The Arctic at Risk

Arctic Pollution 2002

Reviewed by Noelle Eckley and Henrik Selin

While the Arctic environment remains clean compared with many places in the world, pollution does occur in the region and it can be problematic. Pollutants can accumulate to significant levels in Arctic species. Persistent organic pollutants (POPs) and heavy metals are transferred up food webs in animals with a high fat content, such as seals, polar bears, and whales.[1] Radionuclides can also be of concern, as they too can accumulate in Arctic animals. Humans who consume animals with elevated concentrations of pollutants may face health risks.

Under the auspices of the Arctic Council, an organization made up of all eight Arctic countries and six indigenous peoples groups, the Arctic Monitoring and Assessment Programme (AMAP) produces pollution assessments and makes research and policy recommendations, focusing on conditions of ecosystems and risks to wildlife and human residents throughout the region.[2] AMAP recently released its second major Arctic pollution assessment. The policy maker's summary of this assessment, *Arctic Pollution 2002*, presents data on POPs, heavy metals, and radionuclides.[3] This summary report will be followed by the publication of the more extensive scientific reports on POPs, heavy metals, radiation, pathways of transport of pollutants to the Arctic, and human health, upon which the summary is based.[4]

The AMAP pollution assessment draws upon published data, data obtained from AMAP's monitoring program, and traditional knowledge. The assessment, which has been endorsed by all members of the Arctic Council, offers evidence that anthropogenic pollution is affecting human health and the environment in the Arctic. Indigenous communities may be at particular risk from traditional diets that feature high levels of consumption of local wildlife. However, human intake of specific terrestrial and marine animals varies greatly among regions and peoples.

In its second assessment, AMAP proposes the continuation of several research and policy activities to effectively address Arctic pollution problems. Several remaining scientific uncertainties have high policy relevance, and addressing those could greatly aid policymaking. Continued policy efforts to reduce and/or eliminate emissions and human exposure could help to improve human health conditions. However, of concern is the fact that the eight Arctic countries are often at odds on pollution reduction measures, and there are few indications that the recent AMAP assessment will reduce these policy differences.

The assessment offers evidence that anthropogenic pollution is affecting human health and the environment in the Arctic.

The AMAP Pollution Assessment

POPs of long-standing concern in the Arctic include the pesticides DDT (dichlorodiphenyltrichloroethane) and HCH (hexachlorocyclohexane), and the industrial chemicals PCBs (polychlorinated biphenyls). Lead, cadmium, and mercury are well-known heavy metals that can be found throughout the Arctic. Arctic contamination from POPs and heavy metals is most often a result of long-range transport.[5] However, some of this type of pollution comes from local uses of chemicals and metals, which can include industrial and mining activities. Risks to wildlife linked to POPs and heavy metals include effects on reproductive, hormonal, and immune systems.

Arctic Pollution 2002 suggests that while environmental levels of some POPs are decreasing, levels of others are not, and some are even increasing. This reflects the fact that emis-

sion decreases of regulated POPs may not be immediately reflected in environmental levels, because these contaminants are so long-lived in the environment. The AMAP assessment also raises concerns about POPs that are subject to few international controls. For example, the flame retardants polybrominated diphenyl ethers (PBDEs) and polychlorinated naphthalenes (PCNs) and the pesticide endosulfan—which are regulated in some countries but not on an international level—have been found in the Arctic. Levels of PBDEs are increasing in the Canadian Arctic.

There are a number of concerns regarding heavy metals levels. AMAP data on mercury show increasing levels in marine birds and mammals in the Canadian Arctic and western Greenland. Lead emissions have declined significantly due to leaded gasoline bans in many countries around the world, but leaded gasoline is still in use in Russia and some non-Arctic countries. The use of lead shots for hunting is also a continuing source of lead contamination in the Arctic and may be the primary source of lead in the Greenlandic diet.[6] Cadmium levels in some seabirds are high enough to cause kidney damage. Concentrations of other metals such as platinum, palladium, and rhodium in Greenland have increased since the 1970s.

Most of the Arctic radioactive contamination comes from the fallout from nuclear weapons testing between 1945 and 1980; in recent years, Arctic environmental levels of anthropogenic radionuclides have been generally declining. However, releases from reprocessing plants such as Sellafield in the United Kingdom have resulted in increased levels of particular radionuclides in some areas. The Arctic contains large areas of high sensitivity to radionuclides compared with other areas of the world as a result of characteristics of vegetation, animals, human diets, and land- and resource-use practices. Reindeer herding communities can be particularly vulnerable because reindeer accumulate radionuclides efficiently through eating lichen. This contamination can influence both the consumption and the sale of reindeer meat.

Health risks from pollutants for Arctic populations play out in a broader human health context. During the past several decades, the health of Arctic indigenous peoples has undergone both positive and negative changes.[7] In general, life expectancy has increased, infant mortality and risks from infectious diseases have decreased sharply, and access to health care has improved. However, other aspects of health have deteriorated. Alcoholism and suicide rates are high in many areas. Cardiovascular diseases and diabetes have increased as a result of changes in lifestyles.

In some cases, Arctic indigenous peoples' food intake of POPs and mercury exceeds national guidelines. Health concerns have been expressed in particular for pregnant women and small children. AMAP data suggest that human exposure to PCBs, dioxins, and mercury at levels present in some areas of the Arctic may be causing adverse health effects, particularly during early development. Subtle health effects, including effects on fetal and neonatal development and neurobehavioral effects in children, are occurring in some parts of the Arctic due to the consumption of traditional foods.

With insights that have emerged since the first AMAP assessment, the new report also discusses how the transport of pollutants can interact with a changing climate. For example, changes in air currents and temperature can affect air transport patterns of pollutants to the Arctic. Climatic changes can also result in changes in migration patterns in Arctic animals and the accumulation of pollutants by those animals. For instance, changing ocean temperatures affect migration of fish species that prefer a certain water temperature. These altered migration patterns can result in changes in accumulation of pollutants, for which deposition is influenced by air currents and temperatures. In addition, melting of ice as a result of climate change can result in sudden large releases of pollutants that have been captured in the ice for a long time.

Health risks from pollutants for Arctic populations play out in a broader human health context.

Continuing Scientific Challenges

A major strength of the AMAP assessments, and where many other assessments have come up short, is the process-oriented way in which they are conducted. The assessment work was designed to be an ongoing process, so the reports are regarded as important benchmarks in this assessment process, not as endpoints. This makes it possible for AMAP to build on past efforts, as well as make recommendations for future activities.

Another strength of the assessments is their high degree of scientific credibility. AMAP's assessments are conducted by recognized experts on Arctic pollution issues and rely on an extensive data set.[8] Assessments are also subject to stringent peer review before they are published. Combined, these strengths give AMAP a good foundation on which to build future monitoring and assessment activities.

Over the course of its existence, AMAP has taken important steps to standardize research methods for monitoring and assessment. However, more work is needed to facilitate better cross-country comparisons and regional assessments, comparing existing and future data. Continued reporting of environmental trends and health effects of long-term, low-dose exposure will be helpful to better target policy actions; AMAP plans to continue its work in these areas. Further monitoring of human populations believed to be at risk would aid the development of better precautionary measures.

In addition, the AMAP assessment demonstrates that pollution pathways to, within, and from the Arctic interact with climate changes.[9] Studies of these interactions are still at an early stage and will require more sustained research to understand how pollution issues may change in the future as a result of a changing climate. This may have important policy implications regarding pollution reduction measures and consumer advice.

Continuing Policy Challenges

AMAP assessment activities include government experts from all eight Arctic countries and other stakeholders such as indigenous peoples groups. This has aided efforts to make the assessments acceptable and legitimate to multiple stakeholders across the Arctic region. In addition, the participation of government experts and other stakeholders has helped to focus the assessments on policy-relevant issues.

However, despite these efforts and the fact that governments have endorsed the latest assessment, the potential impact of the second pollution assessment on international pollution reduction policies is uncertain. The Arctic Council can only make recommendations on policy measures; it does not have the authority to take legally binding pollution reduction actions. Such actions have to be taken by governments in other international forums, and the eight Arctic countries have often differed widely in their policy positions on pollutants issues.[10] These controversies give rise to serious concerns as desired reductions of Arctic pollution levels will require international controls beyond existing regulations.

AMAP encourages speedy ratification and implementation of international agreements on POPs. In addition, these same agreements include options to address POPs beyond those currently regulated, and AMAP encourages the use of these agreements to take action on POPs that have been identified (by AMAP) as potential risks but that are not sufficiently regulated. These could include endosulfan and the most hazardous brominated flame retardants.[11] However, attempts to regulate POPs internationally over the last decade have often taken place in the face of transatlantic controversies over which substances should be regulated and how. In particular, the United States and the Russian Federation have not ratified either of the two major international POP agreements (the 1998 Protocol on Persistent Organic Pollutants to the Convention on Long-Range Transboundary Air Pollution and the 2001 Stockholm Convention on Persistent Organic Pollutants). Efforts to extend international regulations to additional POPs are also moving at a painstakingly slow pace.

Attempts to regulate POPs internationally have often taken place in the face of transatlantic controversies over which substances should be regulated and how.

To reduce the occurrence of heavy metal contamination, AMAP recommends the elimination of leaded gasoline everywhere and supports an Arctic-wide ban on lead shots. Such efforts are currently under way. AMAP also encourages efforts to reduce worldwide mercury emissions.[12] However, at a recent meeting of the United Nations Environment Programme, the United States blocked calls from European and other non-Arctic countries for the development of a global mercury agreement, arguing that negotiating such an agreement would be too time-consuming and costly.[13] In addition, two Arctic countries, Iceland and Russia, have not ratified the 1998 Protocol on Heavy Metals to the Convention on Long-Range Transboundary Air Pollution, which is the only major international agreement on heavy metals.

Effective pollution abatement also calls for more local policy action. The presence of high levels of contaminants in traditional foods presents "an Arctic dilemma."[14] That is, traditional foods have many nutritional advantages, so the risks of traditional food consumption from contamination need to be weighed against its nutritional benefits. The consumption of local foods is also often culturally important for Arctic indigenous peoples. Any food recommendations in connection with pollutants should therefore consider positive nutritional and cultural aspects of traditional lifestyles.[15] In addition, health risks of traditional food consumption interact with other factors such as substance abuse, nutrition, age, and general health status.

AMAP recommends that dietary advice should take risks and benefits into account when developing guidelines, and it continues to recommend that the benefits of breastfeeding still outweigh the risks. However, setting dietary guidelines is a matter of judgment, and regulations and recommendations vary across countries.[16] For example, Sweden and Finland allow higher levels of the POP dioxin in Baltic fish for domestic sale and consumption than do Germany and Denmark.[17] Among the Yup'ik in western Alaska, almost half of the mothers exceed U.S. Environmental Protection Agency levels on dietary intake of mercury, but none exceed the less-stringent Canadian guidelines. There is a need to continue to develop dietary recommendations and measures to reduce intake of pollutants in concert with local communities.

A Need to Assess Environmental and Social Interactions

It is increasingly recognized that Arctic pollutants issues interact with other environmental, socioeconomic, and political changes at local, regional, and global scales. For

example, global climate changes can alter pathways of pollutant transport. Cigarette smoking is often the main source of cadmium exposure, and reduced smoking would radically reduce such exposure for many people. The ability to sustain livelihoods in reindeer husbandry, hunting, and fishing is closely related to market factors and changes in climate, as well as to the concentrations of pollutants in animals that are harvested and sold.

We have only limited understanding of how interacting environmental and social issues play out across different Arctic areas and local communities.

However, we have only limited understanding of how interacting environmental and social issues play out across different Arctic areas and local communities. Arctic assessments that focus more on interactions among environmental and social issues would be of great interest to researchers, policy makers, and Arctic peoples.[18] The AMAP assessments have made a substantial contribution to knowledge and understanding of pollution-related issues in the Arctic. A challenge for Arctic assessments in the next several years will be to build on AMAP's successes and assess interacting environmental and social influences (including pollution), and examine options to address undesirable implications of such influences.

Noelle Eckley is a graduate student at the Department of Earth and Planetary Sciences at Harvard University. She models global transport of POPs and heavy metals. She can be contacted by e-mail at eckley@fas.harvard.edu. Henrik Selin is a Wallenberg Fellow in Environment and Sustainability at the Department of Urban Studies and Planning, Massachusetts Institute of Technology. He researches international management of hazardous substances. He can be contacted by e-mail at hselin@mit.edu.

NOTES

1. In a study on toxic chemicals in polar bears, G. W. Bowes and C. J. Jonkel were the first to identify PCBs and DDT in animals throughout the Canadian Arctic in 1968–1972. The report was initially presented at the American Chemical Society's 164th National Meeting in August/September 1972 and was later published in 1975 as G. W. Bowes and C. J. Jonkel, "Presence and Distribution of Polychlorinated Biphenyls (PCB) in Arctic and Subarctic Marine Food Chains," *Journal of the Fisheries Research Board of Canada* 32, no. 11 (1975): 2111–23. See also R. J. Norstrom, et al., "Organochlorine Contaminants in Arctic Marine Food Chains: Identification, Geographical Distribution, and Temporal Trends in Polar Bears," *Environmental Science & Technology* 22, no. 9 (1988): 1063–71.

2. The eight Arctic countries are Canada, Denmark (Greenland), Finland, Iceland, Norway, the Russian Federation, Sweden, and the United States. Currently, there are six Permanent Participants of the Arctic Council: the Aleut International Association, the Arctic Athabaskan Council, the Gwich'in Council International, the Inuit Circumpolar Conference, the Saami Council, and the Russian Association of Indigenous Peoples of the North. For more on the Arctic Council, see http://www.arctic-council.org. For more on AMAP, see http://www.amap.no.

3. Arctic Monitoring and Assessment Programme, *Arctic Pollution 2002* (Oslo: AMAP, 2002). The report is available at http://www.amap.no.

4. Scientific reports on human health and changing pathways have already been released. For these reports and expected dates of publication of the other forthcoming scientific reports, see http://www.amap.no.

5. It is hypothesized that POPs and other pollutants preferentially transport toward the poles in a series of depositions and re-emissions termed the "grasshopper effect." See F. Wania and D. Mackay, "Tracking the Distribution of Persistent Organic Pollutants: Control Strategies for These Contaminants Will Require a Better Understanding of How They Move Around the Globe," *Environmental Science & Technology* 30, no. 9 (1996): 390A–396A; and D. Mackay and F. Wania, "Transport of Contaminants to the Arctic: Partitioning, Processes, and Models," *Science of the Total Environment* 160/161 (1995): 25–38.

6. See also P. Johansen, G. Asmund, F. Rigert, and M. Kirkegaard, "Lead Contamination of Greenland Seabirds Hunted with Lead Shot," *The Second AMAP International Symposium on Environmental Pollution of the Arctic: Extended Abstracts. Rovaniemi, Finland. October 1–4, 2002. AMAP Report 2002:2* (Oslo: AMAP, 2002); and P. Johansen, G. Asmund, and F. Rigert, "Lead Contamination of Seabirds Harvested with Lead Shots—Implication to Human Diet in Greenland," *Environmental Pollution* 112 (2001): 501–04.

7. Approximately 3.8 million people live in the Arctic. Nearly 650,000 of these are indigenous peoples. Some areas of the Arctic, such as Greenland and eastern Canada, are mainly inhabited by indigenous peoples. In contrast, populations in Alaska, Arctic Scandinavia, and Russia are mostly nonindigenous. See Arctic Monitoring and Assessment Programme, *AMAP Assessment 2002: Human Health in the Arctic* (Oslo: AMAP, 2003), 10–20.

8. AMAP's second pollution assessment involved more than 200 experts from all Arctic countries.

9. Arctic Monitoring and Assessment Programme, *AMAP Assessment 2002: The Influence of Global Change on Contaminant Pathways to, within, and from the Arctic* (Oslo: AMAP, 2003).

10. H. Selin and N. Eckley, "Science, Politics, and Persistent Organic Pollutants: Scientific Assessments and their Role in International Environmental Negotiations," *International Environmental Agreements: Politics, Law and Economics* 3, no. 1 (2003): 17–42; and H. Selin, "Regional POPs Policy: The UNECE/CLRTAP POPs Agreement" in D. L. Downie and T. Fenge, eds., *Northern Lights against POPs: Combatting Toxic Threats in the Arctic* (Montreal: McGill-Queens University Press, 2003), 111–32.

11. Important regional forums of Arctic relevance for pollution abatement include the North American Commission for Environmental Cooperation, the European Union, the Oslo-Paris Commission for the North-East Atlantic, and the Helsinki Commission for the Baltic Sea region. Major international agreements include the 1998 Protocols on Persistent Organic Pollutants and Heavy Metals under the Convention on Long-Range Transboundary Air Pollution and the 2001 Stockholm Convention on Persistent Organic Pollutants.

12. For more on the global mercury situation, see United Nations Environment Programme, *Global Mercury Assessment* (Geneva: UNEP, 2002). The report is available at http://www.chem.unep.ch/mercury.

13. C. Lazaroff, "U.S. Derails UN Plan to Curb Mercury Emissions," The New Zealand Herald, 19 February 2003; C. Lazaroff, "U.S. Could Block International Action on Mercury," Environment News Service, 29 January 2003; and International Institute for Sustainable Development, "Summary of the 22nd Session of the UNEP Governing Council and the Fourth Global Ministerial Environment Forum: 3–7 February 2003," *Earth Negotiations Bulletin* 16, no. 30 (2003).

14. Arctic Monitoring and Assessment Programme, note 7 above, page 110.

15. See also H. V. Kuhnlein and H. M. Chan, "Environment and Contaminants in Traditional Food Systems of Northern Indigenous Peoples," *Annual Review of Nutrition* 20 (2000): 595–626.

16. Arctic Monitoring and Assessment Programme, note 7 above, pages 106–13.

17. Finland and Sweden requested and were granted an exemption until 2006 from European Union regulations on dioxins in food and feed that entered into force in July 2002. In contrast, Denmark and Germany have accepted the EU limits on dioxins in food and feed. See Helsinki Commission, *Implementation of the HELCOM Objective with Regard to Hazardous Substances: Final Project Report* (Helsinki: HELCOM, October 2002), 9.

18. B. L. Turner II et al., "A Framework for Vulnerability Analysis in Sustainability Science," *Papers for the Proceedings of the National Academies of Sciences* 100, no. 14 (2003): 8074–79; and B. L. Turner II et al., "Illustrating the Coupled Human-Environment System for Vulnerability Analysis: Three Case Studies," *Papers for the Proceedings of the National Academies of Sciences* 100, no. 14 (2003): 8080–85.