

Chapter 1

Introduction

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1.1. Development of international activities for environmental protection in the Arctic

The AMAP assessment is one result of the cooperation among the eight Arctic states on environmental issues that formally began in 1991 with the adoption of the Arctic Environmental Protection Strategy (AEPS). Just a few years earlier, such a degree of cooperation in the Arctic region would have been barely conceivable.

1.1.1. Background

Up until the mid-1980s, international cooperation on environmental protection in the Arctic was relatively poorly developed. It took the form of a number of largely uncoordinated national initiatives and loosely structured bilateral and multilateral arrangements focusing on specific subregions (Young 1995). This situation reflected both the generally clear delineation of national jurisdictions in the Arctic, and the strong national interests in a region of considerable economic, geo-political, and military-strategic importance. However, in the late 1980s a number of events occurred which radically changed this situation. Most significant among these were the developments in the political climate with respect to the former Soviet Union. This led, amongst other things, to an expansion of environmental cooperation, as exemplified by the 1987 Gorbachev 'Murmansk Initiative'.

Bilateral cooperation between the USSR and other Arctic states on a number of issues rapidly developed, in particular between the USSR and Scandinavian countries concerning environmental monitoring and protection (Scrivener 1996).

At the same time, steps were being taken to address environmental protection of the Arctic in a truly circumpolar context. An international initiative in early 1989, led by Finland, pointed to the fact that there was no comprehensive international regime governing human activities adversely affecting the Arctic environment or its inhabitants and resources. This statement was made at a time when an increasing body of scientific evidence was making it apparent that the Arctic region, often perceived as a pristine area, little affected by anthropogenic pollution, was indeed being widely contaminated by pollutants (including certain persistent organics) with no obvious sources in the Arctic.

1.1.2. The Arctic Environmental Protection Strategy (AEPS)

The Finnish proposal to convene a conference on the protection of the Arctic environment was favorably received by the governments of the other countries concerned (Canada, Denmark/Greenland, Iceland, Norway, Sweden, Soviet Union, and United States). Preparatory meetings for this conference were held in Rovaniemi, Finland in September 1989. At this meeting, the 'Rovaniemi process' was initiated, with agreement that a series of reports concerning the main pollutants and potential pollutants in different parts of the Arctic environment and its ecosystems be prepared by lead countries. These first 'State of the Arctic Environment' reports (Anon. 1991) were presented at the First Arctic Ministerial Conference (Rovaniemi, Finland, June 1991). This conference represented a breakthrough in the development of international cooperation for the protection of the Arctic, with its most significant outcome being the adoption of the Arctic Environmental Protection Strategy (AEPS 1991b).

The objectives of the AEPS, as adopted in the Rovaniemi Declaration (AEPS 1991a), are as follows:

- to protect the Arctic ecosystems, including humans;
- to provide for the protection, enhancement and restoration of environmental quality and sustainable utilization of natural resources, including their use by local populations and indigenous peoples in the Arctic;
- to recognize and, to the extent possible, seek to accommodate the traditional and cultural needs, values and practices of indigenous peoples as determined by themselves, related to the protection of the Arctic environment;
- to review regularly the state of the Arctic environment;
- to identify, reduce and, as a final goal, eliminate pollution.

In adopting the AEPS, the governments of the eight circumpolar nations took a further progressive step by formally recognizing the importance, and facilitating the active participation in the process, of groups representing the indigenous peoples of the North.

To implement the AEPS, five programs were instituted to act on requests passed by Ministers and their Senior Arctic Officials and to report back on various issues. These programs and their primary responsibilities are as follows:

Arctic Monitoring and Assessment Programme (AMAP) with responsibilities to monitor the levels of, and assess the effects of, anthropogenic pollutants in all compartments of the Arctic environment, including humans.

Conservation of Arctic Flora and Fauna (CAFF) with responsibilities to facilitate the exchange of information and coordination of research on species and habitats of Arctic flora and fauna.

Emergency Prevention, Preparedness and Response (EPPR) with responsibilities to provide a framework for future cooperation in responding to the threat of Arctic environmental emergencies.

Protection of the Arctic Marine Environment (PAME) with responsibilities to take preventative and other measures, directly or through competent international organizations, regarding marine pollution in the Arctic, irrespective of origin.

Sustainable Development and Utilization (SDU) with responsibilities to propose steps governments should take to meet their commitment to sustainable development of the Arctic, including the sustainable use of renewable resources by indigenous peoples.

Following the First Arctic Ministerial Conference in 1991, two further conferences were held, in Nuuk, Greenland in 1993 (AEPS 1993), and in Inuvik, Canada in 1996 (AEPS 1996). These conferences reviewed the progress of the above mentioned groups and, as appropriate, further developed their tasks and responsibilities.

1.1.3. The Arctic Council

In September 1996, the governments of the eight Arctic countries established the Arctic Council (Arctic Council 1996). At the Fourth Arctic Ministerial Conference, in Alta, Norway, in 1997 (AEPS 1997), the AMAP assessment (AMAP 1997a) was delivered to Ministers for their consideration. This Conference also marked the point at which the Arctic Council assumed responsibility for the AEPS. Amongst other things, therefore, the Arctic Council is now responsible for continuing the work initiated under the AEPS. This also includes overseeing and coordinating the future work of the programs established under the AEPS, including AMAP.

1.1.4. Summary

In contrast to the Antarctic, where a comprehensive regime for the entire region was instituted with the Antarctic Treaty signed in 1959, extensive international cooperation in the Arctic region was slow to develop. However, with the AEPS initiative and the subsequent establishment of the Arctic Council, it can now be concluded that, rather than 'lagging-behind' the Antarctic, the Arctic cooperations on environmental protection have, by the mid-1990s, expanded to such an extent that some components are now being considered as a model for possible further development of the Antarctic regional cooperations.

Widespread contamination of the Arctic by substances originating from sources outside of the region has led to increasing recognition that environmental protection of the Arctic cannot be addressed simply on a national or sub-regional basis. Thus, whereas other recently published reports (e.g., Hansen *et al.* 1996, Nordic Council of Ministers 1997) have highlighted pollution in Arctic environments at the subregional level, the AMAP assessment, as presented here and in *Arctic Pollution Issues: A State of the Arctic Environment Report* (AMAP 1997a), represents the most comprehensive consideration to date in addressing pollution threats to the Arctic in a circumpolar, Arctic-wide context.

This report, *AMAP Assessment Report: Arctic Pollution Issues*, describes in detail the results of AMAP's first assessment. It therefore represents a major component of AMAP's work during its first phase (1991-1996) to fulfill its responsibilities within the framework of the AEPS, as further elaborated in section 1.3.

1.2. International agreements and arrangements relevant to the Arctic

Pollution issues are covered by several international agreements or arrangements that form an important focus for political efforts aimed at reducing impacts on the Arctic environment and its ecosystems. These agreements complement, and in some cases have established the framework for AMAP activities. Before describing the way in which components of the AEPS have been addressed through the work of AMAP, it is therefore appropriate to consider some of the more relevant international agreements and associated organizations.

Some of these agreements and organizations have been reviewed by the AEPS Protection of the Arctic Marine Environment group in relation to their consideration of existing arrangements for protection of the Arctic marine environment (PAME 1996). The following, including additional agreements and organizations not covered by PAME, can be considered to have particular relevance to the AMAP assessment:

UN ECE Convention on

Long-range Transboundary Air Pollution (LRTAP)

The purpose of the UN Economic Commission for Europe's LRTAP Convention is to prevent, reduce and control transboundary air pollution both from existing and new sources. By covering not only the entire Arctic region, but also mid-latitude regions which are the origin of a major part of the pollution reaching the Arctic by, e.g., atmospheric pathways, this regional, binding agreement, and its five related protocols, represents the most appropriate instrument for addressing significant components of the Arctic pollution problem, not only to the marine environment but to all environmental compartments. Current negotiations within LRTAP include efforts to conclude a new protocol on photochemical pollution, acidification and eutrophication. The work of AMAP has been particularly directed to supporting the development of new protocols on heavy metals and persistent organic pollutants, concluded in 1998.

Convention for the Protection of the Marine Environment of the North East Atlantic, 1992 (OSPAR)

Although covering only a restricted segment of the circumpolar Arctic (between longitudes 44° W and 51° E), the 1992 OSPAR Convention, developed under the Oslo and Paris Commissions to update two existing Conventions (the 1974 Paris Convention for the Prevention of Marine Pollution from Land-based Sources, and the 1972 Oslo Convention for the Prevention of Marine Pollution from Ships and Aircraft), is currently one of the most applicable international agreements addressing Arctic marine pollution from various sources. On both monitoring and source-related assessment issues, therefore, OSPAR 1992 represents a relevant agreement to be taken into account in the work of AMAP.

International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 (MARPOL 73/78)

The MARPOL Convention is a combination of two treaties adopted in 1973 and 1978. It covers all technical aspects of pollution from ships, except the disposal of waste into the sea by dumping, and applies to ships of all types. The Convention has five annexes covering oil, chemicals, sewage, garbage, and harmful substances carried in packages, portable tanks, freight containers, etc.

Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, London Convention, 1972

The London Dumping Convention is the primary international agreement regulating, amongst other things, ocean dumping of wastes. It has direct significance to several aspects of environmental protection of the Arctic, but in particular in relation to radioactive waste disposal issues. All eight Arctic countries are Contracting Parties, and have signed a recent comprehensive revision and restructuring of this Convention.

International Atomic Energy Agency (IAEA)

The UN International Atomic Energy Agency is the main body dealing internationally with radioactivity issues (nuclear safety, radiation protection and waste management). IAEA is also the advisor on radioactivity issues for the London Convention. AMAP's consideration of these issues, relevant to the Arctic, has been facilitated through strong mutual cooperation between AMAP and IAEA.

UNEP Global Programme of Action

Adopted by all Arctic countries in 1995, the UN Environment Programme's Global Programme of Action (GPA) for the Protection of the Marine Environment from Land-based Activities (UNEP 1995) has been developed in response to Agenda 21 of the Rio Declaration (UN Publications 1992, COCF 1993), to build on the earlier work of the 1985 Montreal Guidelines on Marine Pollution from Land-based Sources. Under the GPA, the 19th session of the UNEP Governing Council decided to establish a negotiating committee to prepare a global, legally-binding agreement on at least 12 persistent organic pollutants. This latter initiative, together with the POP protocol being developed under the UN ECE, are significant in addressing the threats to the Arctic from persistent organic pollutants, and therefore an important consideration in the implementation of AMAP.

Framework Convention on Climate Change

Adopted at the Rio Earth Summit Conference in 1992, the UN Framework Convention on Climate Change provides an international framework for ongoing discussions to negotiate binding agreements to reduce emissions of greenhouse gasses, in particular carbon dioxide. The ultimate goal of the Convention is to stabilize greenhouse gasses in the atmosphere at levels that will not adversely disturb the global climate system, within the framework of sustainable development.

Vienna Convention for the Protection of the Ozone Layer and the Montreal Protocol on Substances that Deplete the Ozone Layer

The Vienna Convention of 1985 identified ozone as a threatened species in the atmosphere and resulted in the adoption of the 1987 Montreal Protocol, which limits the production of chlorofluorocarbons (CFCs) and other ozone depleting substances. The Montreal Protocol entered into effect in 1989 and has subsequently been amended in 1990 (London Amendment) and 1992 (Copenhagen Amendment). Compliance with these protocols and amendments is the primary mechanism for regulating ozone depleting substances and for protecting stratospheric ozone.

World Meteorological Organization (WMO)

The World Meteorological Organization has sponsored and coordinated a number of scientific activities related to cli-

mate change, ozone, and UV radiation. WMO, together with UNEP, has produced a series of documents assessing the state of ozone depletion on a global scale. Since it is neither feasible nor within the AMAP mandate to comprehensively monitor and assess the (global) effects ozone depletion and increased UV-radiation, these documents, prepared by a panel of internationally recognized scientists, have been extensively used by AMAP in its assessment of these issues in relation to the situation in the Arctic.

Intergovernmental Panel on Climate Change (IPCC)

The Intergovernmental Panel on Climate Change is the international body dealing with global aspects of climate change, providing policy-makers with relevant information concerning expectations for the future. The IPCC was jointly established by the WMO and UNEP in 1988. Again, since it is neither feasible nor within the AMAP mandate to comprehensively monitor and assess the (global) effects of climate change, the work within IPCC represents a source of information available to AMAP in its consideration of these issues (see chapter 11). The main aim of the AMAP work is to assess the effects of these global processes from an Arctic perspective, and to evaluate the effectiveness of the work ongoing within other international fora in relation to the situation in the Arctic.

International Arctic Science Committee (IASC)

The non-governmental International Arctic Science Committee, founded in 1990, was established to encourage and facilitate cooperation in all aspects of Arctic research. IASC is a coordinating body for research in a number of fields of relevance to the work of AMAP. Examples of IASC programs which are followed with particular interest by AMAP include those concerned with 'Effects of Increased UV-B Radiation in the Arctic', and 'Mass Balance of Arctic Glaciers and Ice Sheets'.

Barents Euro-Arctic Region (BEAR)

Established in 1993 following the Kirkenes Declaration, the Barents Euro-Arctic Region aims to identify areas of cooperation between the Nordic countries, Russia and the European Union, and promote these through the Barents Council. It is important that this work is coordinated with similar activities under AMAP.

The above list is by no means exhaustive, but provides an indication of the international bodies with which it is important to link and coordinate relevant work under AMAP.

AMAP cooperations and interactions with other organizations and agencies, including those responsible for the above-mentioned agreements, operate on various levels. On an institutional and administrative level, mutual 'observership' agreements have been established with a number of agencies and organizations (listed in section 1.3.1).

Harmonization with respect to the conduct and further development of monitoring activities, and sharing of monitoring data and data on emissions and discharges, together with other types of information, are fundamental objectives in all such inter-organizational cooperations. In certain cases, the AMAP assessment process has been specifically tailored to include contributions from work being conducted by other organizations (e.g., AMAP and IAEA-IASAP (International Arctic Sea Assessment Project) cooperation with respect to the radioactivity source-related assessment).

Identification and compilation of reliable information on sources of pollution is a field where AMAP has played an active role, often to support ongoing work being conducted

by other relevant international agencies. An example of such an activity is AMAP's contribution to the work of compiling a global emission inventory for Hg (results of which are presented in chapter 7) as an inclusion to the Global Emissions Inventory Activity (GEIA) of the International Geosphere-Biosphere Project (IGBP). The joint AMAP-NEFCO (Nordic Environment Finance Corporation) cooperation to identify environmentally sound investment projects in the Barents region also generated important information on sources in that area (NEFCO 1995, 1996). In all such activities, quality assurance of the information obtained has been a high priority.

As part of its ongoing work, AMAP has attempted, through its interim reports to Ministers, to provide relevant input to the further development of international agreements (e.g., UN ECE consideration of new protocols for persistent organic pollutants and heavy metals reductions). In preparing advice to Ministers, based on its assessment activities (AMAP 1997a), AMAP has similarly attempted to fully recognize and develop its recommendations with practical consideration of existing activities aimed at environmental protection. These include legislative and regulative initiatives at both the regional and international level.

1.3. The AMAP assessment process

1.3.1. The Arctic Monitoring and Assessment Programme: Organizational background

As described in section 1.1, the Arctic Monitoring and Assessment Programme (AMAP) is one of five organizations established to implement the AEPS, specifically those issues relating to pollution of the Arctic.

From its inception, AMAP was conceived as a *process* integrating both monitoring and assessment activities in relation to pollution issues, to provide information for:

- producing integrated assessment reports on the status and trends of the conditions of Arctic ecosystems;
- identifying possible causes for changing conditions;
- detecting emerging problems, their possible causes, and the potential risk to Arctic ecosystems including indigenous peoples and other Arctic residents;
- recommending actions required to reduce risks to Arctic ecosystems.

To prepare its assessment, for the first period (1991-1996), AMAP:

- designed and implemented a coordinated monitoring programme to monitor the levels of pollutants and assess the effects of pollution in all compartments of the Arctic environment (the atmospheric, terrestrial, freshwater and marine environments, and human populations);
- instituted an assessment process to produce assessment reports. The assessment has been performed according to agreed guidelines (AMAP 1995), and is principally based on: i) data already published in scientific literature, ii) data obtained from AMAP's monitoring programme, and iii) traditional knowledge.

Objectives of AMAP

The primary objectives of AMAP are to measure the levels, and assess the effects of anthropogenic pollutants in all compartments of the Arctic environment, including humans; to document trends of pollution; to document sources and pathways of pollutants; to examine the impact of pollution

on Arctic flora and fauna, especially those used by indigenous people; to report on the state of the Arctic environment; and to give advice to Ministers on priority actions needed to improve the Arctic condition.

AMAP priority issues

At the Ministerial Conference in Rovaniemi, Finland (1991), persistent organic contaminants, heavy metals and radioactivity were recognized as the environmental pollution issues of first circumpolar priority. Interim reports prepared by AMAP for the Ministerial Conferences in Nuuk, Greenland (AMAP 1993b) and Inuvik, Canada (AMAP 1996), highlighted further examples of contamination in the North. As a result of this input, the mandate of AMAP was extended to include: acidification and Arctic haze, and oil pollution, in a subregional context; and environmental consequences of, and biological effects due to global climate change and stratospheric ozone layer depletion, relevant to the Arctic.

Organization and structure of AMAP

The work of AMAP in fulfilling its mandate from Ministers is directed by the AMAP Working Group (AMAP WG), which includes representatives from the following members and observers:

Member countries: the eight Arctic rim countries (Canada, Denmark/Greenland, Finland, Iceland, Norway, Russia, Sweden, United States);

Indigenous peoples organizations: Association of Indigenous Peoples of the North, Siberia, and the Far East of the Russian Federation (AIPON), Inuit Circumpolar Conference (ICC), Saami Council;

Observing countries: Germany, Netherlands, Poland, United Kingdom;

Observing and cooperating international organizations: Advisory Committee on Protection of the Sea (ACOPS), European Environment Agency (EEA), International Arctic Science Committee (IASC), International Atomic Energy Agency (IAEA), International Council for the Exploration of the Sea (ICES), International Union for Circumpolar Health (IUCH), Nordic Council of Parliamentarians (NCP), Northern Forum, OECD Nuclear Energy Agency (OECD/NEA), Oslo and Paris Commissions (OSPARCOM), United Nations Economic Commission for Europe (UN ECE), United Nations Environment Programme (UNEP), World Meteorological Organisation (WMO), World Wide Fund for Nature (WWF).

AEPS organizations: Conservation of Arctic Flora and Fauna (CAFF), Protection of the Arctic Marine Environment (PAME), Emergency Prevention, Preparedness and Response (EPPR), Indigenous Peoples Secretariat (IPS), Sustainable Development and Utilization (SDU).

The AMAP WG first met in Tromsø, Norway in December 1991, and has since convened once or twice a year. The AMAP Board, comprising the Chairman and Vice-Chairman of the AMAP WG and the Executive Secretary of AMAP, is authorized to make decisions on AMAP matters during intersessional periods between AMAP WG meetings.

The AMAP Assessment Steering Group (ASG) was established to coordinate all work associated with the preparation of the assessment. ASG members included the coordinators responsible for the preparation of individual chapters of the AMAP Assessment Report.

AMAP is supported by a permanent Secretariat located in Oslo, Norway.

The work of AMAP has been financed through national support from both member and observing countries to finance monitoring and research programs, and participation of scientific experts in the assessment process. Additional funding, provided by Canada, Denmark, Norway, the Nordic Council of Ministers, Sweden, UNEP and the USA has facilitated, in particular, i) the preparation and production of the assessment reports; ii) the establishment and operation of thematic data centres and related data handling work; iii) the participation of indigenous peoples organizations and experts in the work of AMAP; and iv) the provision of data from Russia and participation of Russian experts in the AMAP process.

1.3.2. The development of AMAP and its activities during the first phase (1991-1996)

The AMAP Monitoring Programme

During its first period (1991-1996), AMAP implemented a monitoring programme for the priority contaminants described above in section 1.3.1. This programme was initially formulated in the autumn of 1989 and presented at a preparatory meeting in Yellowknife, Canada in April 1990. The programme was further developed during an expert meeting in Oslo, Norway in November 1990.

The AMAP monitoring programme (AMAP 1993a) was designed to monitor the levels of pollutants and assess the effects of pollution in all compartments of the Arctic environment. Five subprogrammes are described, concerning the atmospheric, terrestrial, freshwater, and marine environments, and human populations with respect to human health. These subprogrammes are defined in terms of essential and recommended parameters and media (matrices) to be monitored on a circumpolar or subregional level.

In addition to the circumpolar monitoring of the priority contaminants, other issues covered in the national implementation programmes for AMAP, for example acidification and oil pollution, are implemented in the form of 'subregional' programmes.

Monitoring strategy and harmonization

The monitoring work within AMAP is based, as far as possible, on existing national and international monitoring and research programs, aiming to harmonize these to the extent possible. Each country defines its own National Implementation Plan (NIP) to meet the AMAP monitoring objectives. Monitoring projects are carried out within each of the participating countries and across borders under bilateral and multilateral cooperations. The resulting monitoring programme was reviewed in an audit process (AMAP 1993c) conducted at the request of AMAP and reported to the Nuuk 1993 Ministerial meeting. This audit revealed a number of deficiencies and gaps in the described implementations, with the result that NIPs were improved, extended, and where necessary new activities were initiated to meet AMAP requirements. Efforts were, and continue to be made to harmonize existing and new programs with respect to methodologies and quality assurance.

A project directory of Arctic research and monitoring projects was compiled to describe the AMAP implementation plan activities and assist AMAP assessment experts in identification of data sources. This directory presently describes some 580 projects and programs; 335 of which are designated as part of the national implementation plans of the eight Arctic countries to fulfill AMAP objectives.

It must be recognized that the design and implementation of a monitoring programme (even one based largely on ongoing activities), the compilation of the resulting data, and its comprehensive assessment, represents a high level of ambition for a five-year period. In many respects, these ambitions were realized. However, for a number of financial and logistical reasons not all countries were able to fully implement all (mandatory) elements of the AMAP programme. Also, several new monitoring (and assessment) activities were initiated which are only now beginning to yield important data and which have a longer-term relevance within the context of environmental monitoring in the Arctic region (e.g., programs addressing human health and risk assessment, further development of atmospheric modeling work relevant to the Arctic, monitoring directed at establishing long-term temporal trends, etc.). An evaluation of the first phase of AMAP, including specific recommendations concerning information gaps, is an integral part of the AMAP assessment. These considerations will be developed in the form of proposals concerning the strategy for further development of the AMAP Monitoring Programme. The second phase of AMAP will continue to eliminate gaps in knowledge and contribute relevant information necessary for a comprehensive assessment of the Arctic environment.

Monitoring data compilation

The major part of the AMAP assessment has been based on information and results published in the scientific literature and available through scientific reports, including results from programs of relevant international bodies. These sources are fully referenced in this report. In addition, results from recent (largely unpublished) AMAP monitoring work have been compiled within AMAP Thematic Data Centres (TDCs) from which data have been made available to scientists responsible for the AMAP assessment. Consideration of quality assurance issues is an integral component of the AMAP monitoring and assessment process.

AMAP Thematic Data Centres have been established to meet the following objectives:

- to provide access to data from recent monitoring and research activities conducted as part of the AMAP NIPs;
- to provide a means to ensure that data are treated in a consistent manner, undergo uniform statistical analysis, etc., including application of objective quality assurance procedures;
- to begin the process of establishing a long-term archive of Arctic-relevant monitoring data, for use in future assessments of, e.g. temporal trends, etc.; and
- to meet the terms of reference of the Ministerial declarations, charging AMAP with establishing databases of sources, types, and levels of radionuclide contamination of the atmospheric, aquatic and terrestrial environments of the Arctic and northern areas.

To date, four such TDCs have been established, for:

- atmospheric contaminants data: at the Norwegian Institute for Air Research (NILU), Kjeller, Norway.
- marine contaminants data: at the International Council for the Exploration of the Sea (ICES), Copenhagen, Denmark.
- freshwater contaminants data: at the Freshwater Institute (FWI-DFO), Winnipeg, Canada.
- radioactivity data, including both sources and levels and trends: at the Norwegian Radiation Protection Authority (NRPA), Oslo, Norway.

AMAP TDCs are located at established centres with appropriate expertise and facilities for conducting the types of international data handling work required by AMAP. Some of these centres also conduct data handling work for other international monitoring programs, facilitating harmonized reporting of data to meet the needs of different regional programs.

Preparation of the AMAP Assessment Reports

A regional environmental assessment involves compilation of current knowledge about a specific area, an evaluation of this information in relation to agreed criteria of environmental quality, and a statement of the prevailing conditions in the area. It was recognized from the outset that a considerable amount of data and information already existed and should be taken into account in the AMAP assessment. Any new data collection initiated by AMAP during the assessment process was, therefore, primarily aimed at filling identified gaps in the information necessary to fulfill the assessment objectives.

Comprehensive assessments of regional areas are potentially useful to both managers and scientists in the following ways:

- providing a concise summary of contemporary knowledge and necessary management action;
- enabling the identification of significant gaps in knowledge and, accordingly, providing an authoritative basis for defining priorities for future scientific and other investigations;
- providing a basis for judging the effectiveness and adequacy of environmental protection measures and for making necessary adjustments.

Assessments of this type should be regarded by managers and scientists as a normal part of the environmental protection process at national, regional and international levels. If prepared in a systematic and uniform manner, such assessments provide a mechanism for intercomparison of regional environmental conditions and for assessing the nature and extent of anthropogenic influences on larger (e.g., global) scales.

At an expert meeting in March 1994 (AMAP 1994), the strategy for the preparation of the AMAP assessment reports was developed. It was agreed that two reports presenting the work during the first phase of AMAP would be prepared:

- the '*AMAP Assessment Report: Arctic Pollution Issues*' (AAR) comprising a fully referenced, comprehensive, technical and scientifically presented assessment of all validated data on the status of the Arctic environment relative to the AMAP mandate.
- the *Arctic Pollution Issues: A State of the Arctic Environment Report* (SOAER) as referred to in section 6.1 (v) of the Rovaniemi Declaration/Strategy (AEPS 1991a, 1991b). A more concise report presenting the results of AMAP and its assessment, and including an executive summary with recommendations specifically addressed to Ministers.

AMAP Assessment Report: Arctic Pollution Issues (this report) constitutes the background material for the SOAER, and provides the accessible scientific basis and validation for any statements made in the SOAER and for conclusions and recommendations addressed to Ministers.

The strategy for preparation of the AAR included establishing drafting groups responsible for individual chapters, with each chapter prepared under the responsibility of one

or more 'lead countries'. These drafting groups comprised a restricted number of 'key' scientific experts with responsibility for coordinating the chapter drafting. A large number of additional experts from both AMAP member and observing countries, international organizations, and others, supported the AMAP assessment work. Representatives of indigenous peoples organizations actively participated in the drafting of several parts of the report, in particular those concerned with human populations in the north and human health issues, and provided vital information, e.g., on dietary habits, which was used in other chapters. A number of international organizations were also associated with the AMAP assessment process and contributed to specific parts of certain chapters. An Assessment Steering Group (ASG), including the principle chapter coordinators, was established to coordinate the overall preparation and production of the reports.

Although chapters were drafted essentially independently, by groups considering specific issues, the need to achieve appropriate 'synthesis' between drafting groups and disciplines was a major consideration. Thus, an expert meeting was held in 1996 specifically to address this issue.

In addition to this report, several countries have prepared their own national reports presenting or including much of the data and information used in the preparation of the holistic AMAP assessment. These reports have been prepared as both popular publications (e.g., Indian and Northern Affairs 1997b, Finnish Environment Institute 1997, Pedersen 1997) and more scientific or reference works (Indian and Northern Affairs 1997a, Danish Environmental Protection Agency 1997a, 1997b). Readers may be interested in referring to these reports, and the publications resulting from the AMAP International Symposium on Environmental Pollution in the Arctic (AMAP 1997b, 1997c), for additional information on, and results from monitoring and research projects in particular geographical areas.

1.3.3. Objectives and structure of the assessment

The AMAP assessments are intended to accomplish the following:

- summarize and analyze the contemporary state of knowledge of the sources, levels, distributions, trends, fate and effects of contaminants and certain other anthropogenic influences on the Arctic environment and human health;
- assess the relative magnitude of damage and threats to the Arctic environment and human health based on existing information;
- recommend actions, both at the national and international level, to reduce assessed damages and threats;
- identify deficiencies and gaps in information and data required to improve the reliability of evaluations of such damage and threats that would warrant rectification through further scientific and social studies.

The Arctic is an integrated part of the global system, and pollution in the region can only be fully considered in relation to processes and pathways that operate not only within the Arctic in its entirety, but also that link the Arctic with adjacent regions at lower latitudes.

The AMAP assessment process has, therefore, been based on the acquisition and analyses of all available existing sources of information and any validated data being acquired through national and international survey, monitoring and research activities that are relevant to the area and focus of the specific assessment being conducted.

Reader's guide

This report is organized according to chapter structures largely developed at an expert meeting in March 1994. After this introduction, a chapter describing the general physical-geographical characteristics of the Arctic region is followed by a chapter detailing the physical processes influencing pollutant transport (pathways) into and within the Arctic. Characteristics of ecosystems and an introduction to the main factors determining biological pathways are then described, followed by a chapter specifically concerned with human populations relevant to pollution issues. These initial five chapters are intended to provide the context for a series of chapters which address in greater detail specific groups of contaminants and pollution issues: persistent organic pollutants (including organotin); heavy metals (including methylmercury); radioactivity; acidifying pollutants (including Arctic haze); petroleum hydrocarbons (including PAHs); and climate change, ozone and ultraviolet radiation. Each of these main chapters has been prepared such that it can essentially 'stand-alone', subject to minimal cross-referencing with material presented in the introductory chapters, e.g. on pathways, etc. The final chapter is devoted to consideration of human health issues, which, with the exception of the chapter concerning radioactivity, are generally not covered in chapters dealing with specific types of contaminants.

Each chapter contains its own set of, often very comprehensive, references. Every effort has been made to ensure that the references contained in this report are consistent and provide an accurate resource for those interested in obtaining further information. In addition, the chapters dealing with persistent organic pollutants, heavy metals, radioactivity, petroleum hydrocarbons, and human health all include annexes. Some of these annexes contain tables summarizing some of the data used in the assessment. Although based on working compilations of data, every effort has been made to ensure that the tables as presented are accurate. An additional appendix to the report provides reference lists of species names, and a glossary of selected terms and abbreviations used in the report.

It is envisaged that further more detailed reports on specific subjects will be produced as a result of the work undertaken in preparation of this assessment. These include papers prepared for the scientific literature, information and data compilations in electronic formats (CD-ROMs, material on the Internet, etc.), an Atlas summarizing historical Russian data, which has been prepared in cooperation with AMAP, and reports evaluating experience gained in subjects such as data handling and quality assurance issues, with a view to further development of appropriate procedures to support future assessment needs.

The attention of readers of this report is also drawn to the complementary *Arctic Pollution Issues: A State of the Arctic Environment Report* (AMAP 1997a); the two reports together constitute the product of the AMAP assessment for its first phase of implementation.

Acknowledgment

Editor

Simon J. Wilson

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