctic region with respect to pollution and climate change. AMAP produces science-based policy-relevant assessments and public outreach products to inform policy and decision-making processes. Since 1996, AMAP has served as one of the Arctic Council's six working groups.

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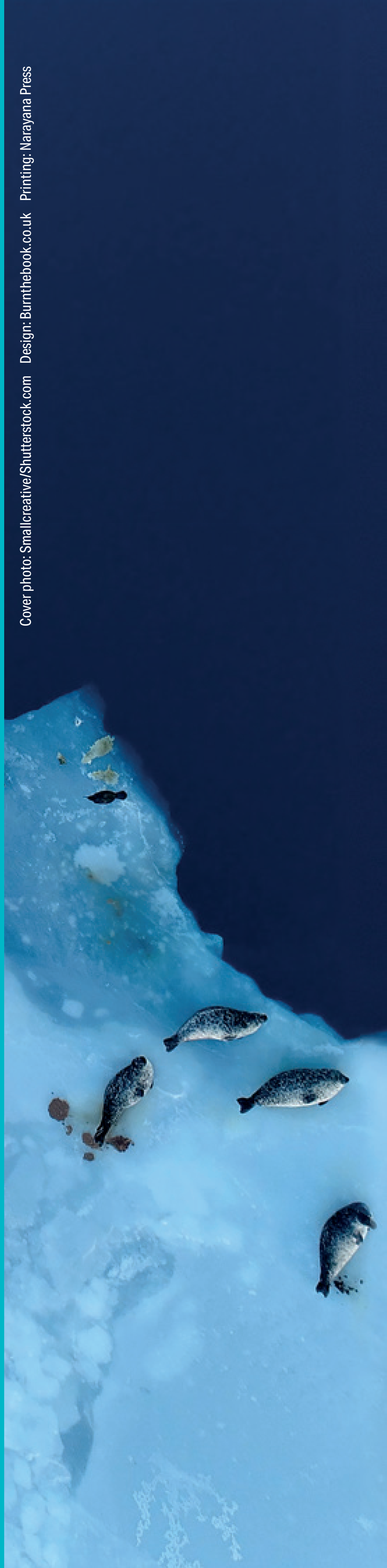

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