AMAP

Swedish National Implementation Plan – *March 2004*

Trend monitoring programme

1. Fresh Water ecosystems

The overall objective of the Swedish national monitoring of fresh water is to describe the state and changes in the environment. In addition to the national program fresh water monitoring is also performed on a regional level by the county administrative boards.

Annual measurements of physical and chemical parameters are taken in about 80 lakes spread over the whole country. Fish samples are also taken in some of these lakes to monitor fish stocks. This is done to monitor large-scale trends and impact. Swedish reference lakes are measured yearly to give a representative picture of the status situation in Sweden. Localities and parameters are selected to be representative and statistical relevant. Fish and bentic macroinverterbrates are measured together with several chemical supportative indicators.

In a small number of lakes and watercourses throughout the country, **a larger number of biological and chemical parameters** are measured. Fish sampling is carried out to monitor fish stocks. The aim is to measure normal fluctuations over the year to complement the other annual measurements.

In 18 lakes, fish are caught and stored in a specimen bank. Annualy some of these fishes are analyzed on the concentrations of metals and hazardous substances are measured.

Annual measurements of biological and chemical parameters are carried out in 50 large and 50 small rivers. The 50 large rivers reflect 85 % of the swedish surface runoff. In these rivers concentrations of metals in water are measured in about 20 river mouths in order to estimate the transport of metals to the sea. The aim is to provide a basis for load estimates and enable pollution sources to be traced. Another 30 or so river mouths are analysed regarding ”general chemistry”.

The groundwater chemistry is measured at more than 100 sites in each of the geological areas in Sweden distributed to represent our different groundwater aquifers. Some 35 different types are recorded in Sweden. Samples are taken four times per year. The objective is to achieve a countrywide picture of the status of Swedish groundwater, with special emphasis on heavy metals, eutrophication and acidification.

A nationwide inventory of lakes and watercourses is carried out every sixth year (next time 2006). This is a general monitoring programme and acts as a complement to time series in lakes and watercourses to provide background data. Chemical parameters are measured in over 3000 lakes and 1500 watercourses spread over the whole country. Biological

measurements are also measured in about 750 lakes and 700 watercourses in order to provide a nationwide picture of the state of the environment in Sweden.

The Environmental Specimen Bank - the ESB - is an essential part of the monitoring of contaminants in the Swedish environment and fauna. The ESB at the Swedish Museum of Natural History collaborates with other national specimen banks to set and follow international standards. Coordination of ESB in the Nordic countries has been carried out under the authority of the Nordic Council of Ministers. In Swedish contaminant monitoring, the ESB prepares and stores all samples that are collected annually from sites in the terrestrial, freshwater, coastal and marine monitoring programs. The ESB also stores older samples of animal tissues and organs from different research projects that have studied the environmental effects of noxious substances. This homogeneous and continuous series of samples is also used for retrospective chemical analysis to detect the levels of new or recently discovered contaminants.

Media	**Parameters**	**Frequence**	**Location of sampling within AMAP area**
Lake water (3 levels)	O_2, Temperature, pH, conductivity, NH_4, NO_2-NO_3, total nitrogen, total phosphorus, PO_4-P, TOC, Si, Absorbance, Fe, Mn, Al, Ca, Mg, K, Na, alkalinity, SO_4, Cl, F	8 times per year	Abiskojaure (Main river system: Torne Älv) High mountain region of Lappland
Lake water (1 level)	Al, Ca, Mg, K, Na, alkalinity, SO_4, Cl, F, chlorofyll, transparancy	8 times per year	Abiskojaure
Lake water (1 level)	Cu, Zn, Cd, Pb, Cr, Ni, Co, As, V	2 times per year	Abiskojaure
Arctic char (muscle: POP and Hg, liver: metals) Start: 1981	PCB (7 congenes), HCH (a- and lindane), HCB, sDDT, Hg, Pb, Cd, Ni, Cr, Cu, Zn, PBDE	1 time per year (metals) occasionally (POP's)	Abiskojaure
Lake water	Temperature, pH, conductivity, NH_4, NO_2-NO_3, total nitrogen, total phosphorus, PO_4-P, TOC, Si, Absorbance, Fe, Mn, Al, Ca, Mg, K, Na, alkalinity, SO_4, Cl, F, chlorofyll, transparency, acidity, oxygen	4 times per year	Louvvajaure and Pahajärvi + Abiskojaure, Njalakjaure, Latnajaure
Groundwater	Temp, Ph, EC, NO2+NO3, NH4, tot N, tot P, PO4, TOC, Si, Mn, Fe, Al, Ca, Mg, Na, F, SO4, Cl, Alk/anc Cu, Zn, Cd, Pb, Cr, Ni, Co, As, V	2-4 times per year	Nattavaara, Abisko, Svappavaara and Pålkem
Watercourses	Chemistry (Temperature, pH, conductivity, NH_4, NO_2-NO_3, total nitrogen, total phosphorus, PO_4-P, TOC, Si, Absorbance, Fe, Mn, Al, Ca, Mg, K, Na, alkalinity, SO_4, Cl, F) Electro fishing		Alep Uttjajåkka, Lansån, Muddusälven, Kaitumälven, Abiskojokk, Pessisjåkka Alep Uttjajåkka, Muddusälven, Pessisjåkka

2. Atmosphere

The objectives of the national monitoring programmes are

- - to follow and describe the state of air and precipitation quality and identify the changes caused by human activities;
- - to provide a basis for identifying and assessing environmental threats from local to the global level and idntify the sources of pollutants, internationally and nationally;
- - to provide a basis for actions designed to ensure a sustainable development of society;
- - to follow up the effects of measurements and actions that are introduced by central agencies and regional and local authorities

The national programme is more directly designed to satisfy the monitoring within international agreements and conventions, for example AMAP.

Due to EU directives the air monitoring of groundlevel ozone, benzaphyrene and metals within the Swedish AMAP area will probably improve (more stations) in the nearest years to come.

Media	**Parameters**	**Frequence**	**Location of sampling within AMAP area**
Air/aerosol	Ozone	Continuously	Esrange
Air/aerosol	SO_2-S (gas), NO_2-N (gas), ozone	Monthly	Pålkem
Bulk precipitation	Wet deposition, pH, H^+, Cl, NO_3-N, SO_4-S, ExSO_4-S, NH_4-N, Ca, Mg, Na, K	Monthly	Abisko, Esrange, Ammarnäs, Pålkem, Reivo,
Bulk precipitation and air/aerosol	12 PAHs, 7 PCBs, 3 DDTs, 3 Chlordanes, 2 HCHs, HCB, PBDE	1 week/month	Pallas
Air/aerosol	Hg (g), Hg (p), As, Cd, Ni	Monthly	Pallas
Bulk precipitation	As, Cd, Co, Cr, Cu, Ni, Pb, Zn, Mn, V, Hg tot, methylic Hg	Monthly	Pallas
Mosses	As, Cd, Cr, Cu, Fe, Pb, Ni, V, Zn, Hg	Every 5^{th}-10th year	Several locations in Northern Sweden (Approximatly 600 samples alla over Sweden)
Air/aerosol	CO_2, particle concentration, soot, light dispersion capacity, MSA (methane sulphonate), NO_3, SO_4, Cl, Na, NH_4 and K	Daily Continuous (CO_2)	Ny-Ålesund, Svalbard
Air/aerosol	NO_3, NH_4, HNO_3, SO_2, SO_4, Na, K, Ca, Mg	Monthly	Katterjåkk, Tjärnberg
Bulk precipitation	pH, SO_4, Cl, NO_3, NH_4, Ca, Mg, Na, K	Monthly	Katterjåkk, Tjärnberg
Deposition (throughfall studies)	pH, SO_4, Cl, NO_3, NH_4, tot-N, Ca, Mg, Na, K, Mn	Monthly	Katterjåkk, Tjärnberg, Myrberg
Stratospheric ozone	Total column ozone	Continuous	One station (Vindeln) represents northern Sweden (incl AMAP area) even though it's located south of the north pole.
Screening of "new" substances	For example: Triclosan, tetrabromobisphenol A (TBBPA), pentachlorophenol (PCP), hexabromocyclododecane (HBCD), antioxidants, methyl phenols, alkyl phenols		In the national screening programme several new substances are studied every year. Often air samples from Pallas represent background levels.

3. Terresterial ecosystems

The aim of this monitoring is to obtain an overall picture of how levels of toxic substances in the environment are changing over time.

Media	Parameters	Frequence	Location of sampling within AMAP area
Reindeer (liver: metals, muscle: Hg) Start: 1981	Al, Ca, Cd, Co, Cr, Cu, Fe, Mg, Mn, Mo, Ni, Pb, V, Zn, Hg (POP's were monitored during 1981-1995)	1 time per year	Abisko area

Effects Media and Parameters

Media	Parameters	Frequence	Location of sampling within AMAP area
Forest (Acidification)	Defoliation, Discoloration, Easily identifiable damage, Foliar analyses, Ground vegetation, Increment	Every 10th year	systematic sample grid
The National Inventory of Landscapes in Sweden (NILS)	Desired information from NILS: For example: - effects of reindeer husbandary - climate change - occurance of certain species	The mapping and field visits will be done in a turnaround fashion, with a fifth of the squares monitored each year, and each square revisited after 5 years.	
Swedish National Bird Monitoring Program	Population trends	Every year	
Monitoring of small mammals (voles and lemmings)	Population trends	Every year	Stora sjöfallet

The Nesting Bird Inventory organises monitoring of nesting birds, and also non-migratory birds during wintertime, mostly on a voluntary basis. The method is based on point counts, but a new scheme combining point counts and line transects is gradually introduced. In total, around 1000 routes are visited annually for nesting bird counting, while another 350-400 routes are visited 1-5 times pr year for winter counts of non-migratory birds.

The National Inventory of Landscapes in Sweden (NILS). The aim of the sub-program is to collect information on the state of the environment on a more detailed level than what is possible in the preceding sub-program. A random (systematic) sample of 600 square plots (5x5 sqkm) will be mapped using infrared false colour air photos, and subsequently visited in the field to check the mapping and make additional data collection on landscape structure, land use and biodiversity. The first round of air photos were taken in 2002. Field work began in 2003. NILS comprises inventories of:

- landscape composition,

- biodiversity,
- aspects of cultural heritage,
- Natura 2000 biotopes.

The National Survey of Forest, Soil and Vegetation
The inventory gathers basic information on forests, soils and vegetation. It includes most aspects concerning soils, for example: soil types, soil chemistry including organic matter, water conditions and content of stones and boulders. Acidification, nitrogen deposition and the contribution by soils to climate change are some of the current issues dealt with. Within the framework for the National Survey of Forest, Soil and Vegetation, soil, soil chemistry and vegetation are mapped on about 23,500 sampling sites that have been objectively chosen spread over the whole country. One tenth of these sampling sites are visited each year. These sites were chosen between 1983 and 1987 and the first reinventory was started in 1993 and ended 2002. These sites are also included in the National Forest Inventory's mapping of the Swedish forest stocks.

A new reinventory started in 2003. It will put stronger emphasis on monitoring of the carbon balance.

The moments included in SK are in brief overview:

1. A general site description of the area closely surrounding the plot, including e.g. general hydrological conditions, typical soil depth etc.

2. A description of soil types and soil horizons.

3. Sampling of organic and mineral soil horizons for subsequent chemical analyses.

4. A description of vegetation, with emphasis on non-timber aspects.

5. Inventory of pendulous lichens and algal growth on spruce needles.

4. Radioactivity

Radiological protection has traditionally focused on protecting human beings. The ambition today is to expand radiological protection to comprise the environment. In Sweden the responsible authority SSI (Swedish Radiation Protection Authority) has initiated a national environmental protection programme for radioactive substances, in consonance with the national environmental monitoring programme of the Swedish EPA. In parallel with this work, a database is being assembled for various radioactive substances that can be detected in human beings and in the environment. Data on radionuclides in the environment has never before been collected in a common database, even though vast amounts of data exist.

Media	**Parameters**	**Frequency**	**Location of sampling**	**Programme and/or responsible institute**
Terrestrial (Sampling of the surrounding soil)	Gammanuclides	continuous	Riksgränsen (Katterjåkk), Kiruna, Pajala, Jokkmokk (Tjåmotis)	SSI
Atmospheric (air/aerosol)	Gammanuclides	A network of radionuclide sampling stations, is operating continuously. Filters from these stations are measured on a weekly basis.	Kiruna	FOA
Milk	90-Sr, 137-Cs	4 times per year	Hedenäset	SSI

5. Human health

The objective behind a health-related environmental monitoring programme is to measure and estimate human exposure to substances that are hazardous to health. This can be effected partly by carrying out measurements of metal concentrations in different body fluids such as blood, or by carrying out measurements in the environment (e.g. in the air, in biological material, crops etc.).

Exposure through the air
Exposure to volatile organic substances. Personal measurements and measurements in background air in urban areas. Alternating measurements in four cities: Göteborg, Stockholm, Lund/Malmö, Umeå. Estimation of the number of persons exposed to high noise. Carried out every fifth year. Estimations of the number of persons exposed to high levels of NO2. Carried out every fifth year.

Exposure through food
Measurements of organic pollutants in mothers milk are carried out at regular intervals. The National Food Administration is carrying out this task.
An estimation of the intake of pollutants via food is also carried out regularly. The most recent one concerned brominated flame retardants.

Human exposure to metals and organic pollutants
Several studies that have as their aim to measure metal and organic pollutant concentrations in blood and/or other body fluids are being supported. These include f.ex.
* measurements of metals in the blood of pregnant women.
* exposure to mercury
* exposure to cadmium
* exposure to organic pollutants

Allergic responses
The connection between air pollutants and different types of allergies and other inconveniences are followed.

Specimen banking
A human biology specimen bank to be used for storing human samples is being compiled at Umeå University.