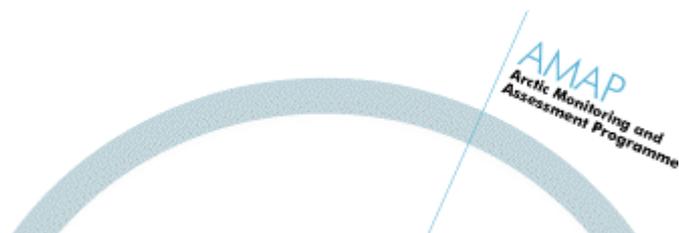


AMAP Trends and Effects Programme: 1998-2003

AMAP Report 99:7



AMAP Trends and Effects Programme: 1998-2003

Preface

In 1991, Ministers of the eight Arctic countries adopted the Arctic Environmental Protection Strategy (AEPS) and, to implement parts of the AEPS, established the Arctic Monitoring and Assessment Programme (AMAP). AMAP was requested to '*examine levels of anthropogenic pollutants ... from any sources ...and to assess their effects in all relevant compartments of the Arctic environment*'.

To meet this request, between 1991 and 1993, AMAP developed a *Monitoring Programme* that focused on the priority contaminant groups and pollution issues identified by the Ministers. The *Monitoring Programme*, covered the atmospheric, marine, freshwater and terrestrial environments, and humans in relation to human health, and was detailed in AMAP Report 93:3 (AMAP, 1993).

The AMAP Monitoring Programme was implemented mainly between 1993 and 1995 and its results provided a significant part of the basis for AMAP's initial assessment of the State of the Arctic Environment in relation to pollution issues. This assessment is documented in two reports: *Arctic Pollution Issues: A State of the Arctic Environment Report* (AMAP, 1997) and *AMAP Assessment Report: Arctic Pollution Issues* (AMAP, 1998). In 1997, the AEPS and its programmes, including AMAP, were reorganized under the responsibility of the newly established Arctic Council (AC).

It is important to note that terms such as monitoring, research, surveys, studies, etc. are understood to mean different things in different countries. Although the word 'monitoring' is included in the title of AMAP, the AMAP assessments, past and future, are based on data and information derived all relevant sources, including the entire range of activities that can be envisaged under the various terms above.

The AMAP assessment was presented to Ministers in June 1997 at a Ministerial Conference in Alta, Norway, and one outcome of this Conference was that Ministers endorsed a continuation of AMAP activities for a further period, including continuation and further development of its monitoring activities to address additional aspects of pollution threats to the Arctic environment (AEPS, 1997). In order to address the updated requests from Ministers, AMAP has reviewed and revised its original Monitoring Programme, the result of which '*The AMAP Trends and Effects Programme*' as described in this document.

The *AMAP Trends and Effects Programme* is the result of a process that involved experts from the Arctic countries, representatives of indigenous peoples organizations, and experts from AMAP observing countries and organizations. Initial work to develop a revised monitoring programme to meet the requirements of AMAP's updated mandate was conducted by experts during 1997 and 1998. The '*AMAP Trends and Effects Programme*' presented in this document summarises the detailed subprogrammes prepared by expert groups dealing with monitoring of Persistent Organic Pollutants (POPs), Heavy Metals, Radioactivity, Climate change and UV effects, Acidification, Human Health, Oil and PAHs, and TBT. It therefore presents the overall *AMAP Trends and Effects Programme* as recommended to the AMAP Working Group by its Assessment Steering Group. The AMAP Working Group have adopted this document as guidance for use, to the greatest extent possible, in the development of National Implementation Plans (NIPs) for AMAP to be implemented during the period 1998-2003 and beyond. The programme is designed to provide the basis for updated AMAP assessments that will be delivered to Ministers during and at the end of this period.

Table of Contents

Preface

Table of Contents

Section A - Background Information

Introduction

Readers guide

How to use this document

Content and arrangement of the document

Basic concepts and definitions

Overall objectives of AMAP and priorities for the period 1998-2003

National implementation plans (NIPs)

Monitoring programme components

Essential and recommended parameters

Circumpolar vs. subregional

Key areas

Monitoring strategy: Temporal vs. spatial trends

Surveys

Methodologies

Section B - AMAP Trend Monitoring Programme

Introduction

Abbreviations and notes employed in the tables

Atmospheric subprogramme (overview)

Marine subprogramme (overview)

Freshwater subprogramme (overview)

Terrestrial subprogramme (overview)

Human health subprogramme (overview)

Section C - AMAP Effects Monitoring Programme

Introduction

Abbreviations and notes employed in the tables

Strategy Considerations

Background

Issues

Ecological Effects Monitoring Programme - Summary Tables

Climate Change effects

UV-B effects

Monitoring effects of contaminants on humans

Rational and issues concerning selection of species

Rational for selection of biological effects techniques

General monitoring strategy for combined effects studies

Section D - Supporting Studies

Supporting Studies

Supporting studies linked to monitoring of contaminant trends and effects

Data and information acquisition relating to 'Sources of Pollution'

Modelling studies to support the AMAP Assessments

Section E - Quality Assurance and Quality Control aspects of the AMAP Trends and Effects Programme

Introduction

QA/QC activities in relation to sampling design

QA/QC activities in relation to field operations and sample handling

QA/QC activities in relation to laboratory operations

QA/QC activities in relation to data handling, analysis and evaluation

Sources of information on QA/QC activities

Section F - Data reporting / Data Policy

AMAP Data Policy

Data Reporting and AMAP Thematic Data Centres (TDCs)

AMAP Project Directory (PD)

Section G - Appendices

References

Trends and Gradients - monitoring strategy considerations - introduction

List of internationally accepted methods and guidelines and references to these

Section A - Background Information

Introduction

The **AMAP Trends and Effects Programme** is a development of the earlier AMAP Monitoring Programme (AMAP Report 93:3). It is designed to provide a basic specification for a programme of activities that can be applied by the eight Arctic countries to ensure the availability of an adequate information base on which to assess the state of the Arctic environment with respect to pollution across the entire circumpolar region.

The revised programme has been optimised with respect to a number of objectives, to provide information for the assessment of both geographical and temporal trends, and the effects of contamination on the Arctic environment and its ecosystems. As such, the programme can be viewed as the set of measurements (of contaminants and related parameters in environmental media, including humans) that Arctic countries hopefully will include in their monitoring and research activities, thus fulfilling their obligations under the Arctic Council's Arctic Environmental Protection Strategy.

The AMAP Trends and Effects Programme is, to the greatest extent possible, built on national monitoring and research activities carried out by the eight Arctic Countries. These activities are designated as the National Implementation Plans (NIPs) for AMAP. Information on NIPs will be compiled in an AMAP Project Directory that will be made available on-line via the AMAP website. In addition, considerable efforts have been made to coordinate the work of AMAP with other relevant activities ongoing under other international organizations, and with activities under bilateral and multilateral cooperations between both the Arctic countries and other nations. These aspects are also reflected in the described programme.

Readers Guide

How to use this document

⇒ This document is intended to be a 'living' document. It will be routinely updated and replacement pages and sections will be distributed at appropriate intervals. To facilitate this process, the most recent version of the document will also be available 'on-line' via the AMAP web site (<http://www.amap.no/>). To ensure access to the most up-to-date material, users are recommended to retrieve this document from the web.

It is distributed as a 'Portable Document Format' (PDF) document, that can be read using the free Adobe Acrobat Reader™ software. Bookmarks and hyperlinks have been created in the PDF document file to allow the document to be quickly navigated by clicking on the desired section headings, etc. To view these bookmarks, select the Acrobat Reader's 'Show Bookmarks' option (available under the main menus or toolbar icons).

If you print the document from the PDF file, select the 'Fit to page' option to ensure that document pagination matches that of the original document.

All readers should refer to Section A (see below) for basic explanations of terms and concepts employed elsewhere. The remaining sections are essentially stand alone documents that can be used for reference. Readers concerned with monitoring of contaminant trends should refer primarily to Section B, and those concerned with effects monitoring should refer primarily to Section C. In both cases, the material of interest will probably be contained in only one (or a limited number) of the sub-sections, for example, sub-sections covering terrestrial monitoring issues, marine monitoring issues, climate effects studies, etc. Material on issues primarily addressed through research initiatives, and modelling and source related issues, is presented in Section D. Where relevant, readers will also need to refer to other sections for, for example, information on recommended methodological and QA/QC issues (Sections E and G), and data reporting issues (Section F).

Content and arrangement of the document

This document is divided into a number of sections:

- **Section A** (this section), provides some general background information, and most importantly includes an explanation of some basic terms and concepts that are used in describing the **AMAP Trends and Effects Programme**.

In the following three sections, the AMAP Trends and Effects Programme is presented according to its three main component parts:

- **Section B** presents the content of the **AMAP Trend Monitoring Programme** in a series of tables summarising five subprogrammes dealing with the atmospheric, marine, freshwater and terrestrial environments, and human health in relation to contaminant monitoring. The AMAP Trend Monitoring Programme is essentially the continuation of the initial (1991-1997) 'AMAP Monitoring Programme' updated and revised to provide improved specification of details of the programme, and to reflect new priorities and the results of the initial assessment work, etc.
- **Section C** outlines the **AMAP Effects Monitoring Programme**, which deals with 'effects' studies. The description of the AMAP Effects Monitoring Programme is arranged according to the three environmental subprogrammes for the terrestrial, freshwater and marine environments; with separate sections concerning effects studies under the Arctic Climate Impact Assessment (ACIA), UV-B effects studies, and studies concerning monitoring the effects of contaminants in humans. Ultimately it will include a sub-section dealing with 'combined effects'.
- **Section D** describes **Supporting Studies**, including research studies that complement the activities covered in the preceding two sections and represent essential additional components to the AMAP Trends and Effects Programme. Supporting Studies should provide detailed information required for the future assessments to allow, for example, valid interpretation of the results of the Monitoring Programme. Together with more routine monitoring components, Supporting Studies form an integral part of the countries National Implementation Plans for AMAP.

Following this overall description of the AMAP Trends and Effects Programme, the remaining sections focus on important associated activities.

- **Section E** covers **Quality Assurance and Quality Control** aspects of the AMAP Trends and Effects Programme. The initial AMAP assessment produced a number of recommendations concerning QA/QC of ongoing and future activities and emphasised the importance of this work as an integral component of the AMAP Trends and Effects Programme.
- **Section F** concerns **Data Reporting** issues. Data reporting is recognized as a vital activity and an integral component of the AMAP Trends and Effects Programme. A main part of this section concerns the AMAP Data Policy - in particular the rules and conditions concerning confidentiality which apply to data reported to AMAP. It also describes procedures for reporting of data to AMAP Thematic Data Centres (TDCs).
- **Section G** includes a series of **Appendices** referred to in preceding sections, the first of which is the list of references for this document, also including references to recommended methodologies.

Basic concepts and definitions

⇒ Please read this section carefully. These terms and concepts defined here are important for a correct understanding the following sections of this document.

Overall objectives of AMAP and priorities for the period 1998-2003

The AMAP Strategic Plan for the period 1998-2003 (AMAP Report 99:6) describes the mandate for the work of AMAP for the period after 1998, as formulated at the Alta Ministerial Conference in June 1997. Under this mandate, Ministers endorsed continuation of AMAP activities for monitoring, data collection, exchange of data on the impacts, and assessment of the effects of the contaminants and their pathways and of increased UV-B radiation due to stratospheric ozone depletion, and climate change on Arctic ecosystems. In addition to the existing priority pollution issues (persistent organic pollutants, heavy metals, radioactivity, acidification, and oil pollution on a subregional basis, UV and climate change effects), the need for special attention to impacts on human health and the effects of multiple stressors is emphasised. The AMAP Strategic Plan also describes the framework for AMAP's future work as part of a programme-based approach to meet the goals and objectives of the Arctic Council, in particular those relating to sustainable development issues.

The overall objective for the future work of AMAP is:

'providing reliable and sufficient information on the status of, and threats to, the Arctic environment, and providing scientific advice on actions to be taken in order to support Arctic governments in their efforts to take remedial and preventive actions relating to contaminants'.

In order to meet this objective, the AMAP Monitoring Programme as developed previously (1991-1993) has been updated to:

- reduce or expand different parts of the programme as necessary to reflect the revised emphasis on certain components;
- reduce or expand different parts of the programme in relation to the results of the initial AMAP assessment (completeness of existing information and identified information gaps, etc.);
- address new components of the work, in particular effects;
- address problems identified during the initial programme in relation to methodologies and QA/QC, etc.

In essence, the **AMAP Trends and Effects Programme** has been designed as the data acquisition component of AMAPs Monitoring and Assessment work; i.e. to provide the information required for the future assessment activities.

National implementation plans (NIPs)

The AMAP Trends and Effects Programme is implemented largely through National Implementation Plans for AMAP. These are activities that are designated by the eight Arctic countries to fulfil their national commitments to AMAP as a component programme of the Arctic Council and Arctic Environmental Protection Strategy. Much of the work of AMAP is concerned with coordination and harmonisation of activities ongoing in the different countries (and also under other national and international programmes). New activities are initiated only where gaps in existing networks are identified.

Monitoring programme components

It is important to note that terms such as monitoring, research, surveys, studies, etc. are understood to mean different things in different countries. Although the word 'monitoring' is included in the title of

AMAP, the AMAP assessments, past and future, are based on data and information derived all relevant sources, including the entire range of activities that can be envisaged under the various terms above.

At present, there is little long-term monitoring being conducted within the Arctic in the traditional sense of the word. Notable exceptions are the ongoing activities at certain atmospheric monitoring sites (Alert, Ny Ålesund, etc.) and some trend studies in Sweden that started in the 1970s. These types of activity are capable of generating the long-time series required for temporal trend assessments. In Russia, the prevailing economic situation has severely cut the Russian Federal monitoring programmes that have been operating for several decades. Thus, much of the 'monitoring' currently being conducted within the Arctic is based on surveys or studies of limited duration (2-3 years), some of which are repeated at intervals. These activities are sponsored by both governmental agencies and research establishments. In particular (biological) effects studies are largely based on work that typically constitutes research activity rather than a traditional monitoring activity.

Monitoring, within the context of this document, should therefore be taken to include any (scientific) activities that are generating data and information that is pertinent to the goals of the AMAP assessment process (see also Section D - Supporting studies).

In the initial AMAP work (1991-1996), the emphasis was on obtaining a sound basis for evaluating the extent of pollution threats in the Arctic in terms of magnitude and geographical patterns. Thus, the programme focussed largely on establishing the spatial distributions of contamination throughout the entire circumpolar Arctic region. For most areas and most priority contaminants the initial AMAP assessment was reasonably successful in establishing the general synoptic patterns of contamination in the Arctic.

In the AMAP Trends and Effects Programme for the period 1998-2003, this type of activity is continued, in particular to fill outstanding gaps in information identified during the initial AMAP assessment activity. However, since the initial assessment provides a reasonably complete pollution status baseline, the future monitoring program is developed to place a greater emphasis on identifying changes in trends, both spatial trends but in particular temporal trends, and on investigating effects of the observed contamination.

The AMAP Trends and Effects Programme for the period 1998-2003 consists of three major types of activity: (i) the trend monitoring programme (ii) the effects monitoring programme, and (iii) supporting studies for assessments.

- *Trend Monitoring Programme*

The trend monitoring programme is defined as long- and short-term, standardized measurements and observations of the environment and its abiotic and biotic components in order to define status and trends (both spatial and temporal).

- *Effects Monitoring Programme*

The effects monitoring programme is designed to detect effects due to single or multiple stressors, where stressors are taken to include both contaminants and relevant environmental factors such as UV-radiation, temperature, etc. Effects on both Arctic flora and fauna, and humans are considered under this part of the programme. In relation to radioactivity assessments, the concept of effects is generally synonymous with the concept of exposure, thus the radioactivity effects monitoring programme essentially aims to monitor environmental or ecosystem exposure to radioactivity.

- *Supporting Studies*

Supporting studies include studies linked to monitoring of contaminant trends and effects, such as surveys (intensive short-term programmes of measurements and observations) or specific research activities (e.g., food-web studies); studies related to acquisition of data and information concerning sources of pollution; and, modelling studies (pathways, transport mechanisms, exposure, etc.).

These studies are intended to provide essential information for interpretation of the basic programme elements or to other assessment needs.

Essential and recommended parameters

In describing both the trend monitoring programme and supporting studies the following terms have been applied when specifying the monitoring media for a particular contaminant or group of contaminants:

- *Essential parameters*

Parameters assigned as Essential (E or ES) represent an '**essential information requirement for assessment purposes**'. The two different sub-categories of Essential Parameters relate to the extent to which this information is essential in a circumpolar context or for specific subregions of the Arctic.

E = essential information requirement for assessment at the circumpolar level. This implies that relevant information is required for all regions of the circumpolar Arctic (i.e., all countries and/or key areas - see below for a definition of 'Key Areas'). In this connection it is recognized that, in some cases (an example being the monitoring of POPs in air in border areas) the monitoring activities of one country may satisfy the basic requirement for adequately covering a particular key area. In such cases, countries may reach bi- or multi-lateral agreements concerning coordination of their respective monitoring efforts to avoid unnecessary duplication of work. There are, however, some instances where monitoring within each country is always appropriate and necessary; an example being human health monitoring.

ES = essential for assessment at a sub-regional level. Some pollution issues (e.g., oil and acidification) are generally only relevant in particular subregions of the Arctic. Essential monitoring at a subregional level (ES) is therefore defined where some relevant regional justification or known local pollution problem exists. ES categorisation is also applied where, for example, the initial AMAP assessment noted an additional information requirement in a particular subregion representing a gap in knowledge. Sub-regional issues can normally be addressed with a more limited type of monitoring activity.

Joint monitoring activities involving several countries may be necessary to provide adequate information for areas outside the national jurisdiction of any one country.

- *Recommended parameters*

Parameters which are **Recommended (R)** should be monitored in the compartments and media proposed wherever possible, and in particular in connection with pollution hotspot areas. It is also important to note that, whilst the emphasis of the programme might be on one particular contaminant, certain methodologies yield information on other parameters at little or no additional cost/effort and these should therefore be included to the greatest extent possible in the monitoring activities.

Circumpolar vs. subregional

AMAP's area of concern is 'the circumpolar Arctic' (see Map 1), and a main feature of previous AMAP assessment work has been to examine the pollution threats to the Arctic environment throughout the circumpolar region. At the same time, certain parts of AMAP's work are specifically identified with problems or issues that are relevant only in specific subregions of the circumpolar Arctic (e.g. oil, acidification). In addition, the practical and logistical constraints of working in the Arctic, the remoteness and the sheer size of the Arctic region, preclude any approach to 'monitoring of the circumpolar Arctic' which implies a high density of monitoring stations with a high frequency of sampling aimed at some sort of 'total coverage'.

In recognizing these limitations, the AMAP Trends and Effects Programme has adopted an approach to 'circumpolar' monitoring that is based on **Key areas** (see definition below) as regions representative of larger parts of the Arctic region. Within these Key areas, the programme aims at applying a reasonably comprehensive monitoring/study effort in which the various component parts of the programme are integrated to the greatest extent possible. To permit efficient use of resources, monitoring of these Key areas can be accomplished either by effort from individual countries or, in

particular in border areas or areas outside of national jurisdiction, by collaborative efforts involving two or more countries.

Subregional monitoring generally applies a more extensive monitoring effort within a limited geographical region to address an identified subregional pollution problem or issue, or to fill an identified geographical 'gap in knowledge'. Again, both individual countries or concerted multilateral activities can be employed in subregional monitoring in order to maximise the AMAP programme implementation. The **Essential subregional** (ES) parameter identification (see definition above) is associated with activities at the subregional level - the subregions concerned for any given part of the programme are identified in lists annexed to, respectively, Sections B and C of this document.

Key areas

Key areas are not a single sampling site or station, but are extended territories that are representative of wider regions of the Arctic. Within these key areas, a number of monitoring, research and other observation activities should be performed, preferably in an integrated manner to maximise the information that can be obtained.

Two types of key areas are defined:

- *background key areas*, which will deliver data on background levels of pollutants, combined effects and ecosystem health, and provide relevant observations to study climate change and UV-B effects;
- *impacted key areas*, which will deliver similar types of data and information, but in areas identified in the initial AMAP Assessments as being affected by one or more types of contamination.

Thus, it is intended that, to the greatest possible extent, all essential components (media, parameters, etc.) of the atmospheric, freshwater, terrestrial and human health subprogrammes, and marine subprogramme where relevant, be monitored in all key areas identified on Map 1, below. To a certain extent, the marine subprogramme represents a special case in relation to key areas, as discussed further in Section B, below.

Monitoring strategy: Temporal vs. spatial trends

The monitoring programme components identified in the following sections include components designed to identify or consider both temporal and spatial trends in contaminants and their.

In relation to aspects such as sampling frequency, it is often necessary to distinguish between those parts of the programme primarily directed towards temporal aspects and those addressing spatial trends. This is not always readily apparent from the programme descriptions as presented in Sections B, C and D, so readers should refer to additional information presented in the detailed programme descriptions in Section G of this document. This section includes remarks concerning the rationale for including specific components (media, parameters, etc.) within the AMAP Trends and Effects Programme, and/or recommendations concerning the time of sampling or sampling frequency, etc.

- *Spatial trend studies*

Monitoring to establish spatial trends (geographical distributions) in contaminant levels was the main objective of the initial AMAP monitoring programme and AMAP assessment work between 1991 and 1996 (AMAP, 1998). The logistical constraints of monitoring in the Arctic, together with the vastness of the region, mean that spatial trends on a circumpolar scale can be addressed in qualitative terms (e.g. identification of areas with relatively elevated concentrations). The main purpose of this type of circumpolar study is to establish a 'background' contamination status against which to make future comparisons, and to identify areas where levels of environmental contamination may be a matter for concern or potential concern, possibly warranting additional more detailed study. Only within limited subregional studies is it generally feasible to introduce concepts such as the statistical significance of the observed spatial trends.

During the earlier work of AMAP, considerable progress was made at establishing the 'background' contamination status of the Arctic. However, a number of 'gaps' in basic geographical coverage were documented. Monitoring to fill these gaps in geographical coverage on the circumpolar scale remains the main reason for activities under the AMAP Trends and Effects Programme that are aimed at establishing spatial trends.

- *Temporal trend studies*

It is important to recognize that monitoring effort aimed at establishing spatial trends, even if repeated at some interval (such as every 5 years) is unlikely to have sufficient 'power' to detect temporal trends (see example in Section E, Appendix 3). Temporal trend data can however, generally be used to supplement other data in spatial trend studies. All trend monitoring programmes should be subjected to statistical analysis to determine their power to detect trends, and to allow the programmes to be optimised to maximise their power to detect trends.

Temporal trend monitoring components typically involve one of two main types of approach:

Repeated sampling strategy: whereby consistent sampling is repeated at a specific location at appropriate intervals (typically, e.g., annual sampling of biota, daily or weekly sampling of air/aerosol, etc.). Under such approaches, information on a number of potential cofactors is also necessary for use in data interpretation. Alternatively, these cofactors may be taken into account in the sampling strategy itself in order to restrict sources of natural variability (limiting sampling to a particular sex or size/age of animal, etc.).

Retrospective temporal trend studies: this refers to activities that involve, e.g., sampling and analysis of environmental media that are capable of revealing the historical record of concentrations of contaminants (e.g., ice cores, sediment cores, peat cores, etc.). A reliable method of dating the historical record is necessary, such as knowledge of sediment accumulation rates, dating using radioisotopes, etc.

A third approach is, to some extent, a combination of repeated sampling and retrospective studies, namely the **analysis of banked specimen samples**, including non-destructive analysis of museum sample collections.

It is essential that one or more of these elements are included in the programmes at key areas in order to obtain time series of contaminant levels.

The AMAP assessments are strongly linked to ongoing international efforts aimed at reducing environmental contamination of the Arctic. A main goal of the temporal trend assessments under AMAP is, therefore, to evaluate the effectiveness of measures that are introduced to reduce emissions and discharges of contaminants; i.e. to see if implementation of these measures has the desired effect of reducing levels of contamination in the Arctic..

Surveys

Surveys include both **one-time surveys** (intensive short-term observation campaigns), that are one of the types of supporting study that are discussed in Section D of this document, and **repeated surveys**, for example surveys repeated at some time interval to study temporal trends, which are considered a type of monitoring activity.

Surveys (intensive short-term observation campaigns) should be used to supplement data acquisition programme where:

- the initial AMAP assessment identified a gap in knowledge about a certain pollution issue, either in the circumpolar context, or in some area where this issue may be significant;
- the initial AMAP assessment identified an anomalous situation in a specific geographical area that cannot be explained on the basis of available information.

If a new issue of concern is raised, a survey, preferably on a circumpolar scale, may be an appropriate approach to acquiring the information needed to make a sounder evaluation of the magnitude and

scope of a potential problem. One example might be a screening study to investigate new substances of environmental concern such as current use pesticides.

All survey programmes should be designed so as to specify:

- the objectives of the survey;
- the geographical area covered by the survey;
- the time frame for the survey;
- component activities of the survey;
- logistic facilities available/needed for surveys.

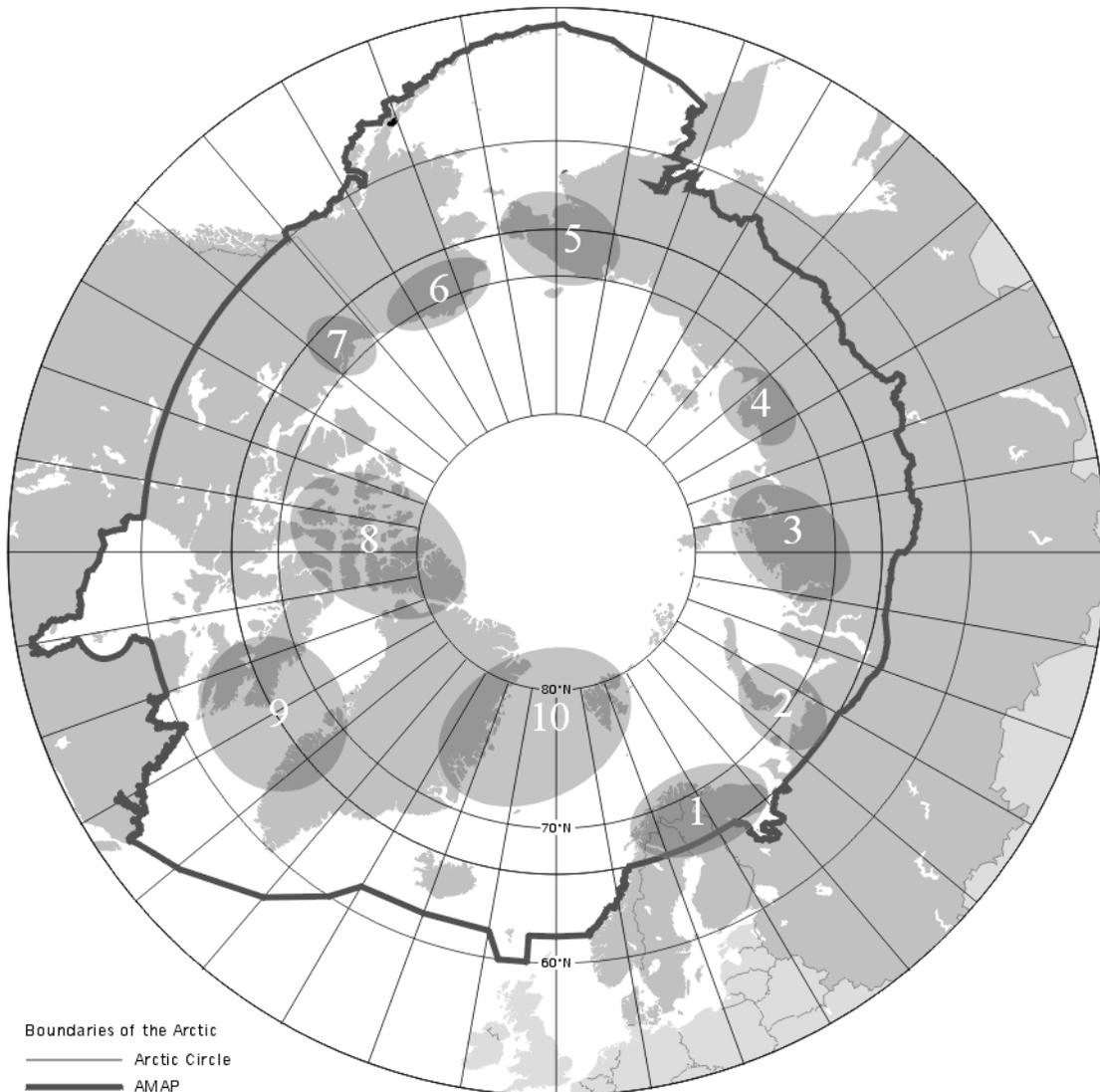
Methodologies

The AMAP Trends and Effects Programme, with a few exceptions, does not prescribe in detail the methods that should be applied in sample collection, pretreatment or analysis. Rather it lists recommendations and references to internationally accepted methods and guidelines, including those developed under AMAP. Participating laboratories and organizations should consider these recommendations and select methodologies appropriate to their circumstances; in some cases methods may need to be adjusted to make them suitable for application under Arctic conditions. In areas where no international guidelines or recommendations exist, the participants should try to agree on common and/or comparable methods based on existing experience within the group of participants involved.

Harmonisation between AMAP and other international programmes with respect to methodologies, etc. is an ongoing goal. This applies not only to sampling and analytical methods, etc. but also to methods employed in QA/QC work, data reporting and techniques employed in data analysis and interpretation.

Lists of references to internationally accepted methods and guidelines are given in Section G.

Map 1: The geographical coverage of AMAP, and designated key areas.



- 1 - Northern Fennoscandian and Kola peninsula area**
- 2 - Mouth of Pechora river, Novaya Zemlya, Kara and Pechora Sea area**
- 3 - Norilsk, Taimyr peninsula area**
- 4 - Mouth of Lena river**
- 5 - Chukotsky peninsula**
- 6 - Northern Alaska, North Slope area**
- 7 - Lower Mackenzie river and delta area**
- 8 - Canadian Arctic Islands and Arctic Archipelego**
- 9 - West Greenland, Baffin Island area**
- 10 - Svalbard, East Greenland area**