Statistics Norway
Department of Economic Statistics

Documents

Nordic Environmental Indicators

Draft document
English version with main points from comments received

Prepared for the Nordic Environmental Monitoring and Data Group by the Nordic Indicator Group

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PREFACE

As from 1994, the state of the environment in the Nordic countries is to be reported annually by means of *environmental indicators*. This has been established in "*Den nordiske miljøstrategi*" (The Nordic Environmental Strategy), signed by the Nordic Ministers of the Environment. It is stated in this document that:

"A set of environmental indicators ("key data set") shall be selected and defined, which can be used to demonstrate the relationship between society's pressures on nature and the environment and the effects of these pressures. Once every year the results shall be described in the form of a report on environmental indicators, directed primarily at decision-makers, with a view to evaluating changes in the quality of the environment in the Nordic countries".

The preparation of this report is the responsibility of the *Nordic Environmental Monitoring and Data Group* (Nordisk miljøovervåkings- og datagruppe - NMD). NMD, on its part, has appointed a project group, the *Nordic Indicator Group* (NIG), to help with the development of environmental indicators in general, but to also be responsible for the actual production of the report on the state of the environment in the Nordic countries, presented by means of indicators. The objective of this work is to arrive at a form of reporting where the same sets of data (indicators) are reported from year to year, to make it possible to follow changes in the state of the environment over time.

NIG prepared a document (see appendix III) in which suggestions for indicators for the different issues were specified. The actual work of collecting and collocating the data was delegated to an editorial committee.

We have been dependent on contributions from several institutions in the Nordic countries during preparation of this report. We should like to thank these institutions and their staff for their effort. The sources of data are documented in the report, both in connection with the presentation of the indicators and in a special appendix after each chapter, which contains supplementary comments.

The members of the editorial committee were:

Frode Brunvoll	Statistics Norway, editor in chief
Ola K. Hunnes	Statistics Norway, national editor, Norway
Bo Chytraeus	Statistics Sweden, national editor, Sweden
Bernt Röndell	National Environment Protection Agency, national editor, Sweden
Edda Hermannsdóttir	The Statistical Bureau of Iceland, national editor, Iceland
Leena Kopperoinen	Finnish Environment Agency (previously National Board of Waters and the Environment) national editor, Finland
John Holten-Andersen	Environmental Surveys of Denmark, national editor, Denmark

This document is a draft report, prepared for distribution to institutions in the Nordic countries for comments. The document has not been officially approved by the Nordic Council of Ministers. The main general conclusions of the comments, and the main conclusions about the individual indicators, are contained in appendix V.

CONTENTS

INTRODUCTION

The interest for sustainable development and the general concern about threats to the environment has drawn attention to how the countries are dealing with environmental problems. Ideally speaking, systems designed to measure wear on the environment and tapping of natural resources in terms of value and of physical units, will show the impacts of human activities on the environment. It can be difficult, however, to place a value on or measure these conditions in a uniform way. Therefore, environmental indicators have received increasing attention as an aid in quantifying changes in the state of the environment, and as a means of identifying and giving priority to important environmental issues. Another important aspect of environmental indicators is their usefulness for evaluating the state of the environment, and pressures on the environment, in relation to national goals and international requirements.

A preliminary core set of environmental indicators, intended among other things as a tool for evaluating the environmental policies and measures of the OECD countries (Environmental performance reviews) has recently been published in *Environmental Indicators OECD Core Set* (OECD, 1994). **The Nordic set of environmental indicators** described in this report is based mainly on this core set. The issues Water Resources and Soil Degradation are not included, since these are not regarded as representing important environmental or resource problems in the Nordic countries.

An environmental indicator is defined as: *A parameter, or a value derived from parameters, which provides information on the state of the environment with a significance extending beyond that obtained directly from the measured properties (parameters) on which it is based.* The purpose of such environmental indicators is to provide a simplified presentation of the state of the environment, in order to reduce the number of data measured and the parameters normally needed to provide a good picture of the existing situation.

The environmental indicators used in this report can be referred to different parts of a cause-effect chain, and described as the **Pressure-State-Response (PSR)** concept. Human activities exert **pressure** on the environment in different ways through emissions and activities, and this is reflected in changes in the quality and quantity of natural resources (**state**). The third step of the PSR-chain is society's **response** in order to prevent these changes, or repair environmental damage. The main conclusions from OECD's work are to be found in an appendix at the end of this report.

The quality of an indicator is always limited by its availability and by the quality of the underlying data. Even for the Nordic countries, there are often large differences between definitions, classifications and methods of measurement. This implies that caution must be exercised when comparing the sets of data obtained in the different countries. In order to improve this situation it is important to continue the efforts to increase comparability by using commonly recognized definitions and methods of measurement.

In an official report on Nordic environmental indicators it is necessary to decide, whenever possible, if the indicators are to be expressed as indices (that is to say, a base year is chosen and is defined as 1) or - as in this preliminary report - in different units of measurement. The first alternative has been used to a large extent in OECD's report on indicators, 1994, which also presents key figures for the last year of a time series. These may be per capita, per unit GDP, etc. It is also necessary to consider whether the trend values should be accompanied by more tables. An example of an alternative organization of the data is shown in an appendix to this preliminary report.

This preliminary report has been prepared on the basis of a list of indicators defined by the Nordic Indicator Group. The editorial committee has changed some of the proposed indicators, partly as a consequence of comments received from scientists during collection of the data, partly because no data were available for the indicators originally proposed. In the case of some of the proposed indicators, we have been content to point out that data or statistics are not available. Whenever possible, the idea has been to present a "Nordic indicator", that is to say, an indicator showing the trend at Nordic level. The fact that such Nordic indicators have not been prepared in this report in all cases can be put down to the problems of standardization and lack of data discussed below.

For each of the 11 issues covered by this set of environmental indicators, comments have been prepared which are presented at the end of the discussion of each issue in the form of *Notes on the individual indicators*. These notes provide information on limitations, definitions, sources, proposals for other indicators and general comments.

To the extent that this has been possible during the project period, the editorial committee has tried to standardize the series of data for the different indicators. However, much work remains in this connection, which will have to be carried out in connection with the preparation of the first official Nordic report on environmental indicators. This work of standardization refers both to different definitions and classifications (as, for example, differences in the classification of municipal waste under *9. Waste*, and different methods of calculating net input of nitrogen and phosphorus under *3. Eutrophication*, to delimitations (as, for example, capitals/the capital regions in *6. Urban environmental quality*) and to the length of time series (as, for example, CO_2-emissions under *1. Climate change*). We are therefore aware of the weaknesses associated with some of the data series presented here, and that this situation must be improved. We have not done too much work in this connection, however, because after comments have been received from the parties concerned, the indicators may - and probably will be - changed. Whatever the case, the review has been useful, since it has shown us where the problems occur and where improvements must be made. The editorial committee also points out that more work must be put into the wording, both of the general texts and the accounts of trends in the different countries. The latter especially need to be more "standardized", so that the same main points are discussed for all countries, in addition to issues that are of particular importance for the individual countries.

1. CLIMATE CHANGE

The chemical composition of the atmosphere determines how much of the long-wave radiation from the surface of the earth is released through the atmosphere. Gases such as water vapour, carbon dioxide, methane, nitrous oxide (N_2O), tropospheric ozone and fluorinated gases absorb the radiation from the earth and contribute to a rise in temperature. Except for water vapour, carbon dioxide is the most important in this respect, and anthropogenic emissions of this gas originate mainly from combustion of fossil fuels.

The greenhouse effect of the atmosphere is an important prerequisite for life on Earth as we know it. Without this effect the mean temperature on Earth would have been -18 °C and not +15 °C as now.

Before the industrial revolution, the atmospheric concentration of carbon dioxide was about 280 ppm. In recent years this level has increased to about 350 ppm, with an annual increase of about 0.5 per cent.

With an increasing concentration of greenhouse gases in the atmosphere, a larger proportion of the heat radiated from the earth will be retained. This could result in a warmer climate, changes in precipitation patterns and wind systems, a displacement of climate zones and a rise in sea level.

There is much uncertainty about the effect of a rise in temperature, but the impacts on the world's agricultural production and ecosystems, for example, and flooding as a result of a rise in sea level, could be considerable.

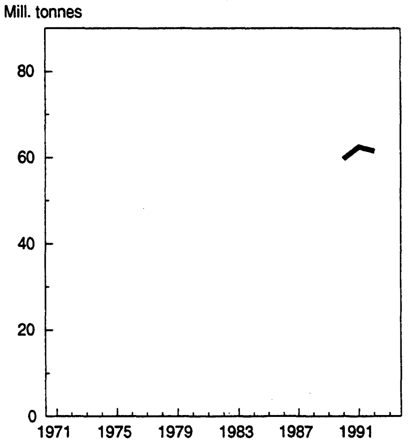
Pressure

Emissions of carbon dioxide

Carbon dioxide (CO_2) is the most important of the so-called greenhouse gases. Many of the other greenhouse gases absorb the heat radiated from the earth much more effectively than CO_2 does, but the emissions of these gases are much smaller than for CO_2, and the concentration in the atmosphere is lower. In the natural carbon cycle, about 200 billion tonnes of carbon are exchanged every year between the atmosphere and vegetation-soil-oceans through the processes of respiration, photosynthesis and chemical diffusion. The total anthropogenic emissions from combustion of fossil fuels, which were estimated to about 6 billion tonnes of carbon in 1990, are relatively small compared with this natural exchange, but can nevertheless influence the climate.

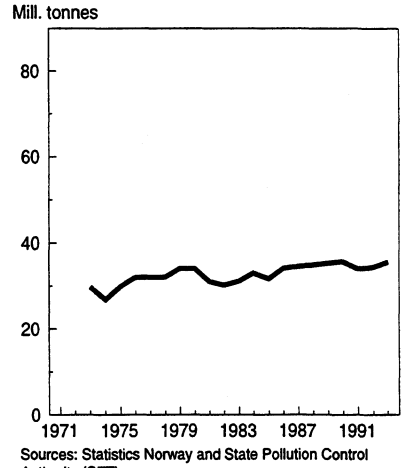
Emissions of CO_2 are not dependent on combustion conditions or cleaning methods - only on the consumption of the energy source. CO_2-emissions from combustion of wood and other bio-fuels are not included in the emission inventories. This is because bio-fuels are renewable resources as long as the use of these fuels is sustainable.

Emissions of CO2. Denmark. 1990-1992



Source: RISØ, Systems Analysis Department

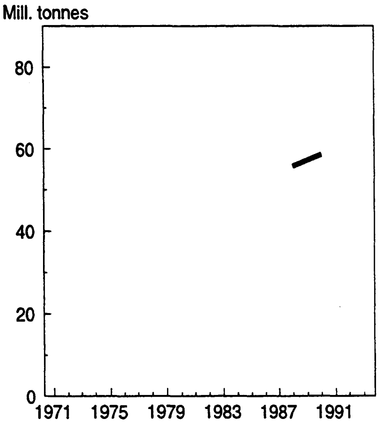
Emissions of CO2. Norway. 1973-1993



Sources: Statistics Norway and State Pollution Control Authority (SFT)

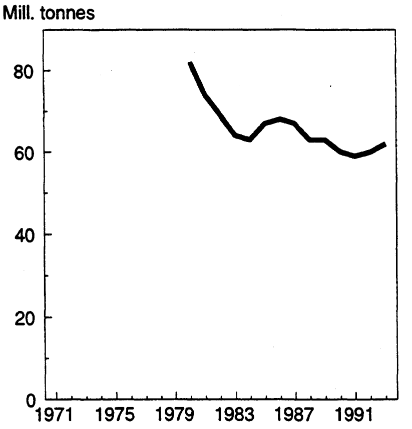
The decrease in CO_2-emissions in 1973-74, 1980-82 and 1990-91 coincides with a rise in oil prices. The decrease in 1990-91 was also due to a general recession in the economy. The emissions from oil-related activities - which are currently the largest source of emissions and account for 29 % of the total emissions - have increased considerably.

Emissions of CO2. Finland. 1988 and 1990



Source: Consulting company Prosessikemia Ky

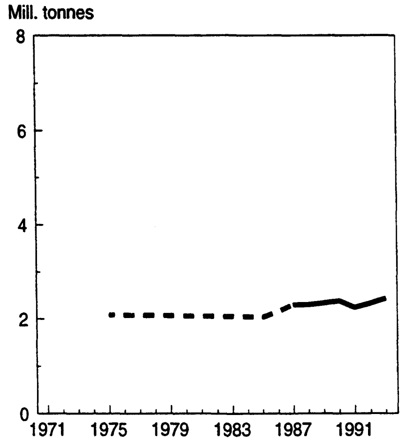
Emissions of CO2. Sweden. 1980-1993



Source: National Environment Protection Agency

Carbon dioxide emissions have decreased by about 30 % in Sweden since 1980. The main reasons are energy-saving, development of nuclear power and a decrease in the share of oil as a source of energy in the energy sectors.

Emissions of CO2. Iceland. 1975-1993



Source: Environment and Food Agency of Iceland

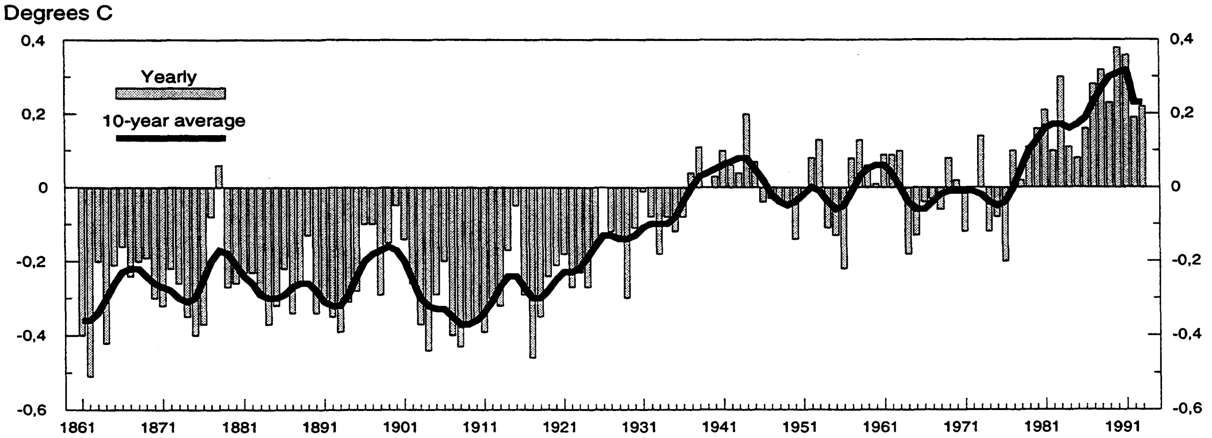
The main reason for the increase in emissions in Iceland is increased emissions from mobile sources - road traffic and shipping, especially the fishing fleet.

State

Global mean temperature

The global mean temperature has increased by 0.3-0.6 °C in the course of the last 100 years. The observed rise in temperature coincides to all intents and purposes with the calculated increases in temperature based on models. The increase is no greater, however, than that it may have been caused by natural variations. The years 1990 and 1991 had the highest global mean temperatures observed since 1861, and seven of the warmest years since 1861 were observed during the period 1983-1993.

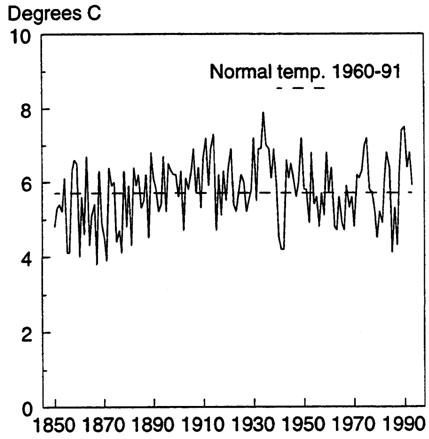
Changes in global mean temperature for the period 1861-1993 in relation to the normal value for the period 1951-1980



Source: P.D. Jones, University of East Anglia

Annual mean temperatures in the Nordic capitals

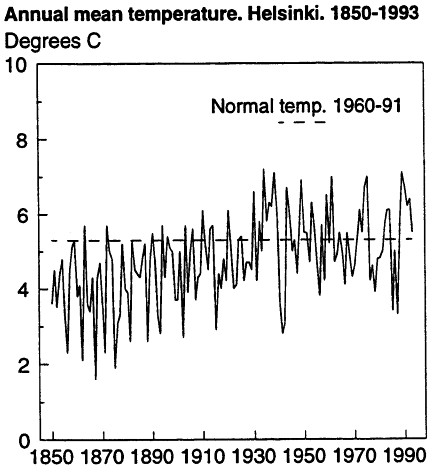
Annual mean temperature. Oslo. 1850-1993



Source: Norwegian Meteorological Institute

The annual mean temperature in Oslo shows no trend that might indicate climate change.

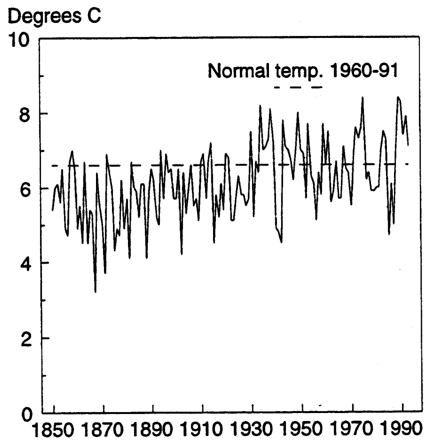
Annual mean temperature. Helsinki. 1850-1993



Source: Finnish Meteorological Institute

The temperature in Helsinki seems to have risen by almost 1 °C in the last century. The increase in temperature is visible even when corrected for the warming effect of a higher concentration of buildings. There is no justification for asserting, however, that the increase is a result of a stronger greenhouse effect as a result of anthropogenic emissions.

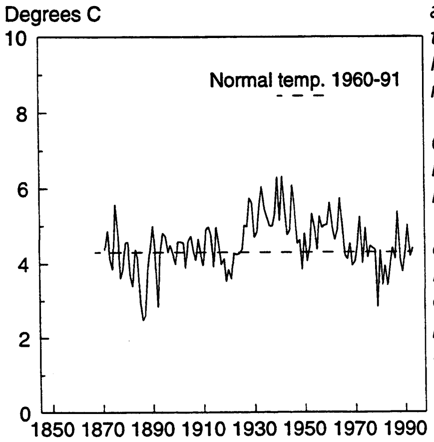
Annual mean temperature. Stockholm. 1850-1993



Source: Swedish Meteorological and Hydrological Institute

The annual mean temperature in Stockholm has risen in relation to the normal temperature. However, as for Helsinki, there is no justification for connecting this with a stronger greenhouse effect owing to anthropogenic emissions.

Annual mean temperature. Reykjavik. 1871-1993



Source: Meteorological Office of Iceland

The highest annual mean temperature in Reykjavik was recorded in 1941 and was 6.3 °C. The lowest is 2.5 °C, recorded in 1886. Temperatures were relatively high during the period 1926-46. During the 1980s, relatively low annual mean temperatures were recorded in Reykjavik.

Response

Changes in the use of fossil fuels

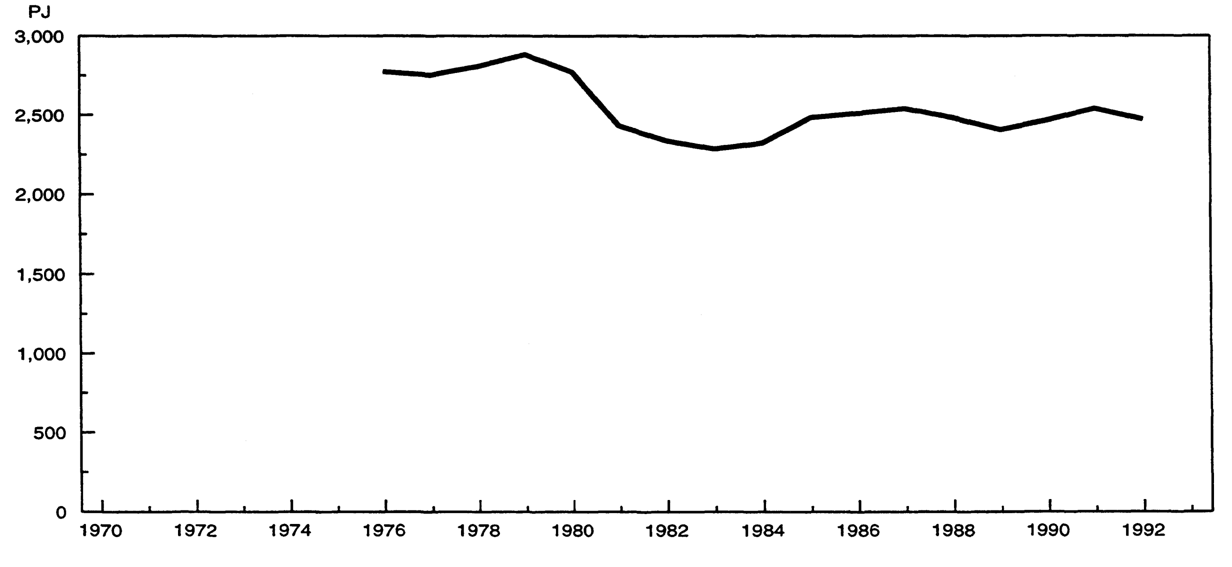
Measures to counteract possible climate change are a global task. In the UN Convention on Climate Change, all industrialized countries undertake to make an effort to reduce anthropogenic emissions of greenhouse gases and to simultaneously preserve the sinks of greenhouse gases (e.g. forests).

The main Norwegian goal is that, from the year 2000 onwards, emissions of carbon dioxide (CO_2) shall not exceed the level in 1989. The goal is the same in Iceland and Sweden, except that the base year is 1990. In Denmark, the national objective is to reduce CO_2-emissions from the total energy and transport sector by 20 per cent in relation to 1988 by the year 2005. Finland has no national objective other than what the country is committed to through the UN Convention on Climate Change.

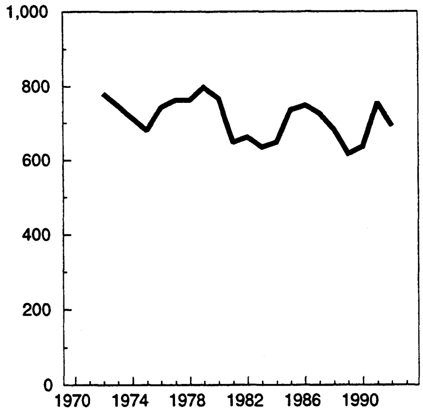
Most of the anthropogenic emissions of CO_2 originate from combustion of fossil fuels. Except for Iceland, the Nordic countries - Denmark (from 1992), Norway (from 1991), Finland (from 1990) and Sweden (from 1991) - have imposed a special CO_2-tax on fossil fuels as a measure to stabilize or reduce consumption.

The decrease in consumption of fossil fuels by about 11 per cent from 1976 to 1992 is to a large extent due to the introduction of nuclear power in Sweden and Finland at the beginning of the 1980s.

Use of fossil fuels in the Nordic countries. Petajoule (PJ=10^{15}Joule)

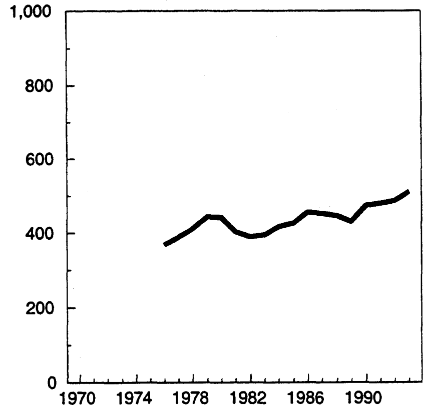


Use of fossil fuels. Denmark. 1972-1992. PJ



Source: RISØ Systems Analysis Department

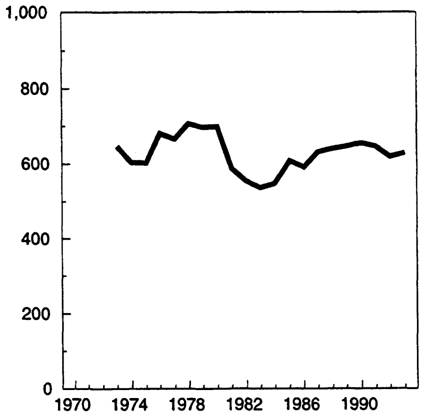
Use of fossil fuels. Norway. 1976-1993. PJ



Source: Statistics Norway

Consumption of fossil fuels in Norway increased during the period 1976 to 1993. The greater part of the increase is accounted for by use of fuel in the energy sectors (oil and gas extraction). There are now signs of an increase in consumption of fossil fuels in other sectors of society following a decrease in the years 1990-91.

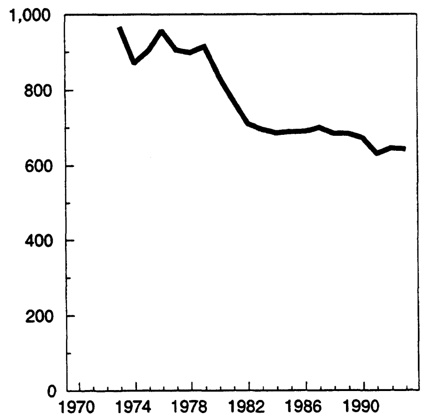
Use of fossil fuels. Finland. 1973-1993. PJ



Source: Statistics Finland

The use of fossil fuels decreased in Finland at the end of the 1970s along with the introduction of nuclear power. Since the mid-1980s, the use of fossil fuels has shown an increasing tendency - oil consumption has decreased, while consumption of natural gas has increased.

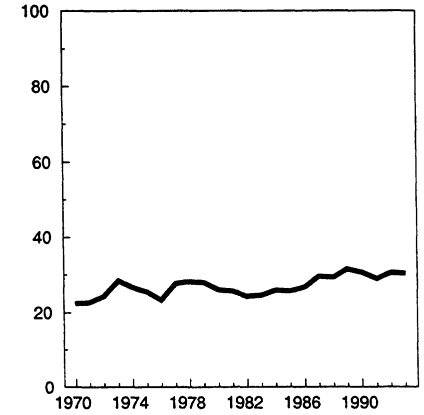
Use of fossil fuels. Sweden. 1973-1993. PJ



Source: Statistics Sweden

Emissions from combustion processes decreased by almost 50 % in the 1980s. This can be explained by energy-saving, changes in the industrial structure and the development of nuclear power. Oil's share of energy sources in the energy sector decreased from 70 to 20 % during this period, partly as a result of an active policy to substitute oil by other sources of energy.

Use of fossil fuels. Iceland. 1970-1993. PJ



Source: National Energy Authority

Consumption of fossil fuels in Iceland increased during the period 1970-1993. The greatest increase occurred for gasoline consumption, but a marked increase was also observed for consumption of heavy oils. Coal consumption increased from 1979, owing to the start-up of a ferrosilicon factory that year.

Notes on the individual indicators - CLIMATE

P - Emissions of CO_2

General: It could have been interesting/desirable to distribute the emissions between main sources: e.g. mobile combustion, stationary combustion and emissions from industrial processes. The Nordic emissions have not been added together, owing to differences in the lengths of the time series and in the years when the emissions are calculated using the same method (IPCC). This should be done in an official report on indicators. The emission figures are not adjusted for climate.

Iceland: The emission figures for 1975, 1980 and 1985-86 are not calculated according to the IPCC method.

Finland: Only the years 1988 and 1990 are calculated according to the IPCC method.

Sweden: The figures are taken from *Major Review of Swedish Strategies and Policies for Air Pollution Abatement - 1998. Report from Sweden to Long-Range Transboundary Air Pollution Convention. UN/ECE. National Environment Protection Agency.*

Denmark: Figures taken from *Inventory of Emissions to the Air from Danish Sources 1972-1992* (J. Fenham and N.A. Kilde - System Analysis Department, RISØ National Laboratory, Roskilde). CO_2-emissions and emissions of NMVOC, CH_4 and CO from industrial processes, as stated in this report, have been converted by the Norwegian editor into total emissions of CO_2 (IPCC method).

S - Annual mean temperature in the capitals

Norway: Oslo: Blindern station. Change of station locality in 1877 and 1937.

Finland: Station 304, Helsinki, Kajsaniemi.

Sweden: Stockholm: Station Observatorielunden.

Iceland: Station Bustadvegur (64°08'N, 21°54'W) Reykjavik.

R - Changes in the use of fossil fuels

Norway: The energy figures include energy sources used as raw material in industry (can only be discriminated for the last few years). Raw materials used in the energy sectors are not included (high consumption in Norway). Energy purchased in Norway for Norwegian and foreign ocean transport is not included. Energy purchased in Norway for Norwegian and foreign international and domestic air traffic is included. The following energy sources are included: Coal, coke, petrol coke, motor vehicle gasoline, other gasoline, heating kerosene, other kerosene, auto-diesel, marine fuel, heating oil, special distillates, heavy oil, liquified petroleum gas, coke furnace and refinery gas, natural gas and crude oil. Combustion of fossil fuels (in the form of plastic material) in waste incineration is not included.

Iceland: The energy figures do not include ocean transport. Energy sources used as raw material in the energy sectors are not included. Energy sources used as raw material in industry are included, but electro-coke that is defined as raw material in ferrosilicon production, and petrol coke that is defined as raw material in aluminium production can be discriminated.

Finland: The energy figures are defined as covering total consumption of fossil sources of energy (oil, gas and coal), also as raw materials. Consumption of energy sources as raw materials in the energy sectors has not been discriminated as in the data sets for Norway, Sweden and Iceland.

Sweden: The energy figures cover total consumption of fossil fuel minus the amount used as raw material in the energy sectors. Ocean transport is not included.

Denmark: Figures stated as PJ. Cover *primary energy consumption* by fuel in Denmark minus consumption of *straw and wood* and *refuse*. The figures do not include ocean transport (*oil international*).

General: The energy figures are not adjusted for export/import of electrical energy.

2. OZONE LAYER DEPLETION

The largest quantities of ozone gas (O_3) are found in the part of the atmosphere located 10-40 km above the ground (the stratosphere). If it had been possible to collect the ozone from the whole atmosphere into a limited area along the ground, with the pressure and temperature normally existing there, this layer of pure ozone gas would not have been thicker than 2.5-5 mm. Globally speaking, the ozone layer is thinner near the equator and thicker near the poles.

The ozone layer of the atmosphere prevents ultraviolet solar radiation (UV-radiation) from reaching the earth.

Emissions of gases such as CFCs and halons deplete the ozone layer, allowing more UV-radiation to reach the earth. This radiation (especially UV-B) has adverse effects on plants and animals.

Health injuries to humans as a result of increased radiation include higher incidence of skin cancer, eye injuries and weakening of the immune system. Plant growth, both on land and in the sea (algae) can be reduced.

Pressure

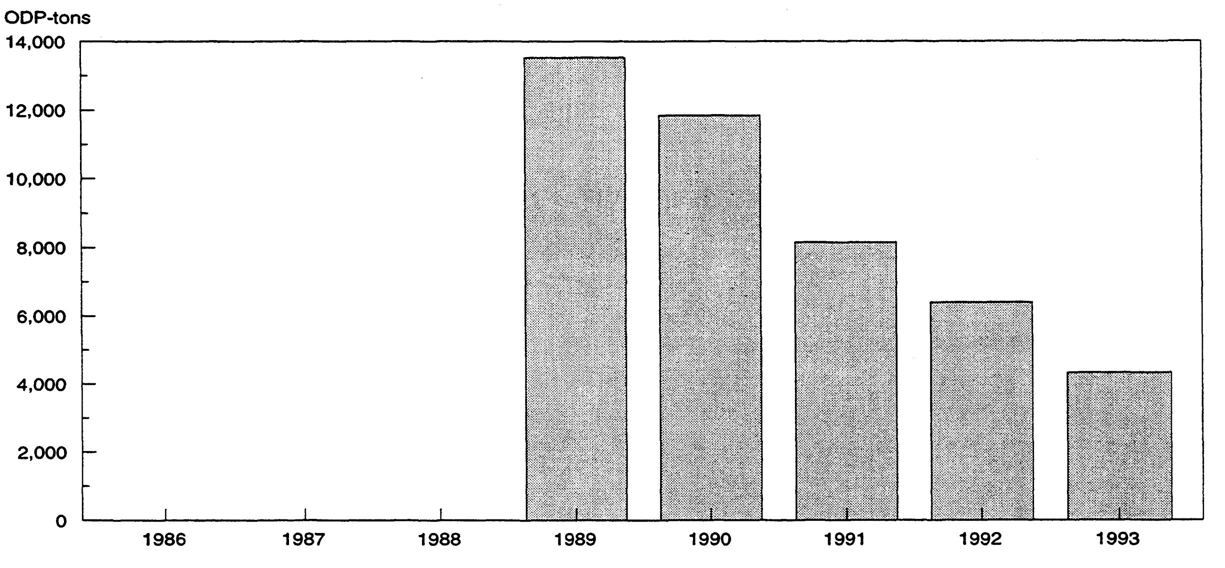
Consumption of ozone-depleting substances

CFCs, HCFCs, halons and other gases containing chlorinated and fluorinated compounds that are released into the atmosphere from human activities are transported with the air currents towards the ozone layer in the stratosphere. There, under certain meteorological conditions, they can cause chemical degradation of ozone. In the clouds of ice particles that occur during the cold polar nights, relatively stable chlorinated compounds are converted into reactive chlorinated compounds that deplete ozone. Halons have the greatest ozone-depleting potential (ODP factor 3.0-10.0), but consumption of CFCs (ODP factor 0.6-1.0) is much higher.

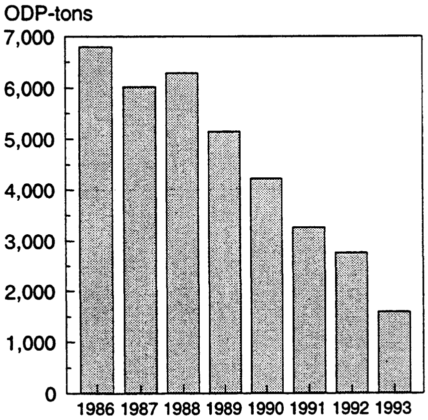
The ozone-depleting substances are very persistent in the atmosphere, and will therefore continue to accumulate long after consumption has decreased.

The total consumption of ozone-depleting substances - calculated as ODP-tons - in the Nordic countries decreased by 69 per cent from 1989 to 1993.

Consumption of ozone-depleting substances. ODP-tons. 1989-1993. Nordic countries



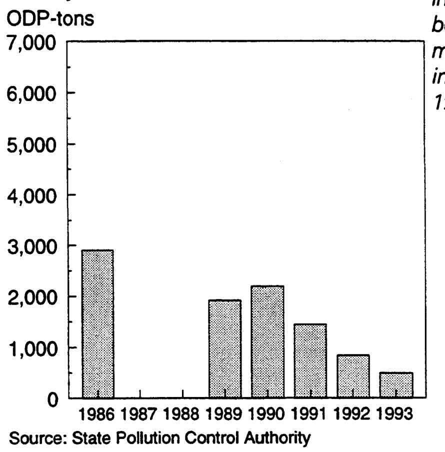
Consumption (import) of ozone-depleting substances. ODP-tons. 1986-1993. Denmark



Sources: National Agency of Environmental Protection and Danmarks Statistik

Consumption of ozone-depleting substances in Denmark was reduced by 77 % from 1986 to 1993. The reason for the reduction of 42 % from 1992 to 1993 was the marked reduction in consumption of CFCs and lower consumption of halons. Consumption of HCFCs in Denmark is increasing, but most applications of HCFC are to cease by 1 January 1996.

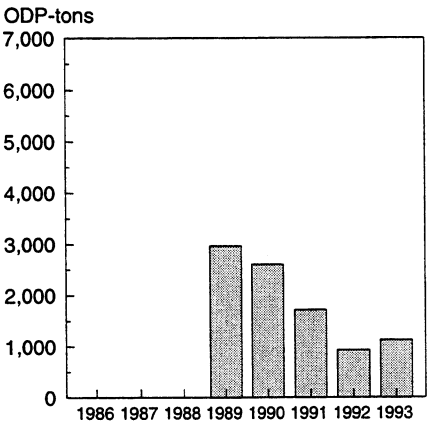
Consumption (import) of ozone-depleting substances. ODP-tons. 1986 and 1989-1993. Norway



Source: State Pollution Control Authority

Consumption of CFCs and halons in Norway has been reduced by more than 80 % in relation to 1986.

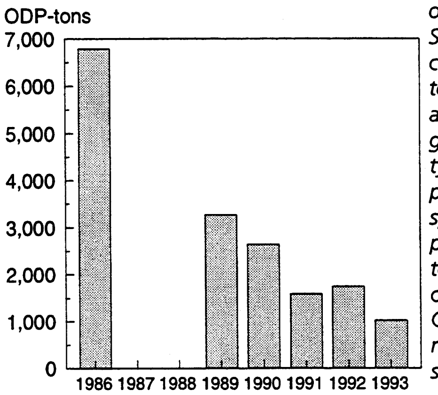
Consumption (import) of ozone-depleting substances. ODP-tons. 1989-1993. Finland



Source: Ministry of the Environment

Consumption of ozone-depleting substances in Finland has been reduced considerably. However, the CFC contained in consumer goods such as refrigerators and freezers represents a potential source of emissions when these articles are discarded and disintegrate.

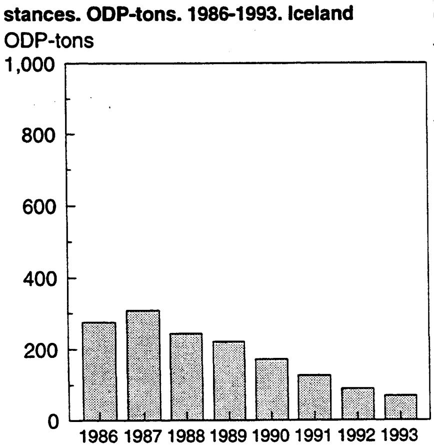
Consumption (import) of ozone-depleting substances. ODP-tons. 1986 and 1989-1993. Sweden



Source: National Environment Protection Agency

Today, CFCs and similar substances are only used in Sweden as cooling medium, textile cleaning agent, insulating gas in certain types of foam plastic and in sprays for asthma patients. The total consumption of CFC has been reduced by 85 % since 1986.

Consumption (import) of ozone-depleting substances. ODP-tons. 1986-1993. Iceland



Source: Environment and Food Agency of Iceland

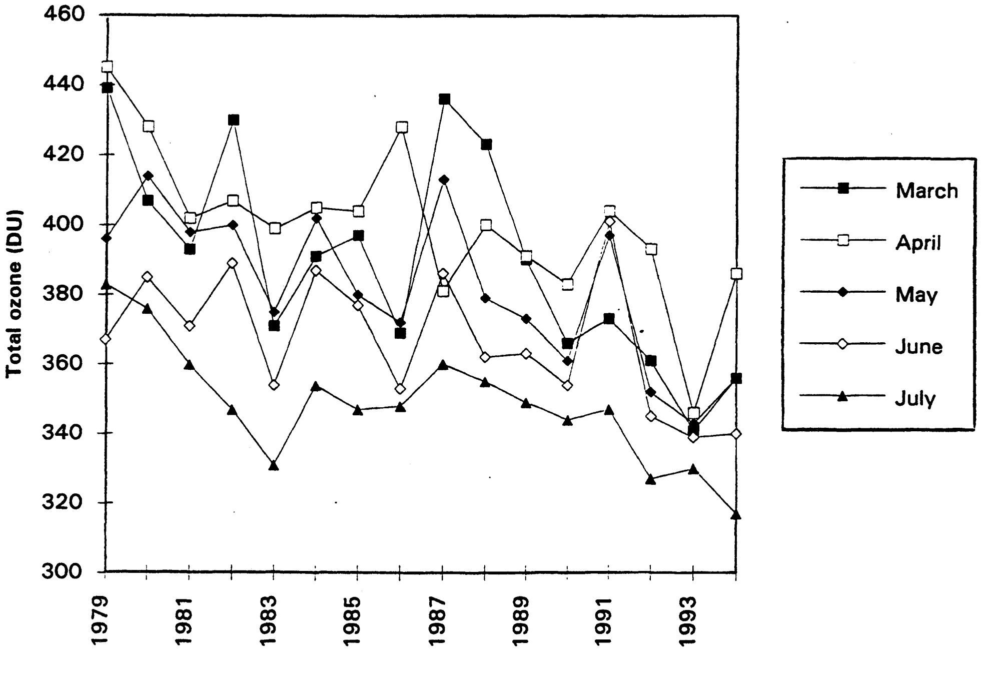
Consumption of ozone-depleting substances in Iceland has been reduced by 75 % since 1986.

State

Total ozone

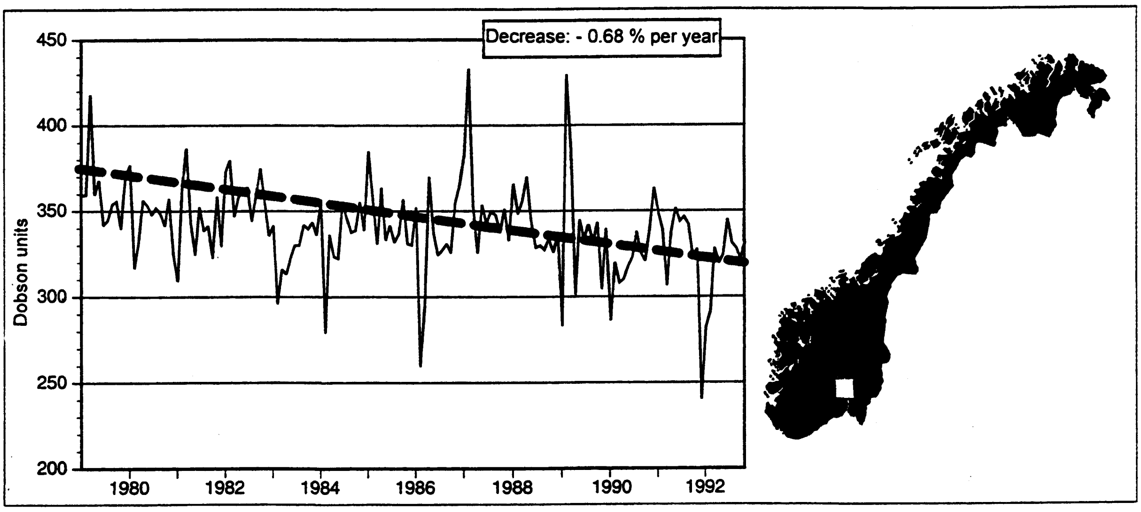
Equally high chlorine and bromine values have been measured in the stratosphere in the Arctic and over the Nordic countries as in the Antarctic. However, no ozone holes have been observed in northern areas which can be compared either in extent or frequency with those over the Antarctic. This is probably because the meteorological conditions in the atmosphere in northern areas differ from those in the atmosphere over the Antarctic. In spite of this, some depletion of the ozone layer over the Nordic countries - caused by break down of ozone - has occurred in recent years.

Ozone measurements over Copenhagen



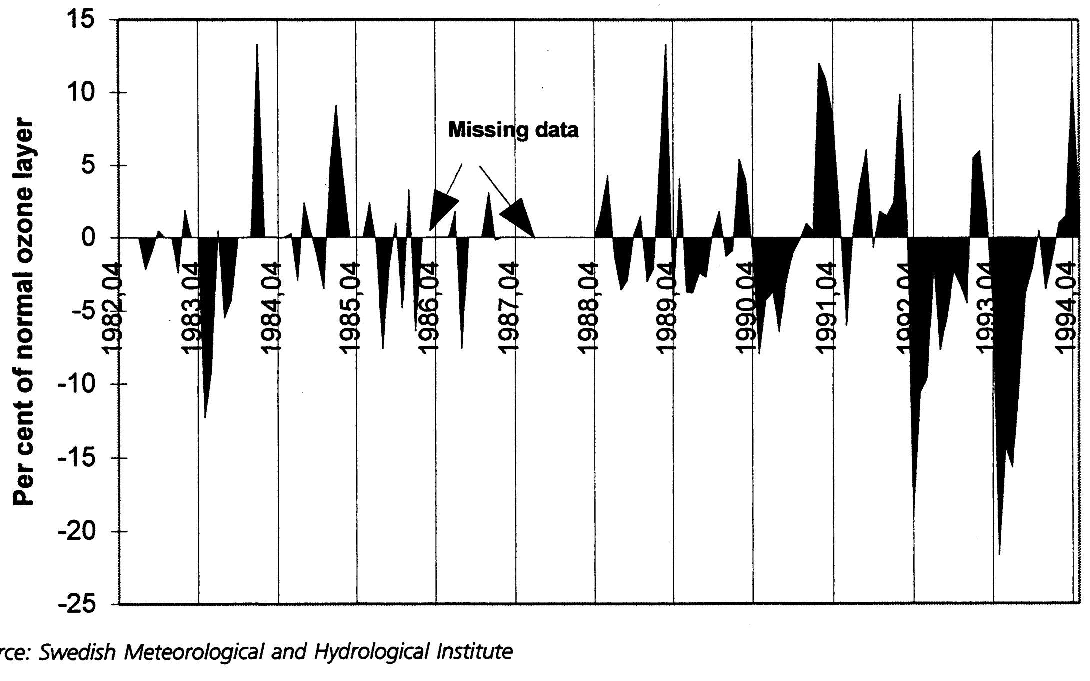
Source: Danish Institute of Meteorology

The measurements carried out with the TOMS instrument on the satellite NIMBUS-7 show that the thickness of the ozone layer over Denmark has decreased by average 0.6 per cent per year over the last 10-12 years.



Source: Norwegian Institute of Air Research

Satellite measurements of the quantities of ozone over Oslo during the period 1979-1993 show a reduction of average 0.7 per cent per year. Short periods with considerably reduced ozone quantities - especially in the spring - have contributed to this reduction. However, the measurements of ozone over Oslo in spring 1994 show normal values.



Source: Swedish Meteorological and Hydrological Institute

During the period 1982-1991 there was no tendency to depletion of the ozone layer over Norrköping. In 1992 and 1993, however, considerable depletion was measured in late winter, spring and early summer. In February 1993 the ozone layer was on average 21.7 per cent thinner than the normal value for the month. In February, the sun is still low in the sky, and this decrease in thickness is thus of little significance for ultraviolet radiation; even if all the ozone were to disappear, very little of the UV-B radiation would reach the earth. Therefore, the reduction in thickness of 10.3 per cent observed in May 1993 was much more serious. The combination of a thinner ozone layer and sunny weather then gave a monthly UV-B dose 30 per cent above normal.

Response

Targets for reduction of ozone-depleting substances

The Montreal Protocol which came into force in 1989 was revised in 1992, and more stringent reduction requirements were introduced for ozone-depleting substances. All the Nordic countries have undertaken to comply with the provisions in this protocol. The national targets in the Nordic countries are the same (or somewhat stricter) than those specified in the protocol. The main provisions of the Montreal Protocol are listed below. Special provisions and reduction targets apply, for example, when the use of specific substances is necessary in order to comply with the international rules concerning safety and health.

Chlorofluorocarbons (CFCs):
1994: 75 per cent reduction in relation to consumption in 1986
1996: Consumption to cease

Halons:
1994: Consumption to cease

Carbon tetrachloride:
1995: 85 per cent reduction in relation to consumption in 1989
1996: Consumption to cease

1,1,1-trichloroethane:
1994: 50 per cent reduction in relation to consumption in 1989
1996: Consumption to cease

Hydrochlorofluorocarbons (HCFCs):
1996: Stabilization of consumption at 1989 level and 3.1 per cent of CFC consumption in 1989
2004-2030: Gradual reduction
2030: Consumption to cease

Methyl bromide:
1995: Stabilization of consumption at 1991 level.

Hydrobromofluorocarbons (HBFCs):
1996: Consumption to cease

Notes on the individual indicators - OZONE LAYER DEPLETION

P - Import/consumption of ozone-depleting substances

Iceland: Figures supplied already converted into ODP-tons, specified for the following groups/ substances: CFC-11, CFC-12, CFC-113, CFC-114, CFC-115, halon-1211, halon-1301, halon-2402, HCFC-22, HCFC-124, HCFC-141b, HCFC-152a, CCl_4, 1,1,1-trichloroethane and HFC-134a.

Finland: Figures already converted to ODP-tons for the groups/substances CFCs, halons, CCl_4, 1,1,1-trichloroethane and HCFC. Figures for CFC from 1986 onwards - the other substances only from 1989 onwards.

Sweden: Figures supplied in metric tonnes. Converted into ODP-tons by the Nordic editor. The following substances are included: CFC-11, CFC-12, CFC-113, CFC-114, CFC-115 and "other CFCs". Halon-1211, halon-1301. 1,1,1-trichloroethane. HCFC-22, HCFC-123, HCFC-141b, HCFC-142b. Methyl bromide (only 1992 and 1993). CFC is lacking in 1987 and halons in 1987 and 1988. For the other substances the figures are from 1989 onwards.

Norway: Figures supplied already converted into ODP-tons for CFCs and halons. Figures for CCl_4 and 1,1,1-trichloroethane are lacking for 1986. Therefore, the 1985 figures for these substances are used for 1986 in the figure. Methyl bromide is included as from 1991.

Denmark: Figures supplied in tonnes and ODP-tons for the groups CFCs, halons, trichloroethane, CCl_4 and methyl bromide. HCFC accounted for 6 per cent of the ODP-weighted consumption in 1993. It has been decided by law that all use of HCFCs for all purposes shall cease by the end of the year 2001. Most uses of HCFC (filling foam, insulating foam etc.) shall cease, however, by 1 January 1996 at the latest.

S - Total ozone

General: The originally proposed indicator - *Lowest monthly mean per year* - was rejected. In the Nordic countries the lowest monthly means seem to occur in autumn/winter (most often in October/November). Comment from Sweden that the ozone values should be compared with a normal curve. The potential for ozone damage is greatest in spring/summer (thin ozone layer/much sunshine) and the measurements in Norrköping indicate that the greatest change in the thickness of the ozone layer occurs in fact in the spring. Comment from the Norwegian suppliers of data, (Norwegian Institute for Air Research (NILU) and the Norwegian Pollution Control Authority (SFT)), that the lowest monthly mean is a poor indicator and that a yearly trend analysis based on a time series of minimum 10 years (satellite data) should be used instead.

Three examples of possible indicators are shown instead: Copenhagen, Norrköping and Oslo. The figure for Oslo has been copied from the publication "*Forurensning i Norge 1994*" Norwegian Pollution Control Authority - Oslo.

R - Collected quantities of ozone-depleting substances

General: For the proposed indicator - *Collected quantities of ozone-depleting substances* - there are, in fact, no data to present.

A new indicator, a table showing the reduction requirements in the Montreal Protocol (after the latest amendments in 1992) is presented instead.

3. EUTROPHICATION

Eutrophication is a process that takes place in water, characterized by a development towards an environment rich in nutrients (nitrogen and phosphorus) and proliferous plant production. The eutrophication process causes a change in the aquatic ecosystem. With particularly large inputs of nutrients the algal blooms can become excessive; much more algae are produced than the organisms that feed on them can consume. Nutrient enrichment can also lead to blooms of toxic algae.

When the algae die, the organic material is decomposed by fungi and bacteria. This also applies to organic material that enters the sea or watercourses with waste water (sewage). This process of decomposition requires large amounts of oxygen, causing depletion of oxygen in the water. A complete lack of oxygen can lead to generation of the toxic and malodorous gas, hydrogen sulphide.

Visible effects of eutrophication are cloudy, discoloured water, an overgrown bed and shore, and excessive plant growth. Other effects can be fish death, destruction of spawning grounds and a layer of sludge on the bottom.

The most important sources of inputs of nutrients and organic material are:

- Agriculture
- Waste water from the population
- Industry
- Fish farms
- Long-range transported pollutants (nitrogen compounds)

Pressure

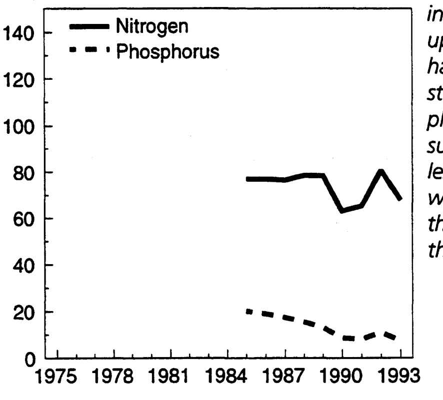
Net supply (surplus supply) of commercial fertilizer and manure

The most important sources of anthropogenic inputs of nitrogen and phosphorus to water are run-off from cultivated land and discharges from municipal waste water treatment plants. These inputs cause increased algal growth in lakes, rivers and fjords.

Today, far more nutrients are supplied to cultivated land in the fertilizer than can be absorbed by the crops. This surplus can either be stored in the soil or can leak out of the system. Nitrogen is more volatile than phosphorus and can be washed out through the soil profile, or disappear into the air through evaporation of ammonia or denitrification. Phosphorus is more easily adsorbed to the soil particles and leaches into the system with eroded particles of soil, or is dissolved in the surface run-off. The degree of eutrophication in lakes, rivers and fjords depends on the properties of the recipient and the size of the inputs. The latter is in turn dependent on how much surplus fertilizer is supplied to the cultivated land.

Net inputs of nitrogen and phosphorus. 1985-1993. Norway

1 000 tonnes

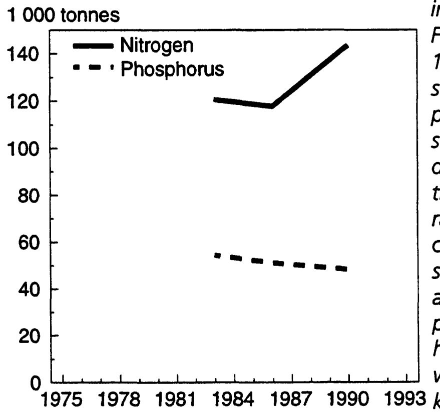


Source: Statistics Norway

The surplus of nitrogen (net fertilization) increased right up to 1990, but has since stabilized. The phosphorus surplus is now less than half what it was at the beginning of the 1980s.

Net inputs of nitrogen and phosphorus. 1986 and 1990. Finland

1 000 tonnes

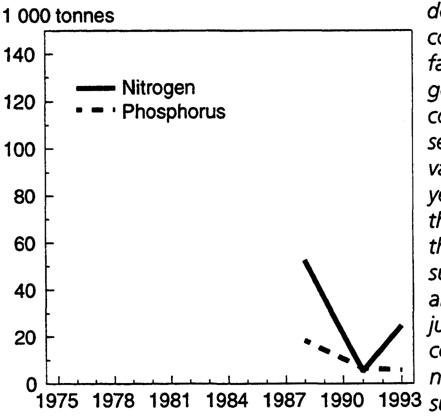


Source: Agricultural Research Centre and Statistics Finland

The surplus of nitrogen has increased in Finland since 1983, but the surplus of phosphorus shows a decreasing trend. On average, Finnish crop land is supplied with about 30 kg phosphorus per hectare per year, while only 12-13 kg per hectare is absorbed by the plants.

Net inputs of nitrogen and phosphorus. 1991 and 1993. Sweden

1 000 tonnes

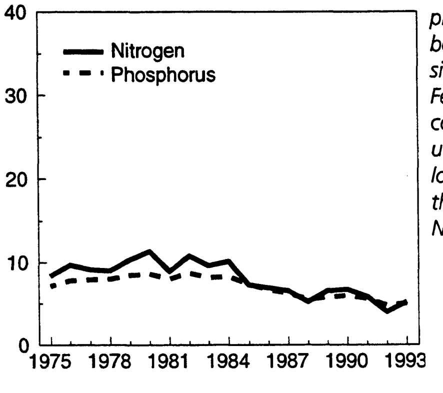


Source: Statistics Sweden

The phosphorus surplus has decreased continuously. As far as the nitrogen surplus is concerned, there seem to be large variations from year to year. At the highest level the nitrogen surplus has amounted to just over 15 per cent of the total nitrogen supplied to the land.

Net inputs of nitrogen and phosphorus. 1975-1993. Iceland

1 000 tonnes



Sources: Yearbook of Nordic Statistics and The Agricultural Society of Iceland

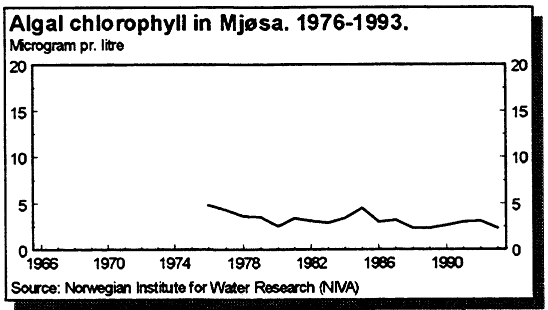
In Iceland, the surplus of both nitrogen and phosphorus has been reduced since 1975. Fertilizer consumption per unit of land is lower in Iceland than in the other Nordic countries.

State, lakes

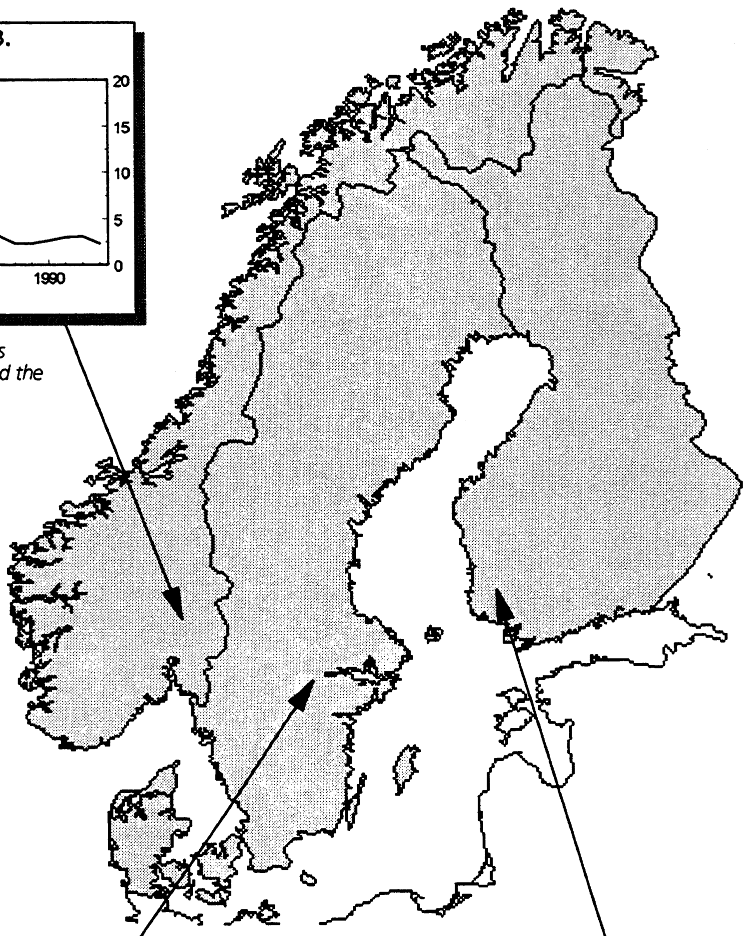
Algal chlorophyll

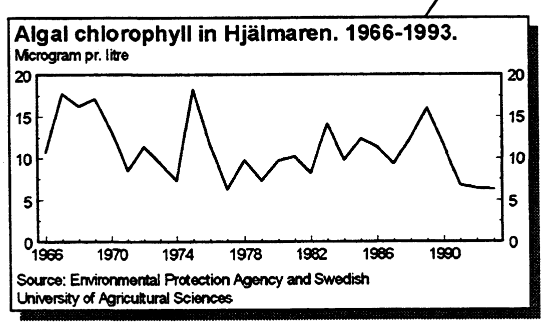
The content of algal chlorophyll in the water masses is a measure of the plant production and is often used - together with, for example, the phosphorus content, nitrogen content and light penetration - to evaluate the water quality as regards extent of eutrophication. For the content of algal chlorophyll, the natural state will vary for the different lakes. For example, for lakes above the marine limit in Norway, a typical value (expected natural state) is 1 $\mu g/l$. Such lakes with a chlorophyll-a content of up to 2 $\mu g/l$ are evaluated as having *good water quality*, lakes with concentrations of 2-3.7 $\mu g/l$ have *fair water quality*, lakes with concentrations of 3.7-7.5 $\mu g/l$ have *poor water quality* while lakes with higher values have *bad water quality*.

The concentrations of chlorophyll-a vary in the course of the year, but are directly affected by the concentration of nutrients only during the summer, when the supply of light is not a limiting factor.

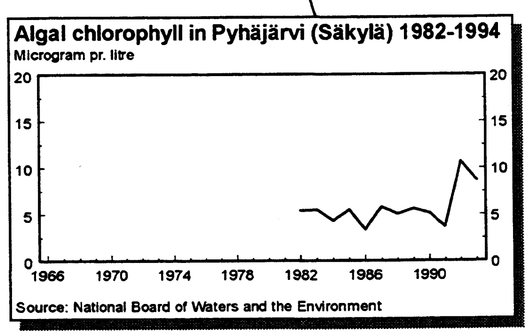


The state of the environment in Lake Mjøsa has improved considerably since the mid-1970s, and the water quality is now the same as in the 1950s.





Hjälmaren is a relatively large and shallow lake in the agricultural landscape of central Sweden. The state of the environment in the lake has varied considerably, but the present trend seems to be towards a lower content of nutrients.



Pyhäjärvi is a large lake in an agricultural district. The state of the environment in the lake has been relatively good for some time, but a deterioration has been registered in recent years, reflected, for example, in an increased content of chlorophyll-a.

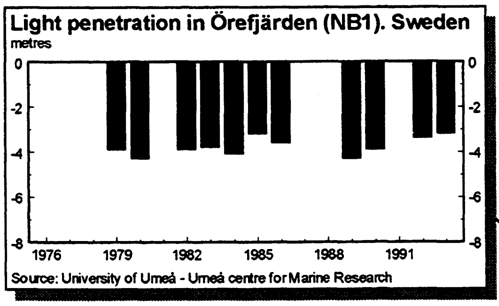
State, fjords

Light penetration (Secchi depth)

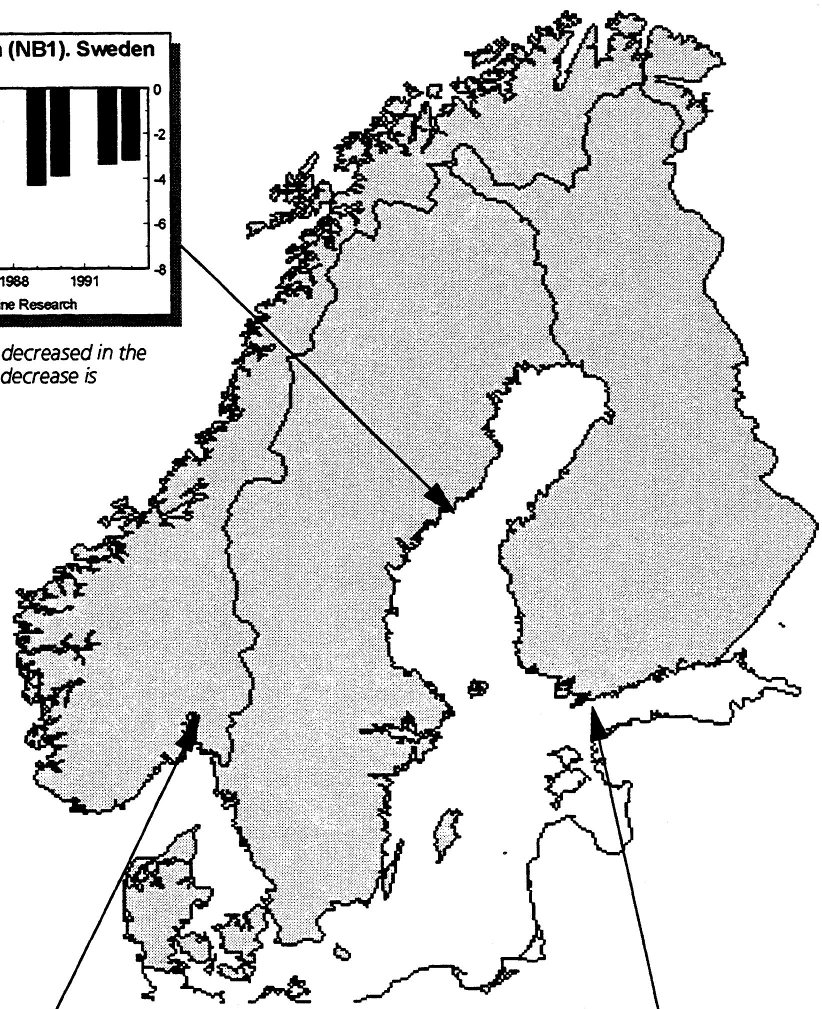
Measuring the Secchi depth is a simple method of observing the content of particles in the water (turbidity). When the water contains few other types of particles, such as humus particles, sludge from glaciers, and eroded material, the Secchi depth also gives an indication of the amount of algae in the water.

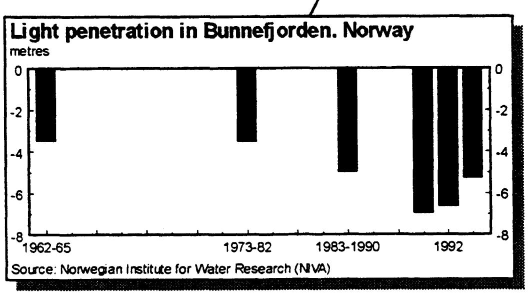
A five-scale classification is used for the quality status of the surface water in Norwegian fjords and coastal areas, evaluated in terms of light penetration (Secchi depth):

Good	> 7.5 metres
Fair	7.5-6.2 metres
Poor	6.2-4.5 metres
Bad	4.5-2.5 metres
Very bad	< 2.5 metres

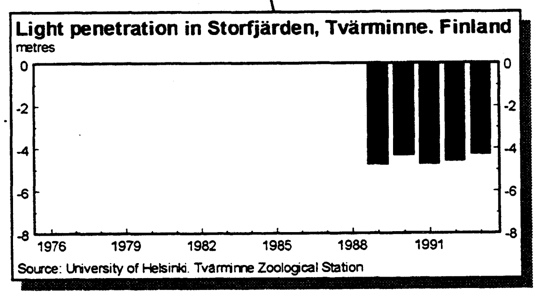


Light penetration in Örefjärden has decreased in the course of the last 15 years, but the decrease is marginal.





The water quality of the surface layers of the inner Oslofjord has improved since the beginning of the 1980s. The main reason for the improvement is more efficient cleaning of the waste water in waste water treatment plants.



In general, there has been a marked reduction in light penetration in the northern part of the Baltic Sea. It is estimated that, in the early years of this century, the light penetrated on average 2,5-3 m deeper than now. Measurements have been made in Storfjärden only since 1989 - far too short a period to indicate possible trends.

Response, lakes

"Winter green" crop land (land with a cover of vegetation in winter)

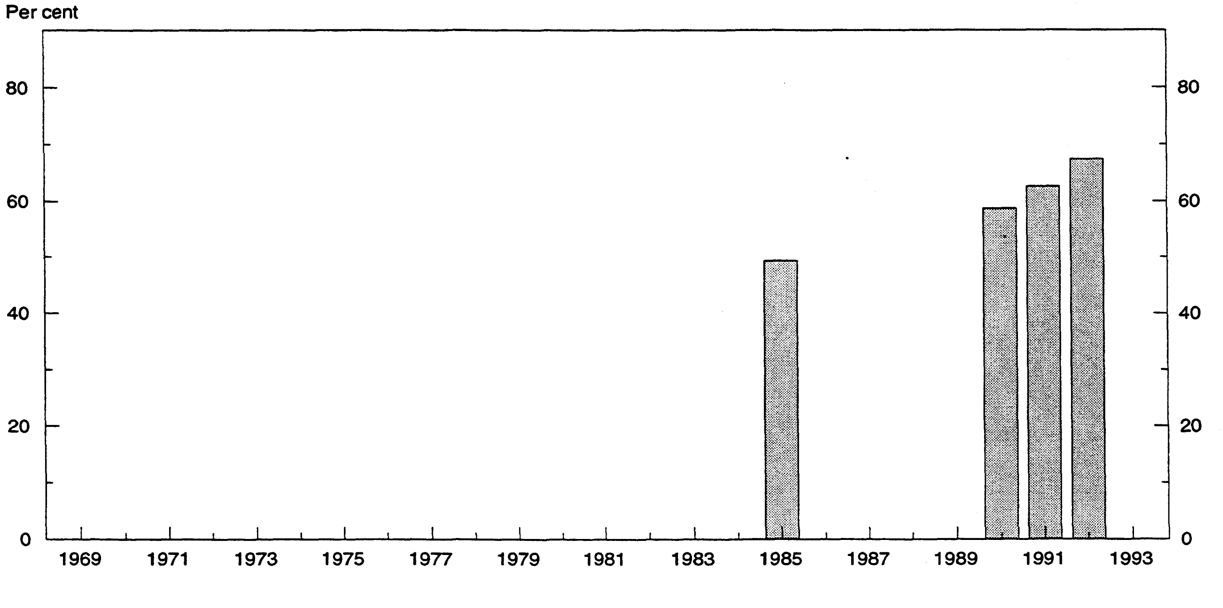
In the North Sea Declarations, Denmark, Norway and Sweden have undertaken to reduce inputs of nitrogen and phosphorus to the North Sea by half by the end of 1995, with 1985 as base year. For the agricultural sector the most important measures are improvements to manure stores, more effective use of fertilizer and changes in cultivation practices.

In the ministerial declaration from the HELCOM countries in 1988 (at that time, East and West Germany, the Soviet Union, Denmark, Finland, Sweden and Poland), the objective as regards nutrients is to reduce discharges to the Baltic Sea by half by the end of 1995, with 1987 as base year.

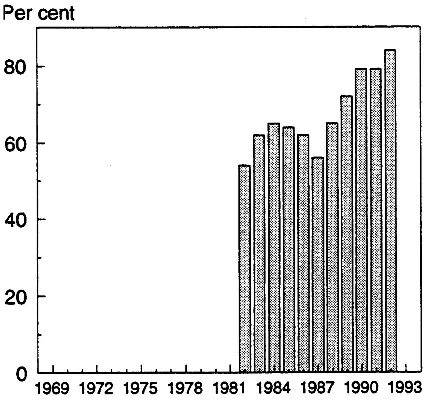
An important measure in connection with cultivation practices is to postpone ploughing and other soil preparation until the spring, or to sow the grain in the autumn. This implies that the land will have a cover of vegetation throughout the winter ("winter green"), which helps to reduce both erosion and run-off of nutrients.

The share of "winter green" cultivated land in the Nordic countries has increased from 49 per cent in 1985 to 67 per cent in 1992.

Share of "winter green" crop land. Nordic countries. 1985 and 1990-1992



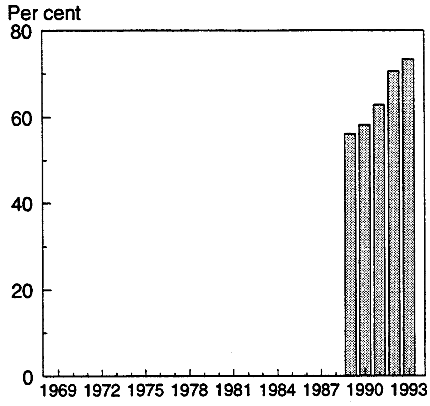
Share of "winter green" crop land. Denmark. 1982-1992



Source: Danmarks Statistik

The area of "winter green" cultivated land in Denmark increased from 54 per cent of the cultivated land in 1982/83 to 79 per cent in 1991/92. The increase has occurred mainly since 1987/88. The requirement for 65 per cent "winter green" land has now clearly been realized.

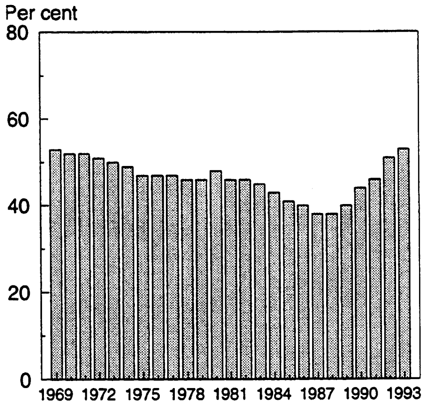
Share of "winter green" crop land. Norway. 1989-1993



Source: Statistics Norway

The share of "winter green" grain and meadow land in Norway has increased from about 56 per cent in 1989 to about 73 per cent in 1993.

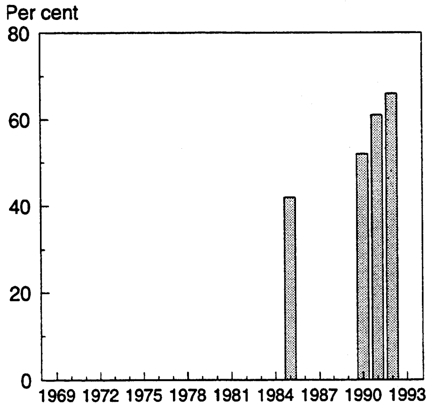
Share of "winter green" crop land. Finland. 1969-1993



Source: Ministry of Agriculture and Forestry

The share of "winter green" crop land in Finland showed a decreasing tendency for many years. Since 1987, the share has increased, partly as a result of grants for the cultivation of crops which prevent erosion and leakage of nutrients, and now comprises about 53 per cent of the cultivated land.

Share of "winter green" crop land. Sweden. 1990-1992



Source: Statistics Sweden

From 1994 inclusive, at least 60 per cent of the crop land on each agricultural property in the southernmost counties and 50 per cent in the rest of Götaland shall be so-called "green" land. The share of "winter green" cultivated land in Sweden has increased considerably since 1985, and now comprises about 66 per cent of the crop land.

Response, fjords

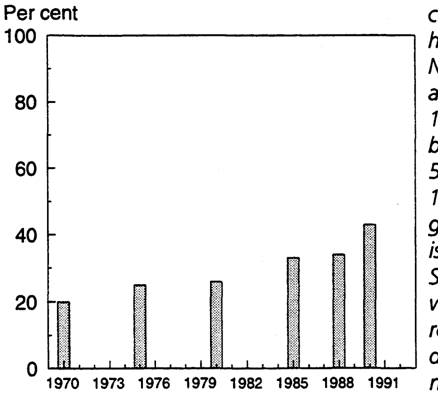
Connection to chemical waste water treatment plants

The agricultural sector is not the only sector where measures are being introduced for instance in connection with the North Sea Declarations. One of the most important measures within the municipal sector is to improve the degree of connection to municipal waste water treatment plants with chemical or biological-chemical treatment of the water.

Well functioning chemical treatment plants remove phosphorus from the waste water very effectively. As far as nitrogen is concerned, the extent of removal is low, both at pure chemical plants and at the traditional biological-chemical plants. To make the nitrogen removal more effective, the chemical treatment must be supplemented by advanced biological treatment.

Connection to chemical treatment plants must also be evaluated in relation to the need for such treatment of waste water from the population. In Norway the need is greatest in the southern parts of the country, and this is where the largest percentage of the population is connected to waste water treatment plants. Waste water is not treated chemically in Iceland, and only 6 per cent of the population is connected to mechanical treatment plants. As regards treatment of waste water, Iceland is in a unique position, owing to its geographical position, scattered pattern of settlement and good recipient conditions along the coast.

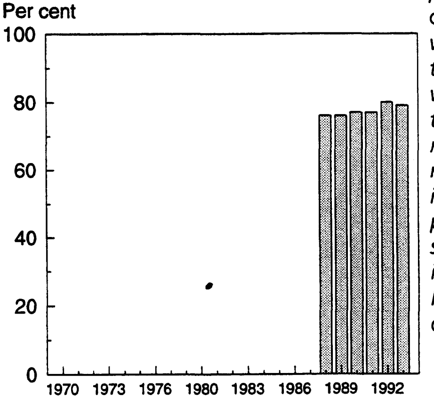
Share of population connected to waste water treatment plants with minimum chemical treatment. 1970-1990. Norway



Source: Statistics Norway

The share of the population connected to chemical plants has increased in Norway from about 20 % in 1970 to between 40 and 50 % in the 1990s. The degree of coverage is highest in Southern Norway. Good recipient conditions in the northern parts of the country reduce the need for chemical cleaning there.

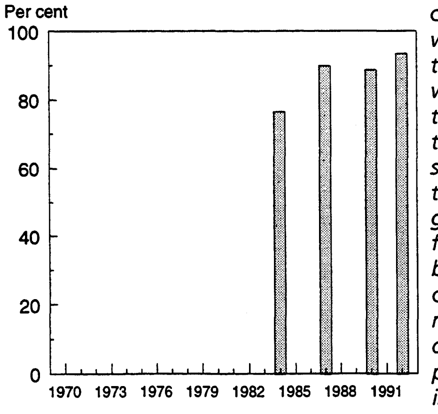
Share of population connected to waste water treatment plant with minimum chemical treatment. 1988-1993. Finland



Source: National Board of Waters and the Environment

About 80 % of Finland's population are connected to waste water treatment plants with chemical treatment. It is not considered relevant to increase this percentage, since such an increase would have little effect on water quality.

Share of population connected to waste water treatment plants with minimum chemical treatment. 1984-1992. Sweden



Source: Statistics Sweden

In Sweden, about 90 % of the population is connected to waste water treatment plants with chemical treatment. Since the 1980s, supplementary treatment, nitrogen removal or filtering has become more common. All the residents of densely populated areas in Sweden are connected to waste water treatment plants.

Notes on the individual indicators - EUTROPHICATION

P - Net supply of commercial fertilizer and manure

Norway: The net supply is the total supply of N and P in manure (excluding manure to uncultivated land) and commercial fertilizer minus N and P removed by crops. The figures are adjusted for total loss of ammonia.

Finland: Net supply is defined as supply of N and P in commercial fertilizer and manure minus the nitrogen and phosphorus absorbed by the crops.

Sweden: Net supply (surplus supply) is calculated on the basis of total supply of N and P in commercial fertilizer and manure, minus the amount removed with the grain and the straw. The supplies of nitrogen are adjusted for loss of ammonia during management/spreading of the fertilizer.

Iceland: Net supply is total supply of N and P in commercial fertilizer and manure (calculated from the number of domestic animals) minus the amount removed by the crop.

Denmark: Has figures for consumption of N and P in commercial fertilizer. Some estimates of manure production, as well as net supply, but no time series.

General: There are large differences between the countries as regards the reported figures for net supply of N and P For an official report on indicators, it is necessary to review the methods of reporting, with a view to standardization. Net supply is actually the best indicator, but perhaps, for the time being, it would be best to use total consumption of N and P in commercial fertilizer and manure. Long time series are available for this indicator. The indicator used in OECD's core set is the quantity of N in commercial fertilizer and manure per km^2 of land.

S - Lakes. Algal chlorophyll

Norway: Time-weighted mean for measurements during the period June-October. Mixed sample 0-10 m. Station: Skreia.

Finland: Data delivered from the National Board of Waters and the Environment (individual measurements). Time-weighted average value for the whole season (June - October) calculated by the Nordic editor. Method described for the Board. The high value in 1992 is due to an extreme value of 22 $\mu g/l$ at the end of September 1992. However, even without this value, there was a marked increase from 1991 to 1992. The Board also confirms that eutrophication in this lake has become worse. Cultivated land accounts for about 15 % of the lake's run-off catchment area (61647.6 hectares).

Sweden: Reported "annual mean value" for Storhjälm Centr.

Iceland: The indicator is not relevant for Iceland. Eutrophication is not a problem in Iceland. Algal chlorophyll is not measured.

Denmark:

General: The indicator has become examples from selected lakes. A much better indicator would be achieved if a sample of lakes in each country were placed in quality status classes with regard to algal chlorophyll. A necessary prerequisite would be a monitoring programme which would ensure collection of data enabling a description of trends. At the moment the Nordic countries do not have a common quality status classification, nor a system of regular monitoring (even if investigations/surveys are carried out - cf. the 1000-lakes survey in Norway) in all the Nordic countries. This comment is equally applicable to fjords and light penetration.

S - Fjords. Light penetration (Secchi depth)

Norway: Mean light penetration for the period June-August. Station: Bunnefjorden.

Finland: Average values for light penetration. Station: Storfjärden, Tvärminne.

Sweden: Annual mean value for Örefjärden (station NB1).

Iceland: Data supplied for the inner part of Faxaflói. The available data from Iceland have not been collected with a view to following changes in the extent of eutrophication.

Denmark:

General: See comments under *S - Lakes. Algal chlorophyll, general.*

R - Lakes. "Winter green" crop land/total crop land

Norway: Includes land with stubble, autumn-sown grain, catch crops and fully cultivated meadow.

Finland: "Winter green" area includes winter wheat, rye and grasses, "green fallow", fields removed from production and other unused fields.

Sweden: Includes autumn sown grain and oleiferous plants, herbage plants (grass land on arable land for hay or silage, pasture, seed ley, not utilized grassland), conversion areas waiting for new use (arable land reported for other production than foodstuffs. These areas are to be "wintergreen" according to the rules) and other "winter-green" crops such as sugar beets, fruit-trees, berry-bushes and energy forests.

Iceland: Not relevant for Iceland.

Denmark: Includes fields with winter crops, other cash crops, coarse fodder, catch crops, and straw incorporation, as well as fallow land (only from 1992/93). The share of "winter green" land is calculated on the basis of the total cultivated land in Denmark. That is to say, grazing land and meadow are included.

General: There are large differences between the countries as regards the reported figures for "winter green" area. For an official report on environmental indicators it is necessary to review the methods with a view to standardizing the data to enable comparison of the different countries. Other comments: Figures for seasons, e.g. 1990/91, are entered for the first year (in this case: 1990).

R - Fjords. Share of the population connected to waste water treatment plants with minimum chemical treatment

Iceland: No chemical treatment of waste water in Iceland.

Finland: With about 80% of the population connected to chemical waste water treatment plants, it does not seem relevant to increase this percentage. The goal has been achieved. A comment from Finland that this is not a particularly good indicator.

Denmark: Has reported the share of piped waste water treated by minimum chemical treatment. Not the share of the population connected to such plants. About 90 per cent of Denmark's total population is connected to waste water treatment plants.

4. ACIDIFICATION

Emissions of sulphur dioxide and nitrogenous gases lead to deposition of acidifying compounds. The gases are transported in the atmosphere and are finally deposited as wet or dry depositions.

Oxidized nitrogen is deposited slowly, and may therefore be transported a long distance from the source of the emissions. Depositions of oxidized sulphur, and to an even greater degree of reduced nitrogen, provide a better picture of the distribution of emissions, since these compounds are deposited more quickly. The clearly largest share of the depositions of both sulphur and nitrogen originates, however, from long-range transported pollution from other countries.

The soil, rivers and lakes are all affected by precipitation of acid air pollution. Sulphur is the main cause of the acidification. So far, acid nitrogen compounds have had only a moderate effect on the acidification status in soil and water in the Nordic countries. This is because a large share of the nitrogen is absorbed as nutrient by the vegetation. In southern Scandinavia, however, the nitrogen depositions have almost reached the limit of what the vegetation can absorb, and the acidification status could easily deteriorate. Rising nitrate concentrations in water show that the effect of nitrogen is increasing, just as a decrease in sulphate concentrations show that the effect of sulphur is decreasing.

Acidification of lakes and watercourses has a marked impact on plant and animal life in these environments. Acid air pollution can also cause damage to forest in the form of loss of needles or leaves, and discolouration of the crown of the tree.

Pressure

Deposition of acidifying substances

Depositions of oxidized sulphur have decreased considerably in recent years. The total deposition decreased by about 30 per cent from 1985 to 1992.

The same reduction has not been experienced for depositions of nitrogen compounds. The total deposition of oxidized nitrogen was just as large in 1992 as in 1985, in spite of an increase in some countries and a reduction in others. For the Nordic countries as a whole, the deposition of reduced nitrogen compounds has decreased by just over 10 per cent during the same period, and these depositions have been reduced in all the Nordic countries.

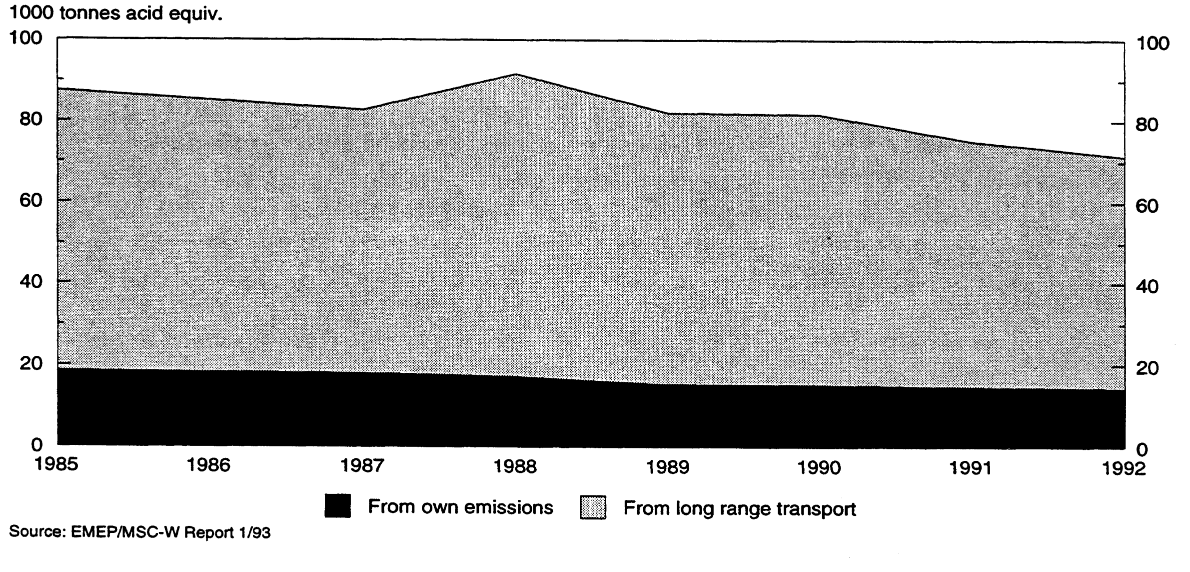
If the deposition of sulphur and nitrogen compounds is converted into acid equivalents, the total deposition in the Nordic countries has decreased by about 18 per cent since 1985. In Sweden, Finland and Denmark, the total deposition was 20 per cent lower in 1992 than in 1985. In Norway it was 10 per cent lower, and in Iceland as much as 40 per cent lower.

In 1985, sulphur accounted for 51 per cent of the total depositions (calculated in terms of acid equivalents) in the Nordic countries. In 1992, this share had decreased to 45 per cent.

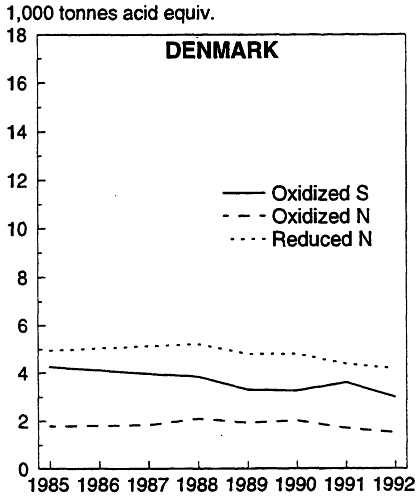
In 1985, the largest share of the sulphur depositions in the Nordic countries as a whole originated from the Soviet Union. 17 per cent of the total depositions came from this country. In 1992, the largest contribution, 15 per cent of the total depositions, came from Germany.

Which country dominates the depositions varies, however, from one Nordic country to another. Meteorological conditions such as wind direction, and intensity of precipitation, are of marked significance. Great Britain is the most important single contributor of depositions in Norway (21 per cent of total depositions in 1992) and in Iceland (9 per cent). The earlier Soviet Union makes the largest contribution to Finland (26 per cent), while Germany is most important for depositions in Sweden (20 per cent) and in Denmark (21 per cent).

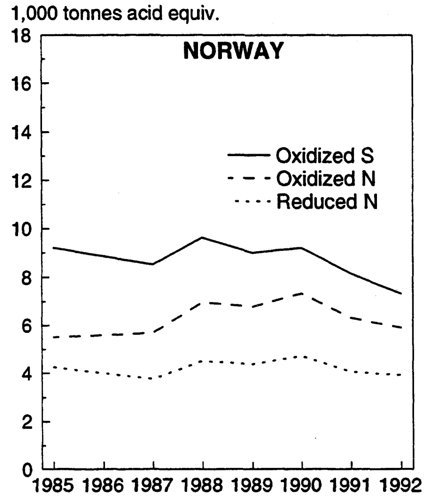
Total deposition of acidifying substances. The Nordic countries. 1985-1992. 1000 tonnes acid equivalents



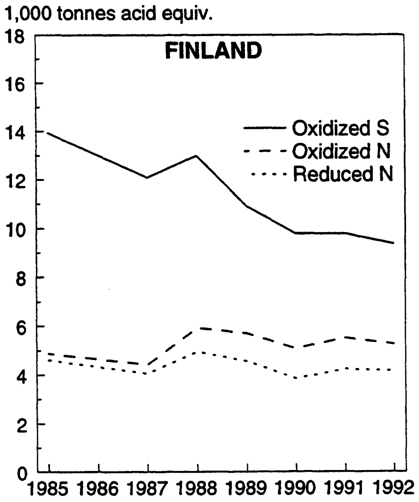
Source: EMEP/MSC-W Report 1/93



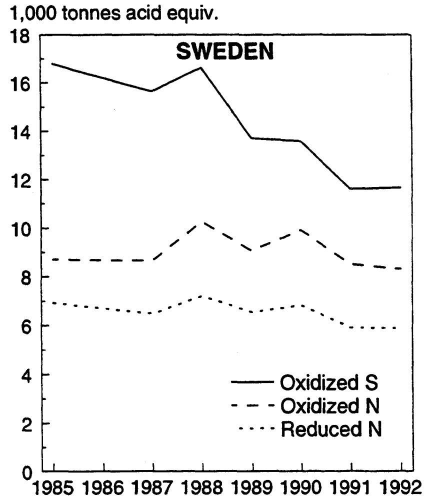
Sulphur depositions in Denmark have decreased by 30 %. Depositions of both oxidized and reduced nitrogen have decreased by 15 %. Reduced nitrogen dominates the depositions of acidifying components in Denmark. This can be explained to a large extent by emissions of ammonia from Denmark itself.



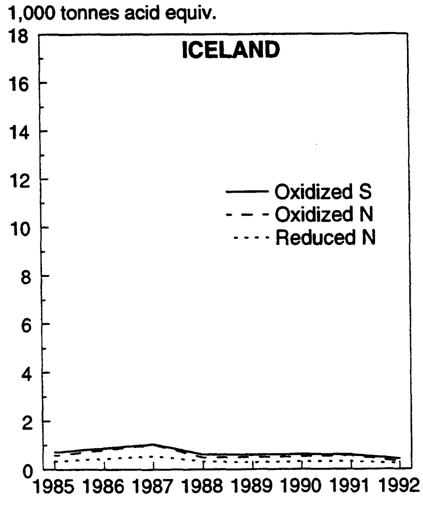
Sulphur depositions in Norway have decreased by 21 % since 1985. The largest share of this reduction has occurred since 1990. Depositions of oxidized nitrogen have increased by 7 %, while depositions of reduced nitrogen have decreased by 8 %.



Sulphur depositions in Finland have decreased by 33 % since 1985. Depositions of oxidized nitrogen have increased by 8 %, while depositions of reduced nitrogen have decreased by 9 %.



Sulphur depositions in Sweden have decreased by 31 % since 1985. The level of the depositions of oxidized nitrogen was 5 % lower and reduced nitrogen 15 % lower in 1992 than in 1985.



Depositions of acidifying compounds in Iceland are relatively small. The level in 1992 was much lower than in 1985, but a large share of the reduction occurred from 1991 to 1992. Depositions of both sulphur and oxidized nitrogen have decreased by 40 %.

Source: EMEP/MSC-W Report 1/93.

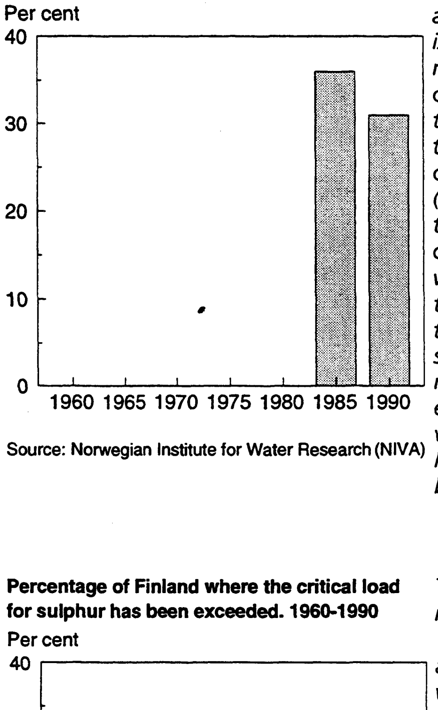
State

Areas where the critical load for sulphur has been exceeded

Nature's critical load is a term used to express how much pollution the natural environment can withstand without becoming damaged or changed. The critical load is the highest level that does not cause damage, and is defined on the basis of information on the relationship between pollution load and adverse effects. During the work being done under the ECE Convention - the Convention on Long-Range Transboundary Air Pollution - it has now been decided that new agreements shall be based on nature's critical loads rather than on the principle of equal percentage reductions of emissions in all countries.

The effect of acid precipitation will vary with the properties of the water and land concerned. In areas where the rock is rich in calcium the capacity to neutralize the acid is good, while typical areas of bedrock and areas with a thin layer of soil have little such capacity. Of the Nordic countries, Iceland is the only one where acidification is not a problem. The critical load is not exceeded anywhere in Iceland.

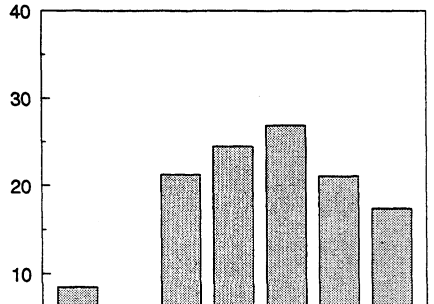
Percentage of Norway where the critical load for sulphur has been exceeded. 1985 and 1990



Source: Norwegian Institute for Water Research (NIVA)

The critical load for depositions of acidifying substances is exceeded over more than 30 per cent of Norway. It takes a relatively long time from when a change in the dose (deposition) occurs to when the effect can be measured in water or soil, and it is therefore impossible to conclude that the state of the environment has improved, even if the area where the critical load is exceeded has been reduced.

Percentage of Finland where the critical load for sulphur has been exceeded. 1960-1990



Source: National Board of Waters and the Environment (Matti Johansson og Maximilian Posch)

There was a marked increase from 1960 to 1980 in the area of lakes and forests in Finland where the sulphur depositions exceed the critical load. Since 1980 the situation has improved slightly. The forest areas where the critical load is exceeded are located mainly on the southern coast, while, for lakes, the critical load is exceeded in almost all parts of the country. Per 1990, the critical load was exceeded in just less than 20 per cent of Finland.

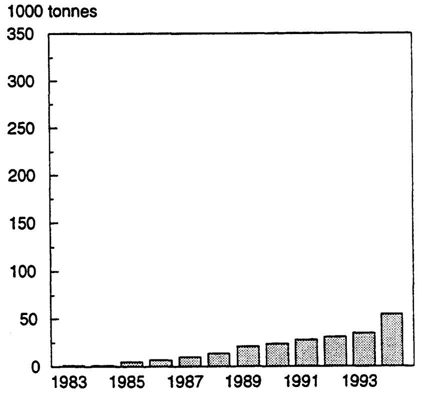
Response

Quantity of lime used

Liming is one of the measures used to reduce the adverse effects of depositions of acidifying compounds. This measure is used most in Norway and Sweden. For example, in 1993, the liming projects in Norway included 1751 localities with a precipitation impact area of 4598 km^2. Some liming is also carried out in Finland, but the amount of lime used is minimal compared with the amounts used in Norway and Sweden. Liming to counteract acidification is not carried out in Denmark or Iceland.

Liming can repair the damage to some extent, but is not a permanent solution. A permanent improvement can be achieved only by reducing emissions of acidifying compounds such as SO_2 and NO_x. A number of protocols under the ECE Convention contain provisions concerning emission reductions. The latest was signed in Oslo in June 1994. Several countries have achieved considerable reductions in SO_2 emissions, but it seems more difficult to reduce emissions of NO_x.

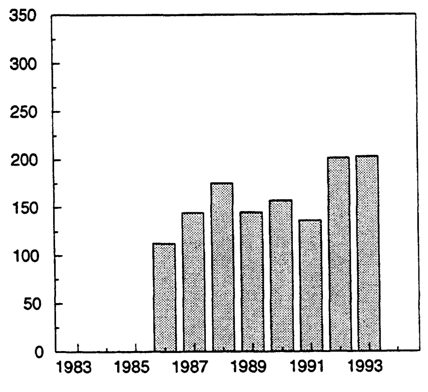
Consumption of lime for liming of lakes and rivers. 1983-1994. Norway



Source: Directorate for Nature Management

The quantity of lime used to counteract acidification has increased considerably in Norway since 1983. About 60,000 tonnes of lime was used for this purpose in 1994.

Consumption of lime for liming of lakes and rivers. 1986-1993. Sweden



Source: Statistics Sweden

In Sweden, about twice as much lime is used today as in 1986. More than 200,000 tonnes of lime was used for liming of lakes and rivers in 1993. Since 1985, more than 7000 lakes and 6000 km of river have been limed in Sweden.

Notes on the individual indicators - ACIDIFICATION

P - Deposition of acidifying substances

Acid equivalents: Conversion factors: 1 tonne SO_2 = 1/32 tonnes acid equivalents
1 tonne NO_2 = 1/46 tonnes acid equivalents
1 tonne NH_3 = 1/17 tonnes acid equivalents

S - Areas where the critical load for sulphur has been exceeded

Finland: Data from Matti Johansson and Maximilian Posch. National Board of Waters and the Environment, Water and Environment Research Institute. The method for calculating the critical load is described in Posch et al. (1993). It is pointed out that the critical load for sulphur also depends on depositions of polluting nitrogen compounds, and that nitrogen deposition is included in the calculations. The deposition has been calculated using the emission and transport models described in Johansson et al. (1990) and Sandnes (1993).

References:

Johansson, M., J.Kämäri, R.Pipatti, I.Savolainen, M.Tähtinen and J.-R.Tuovinen (1990): *Development of an integrated model for the assessment of acidification in Finland.* In: Acidification in Finland, ed. by Kauppi, P., P.Anttila and K.Kenttämies. Springer-Verlag, Berlin Heidelberg. pp. 1171-1193.

Posch, M., J.-P. Hettelingh, H.U. Sverdrup, K. Bull and W. de Vries (1993): *Guidelines for the computation and mapping of critical loads and exceedances of sulphur and nitrogen in Europe.* In R.J.Downing, J.-P Hettelingh and P.A.M. de Smet (Editors) Calculation and Mapping of Critical Loads in Europe, Status Report 1993, Coordination Center for Effects, National Institute of Public Health and Environmental Protection (RIVM), Bilthoven, The Netherlands. pp. 25-38.

Sandnes, H. (1993): *Calculated budgets for airborne acidifying components in Europe, 1985, 1987, 1988, 1989, 1990, 1991 and 1992.* EMEP/MSC-W Report 1/93. The Norwegian Meteorological Institute, Technical Report no. 109.

Norway: Data from the Norwegian Institute for Water Research (NIVA). The figures for 1985 are a mean for the period 1983-1987 and the figures for 1990 are a mean for the period 1988-1992. The data on depositions were prepared by the Norwegian Institute for Air Research (NILU). Both sulphur and nitrogen depositions are included in the calculations.

General: It is pointed out by NIVA (ref. Arne Henriksen, Director of Research) that it should be possible to carry out the type of calculations carried out for Finland for all the Nordic countries. Nordic cooperation has been good with regard to critical loads for soil and water.

Therefore, for an official Nordic report on environmental indicators, a special project should be defined to calculate comparable values for all the Nordic countries. Presentations in the form of maps should be suitable for this indicator, together with figures showing trends (editor's comment).

R - Quantity of lime used

Norway: Calculated on the basis of the funds allocated for liming and a fixed price for lime of NOK 1000 per tonne throughout the period. The Directorate for Nature Management proposes that de-acidified area, or number of limed localities, is a better indicator of response.

Finland: No statistics on this are available. It is reported that about 20-30 tonnes are used in Finland per year, and that the total amount used since the 1970s is about 1000 tonnes for the whole country. The liming is not carried out regularly, and most of the lime is used in south-eastern Finland. Liming of lakes to counteract acidification is carried out only by a number of private enterprises and private persons. As yet, liming of forest has been carried out only as an experiment.

Denmark: Liming to counteract acidification is not carried out in Denmark.

Iceland: Liming to counteract acidification is carried out in Iceland. No acidification problems.

General: The choice of indicator must be reconsidered. Only relevant for Norway and Sweden.

5. TOXIC CONTAMINATION

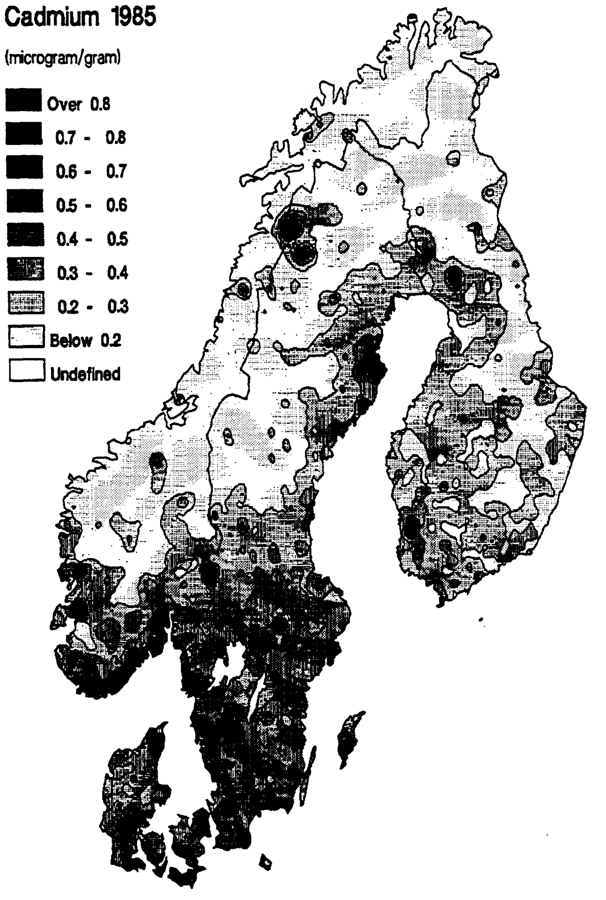
Toxic contaminants (also called environmentally hazardous substances, cf. North Sea Declarations) may be harmful to the natural environment even at low concentrations or in small quantities. They are persistent, and may accumulate in the food chain. Their most serious effects include impairment of reproductive processes and foetal damage. They may also weaken the immune system, the nervous system or muscle function in both humans and animals.

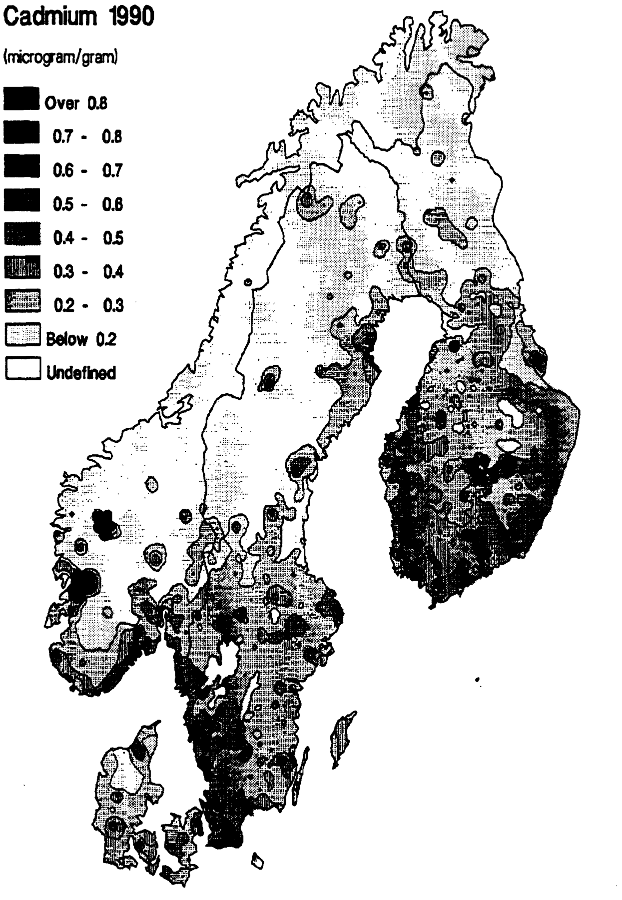
The hazardous substances include heavy metals such as lead, mercury and cadmium, and organic compounds such as dioxins and PCBs. They enter the environment through discharges from industry and mines, transport, use of products, incineration of waste and municipal waste water. In addition, environmentally hazardous substances may leach from cultivated land, landfills, contaminated ground and polluted sediments. To these sources must be added long-range transport of hazardous substances in the atmosphere and with ocean currents.

Pressure

Cadmium in moss

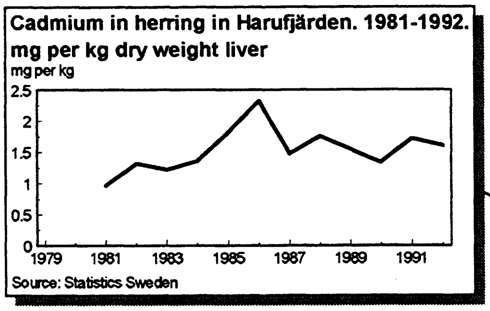
Mosses absorb most of their supply of nutrients from the precipitation. Therefore the content of other substances, e.g. heavy metals, is a good indicator of what is supplied through the precipitation. The cadmium deposition decreases along a gradient from the south-western parts of Scandinavia to smaller quantities in the northern parts. In the central and northern parts of Norway, and the northern parts of Sweden and Finland, the concentrations of cadmium in moss are usually less than 0.2 μg per gram dry weight. Higher concentrations may occur locally, however. Concentrations of 0.2-0.5 μg/g may be measured in somewhat more polluted areas, and values exceeding 0.7 μg/g are recorded in some places close to industrial activity. The deposition of cadmium has decreased considerably since 1985.



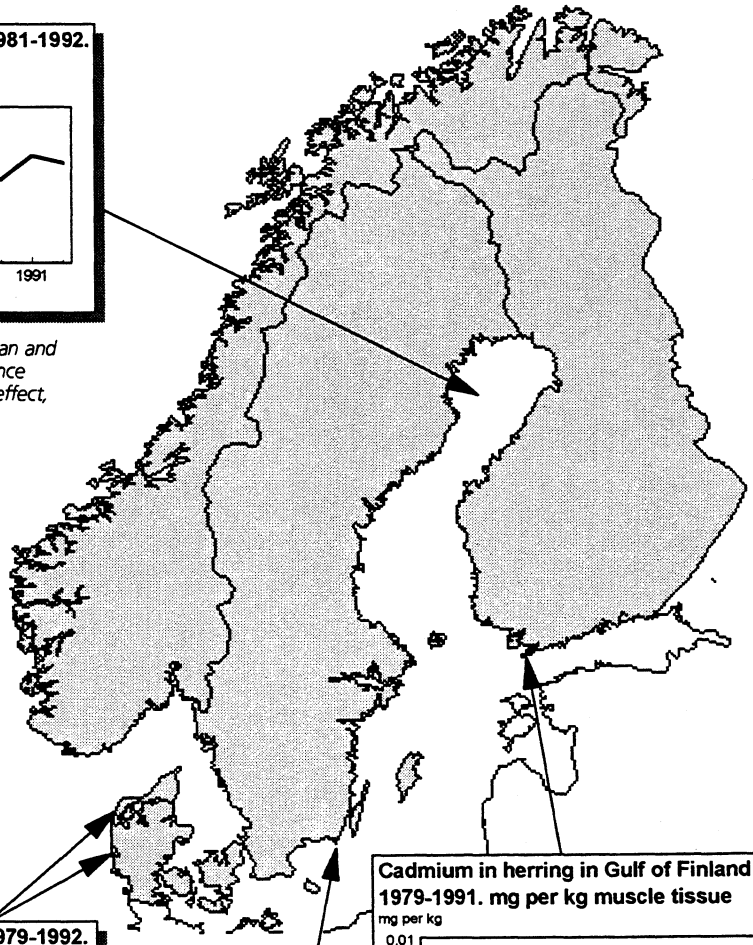


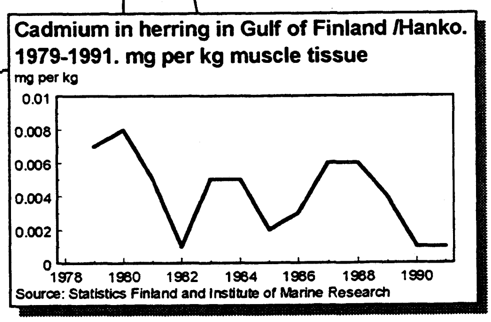
Source: Swedish Environmental Research Institute, Lund.
(See better, enlanged version in Appendix)

HEAVY METALS

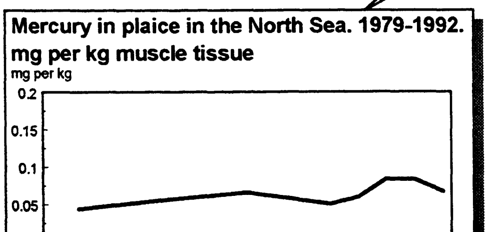


Cadmium content in herring, both in Utlängan and in Harufjärden, has increased significantly since 1980. The reasons for this increase, and its effect, have not yet been established.

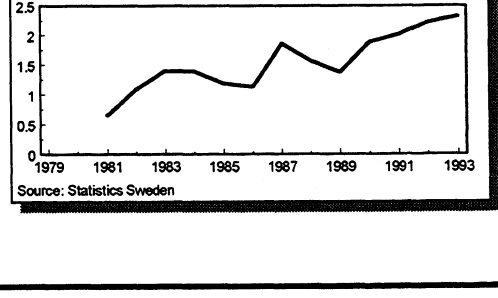


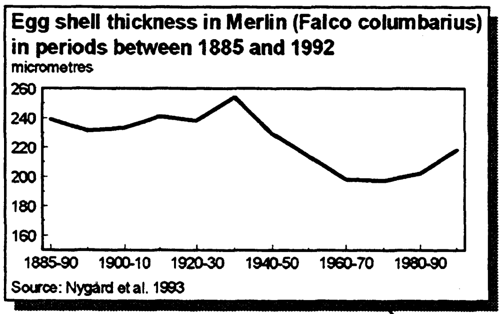


Large annual variations occur in the content of cadmium in herring in the Gulf of Finland.

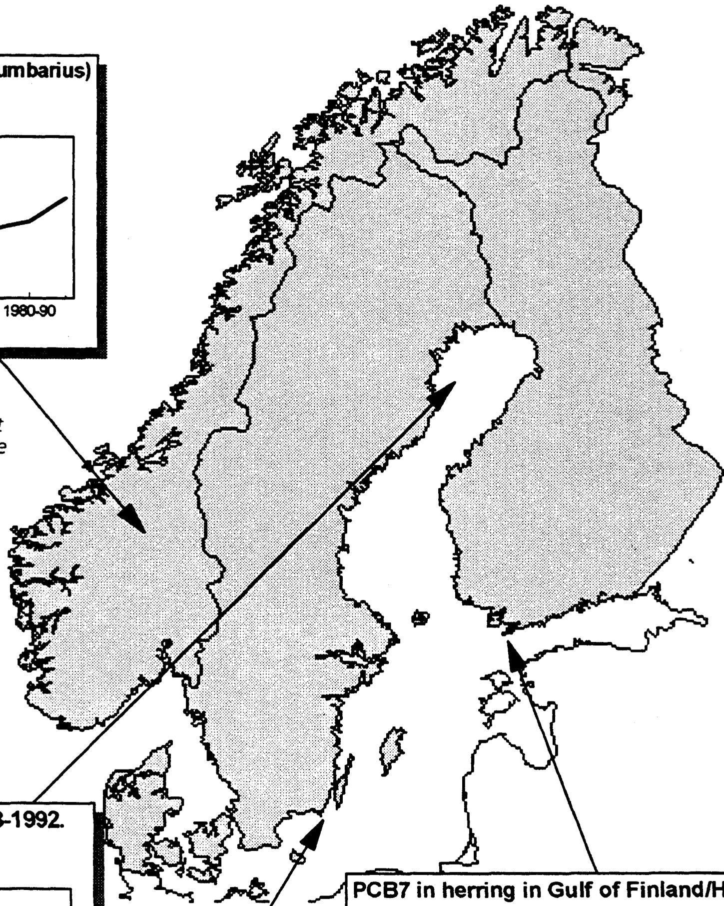


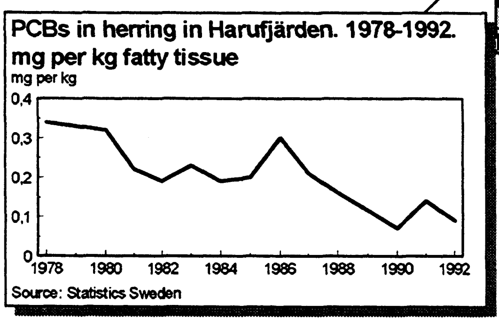
The concentration of mercury in plaice from the stations Hvide Sande and Hanstholm is higher now than in the 1970s, but a decrease was registered from 1991 to 1992. The measured concentrations lie well below the threshold limit for human consumption, which is 0.3 mg Hg/kg wet weight.



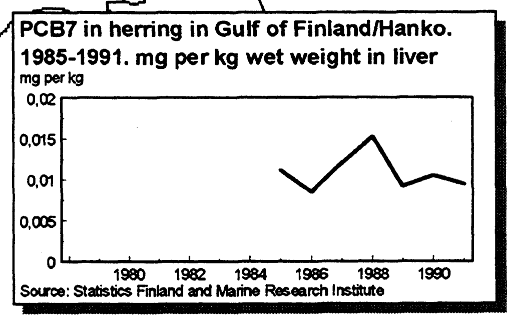


The Merlin, which nests in Norway, has been exposed to high loads of hazardous substances since World War II. DDE (a degradation product of DDT) reduces the thickness of the shell of the eggs. On average, the shell has become 15% thinner since 1947, the year when the use of DDT started on a large scale. An improvement has been observed since 1980.

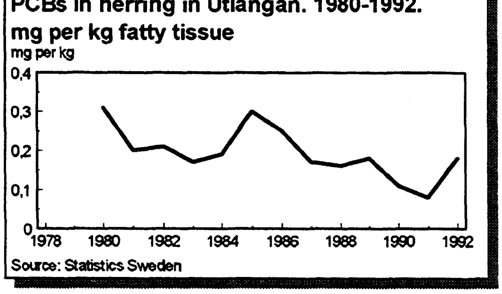




The time series for PCB in herring, both in the northern part of the Gulf of Bothnia (Harufjärden) and in the southern part of the Baltic Sea (Utlängan) show clearly decreasing trends. The levels of PCB registered in fish are assumed to originate mainly from airborne pollution.



Measurements of PCB7 in the Gulf of Finland do not show the same declining trend as seen for the PCB-measurements conducted at the Swedish stations.



Response

Collection of Hg, Cd and PCB

No statistical data available at present.

Notes on the individual indicators -

TOXIC CONTAMINATION

P - Cadmium content in moss

General: An alternative for the issue toxic contamination might be to divide the indicator into two sets; one set for the terrestrial environment and one for the marine environment. Furthermore, in subsequent versions of an official report on environmental indicators, it would be possible to present a P-S-R set for one hazardous substance at a time, and rather choose different hazardous substances (metals/organic substances). A proposal from the Norwegian editor that cadmium in the precipitation at selected stations could be an alternative P-indicator. Long time series are available for this value. The maps showing cadmium in moss were drawn by Åke Rühling (Swedish Environmental Research Institute, Lund).

S - Heavy metals

Cadmium (Cd) in herring in the Gulf of Finland/Hanko (Hangö): Concentrations measured as wet weight in muscle tissue.

Cadmium in herring in Utlängan and Harufjärden: Measured in liver, dry weight.

Mercury in plaice: Measured in muscle, wet weight. The values represent the average of measurements at the 2 stations Hvide Sande and Hanstholm.

S - Organic hazardous substances

PCB7 in herring in the Gulf of Finland/Hangö: Concentrations measured as wet weight in liver tissue. Time series are also available for PCB from 1979, which show a clearly declining trend, but no values are available from after 1987. If these measurements are no longer carried out, these data are unsuitable for use as indicator.

PCB in herring in Utlängan and Harufjärden: Concentrations measured in fatty tissue. The PCB values are expressed as IUPAC 138 and 163, which account for approximately 10 per cent of the total PCB.

Egg shell thickness in Merlin: Source: Nygård, T., P. Jordhøy and J.U.Skaare 1993: *Landsomfattende kartlegging av miljøgifter i dvergfalk* (Nation-wide survey of hazardous substances in Merlin). Commissioned report 232, Norwegian Institute for Nature Research (NINA), Trondheim.

R - Collection of mercury (Hg), cadmium (Cd) and PCB

General: Doubtful indicator, owing to lack of/poor basic data and uncertainty about what it indicates. With high consumption, the amount collected can also be high - even if the share collected in relation to total consumption may be small, and therefore the discharges high. A better indicator would be: *Collected, recycled, destroyed or permanently deposited Hg, Cd and PCB in relation to total consumption of these substances*. However, the problem of poor basic data will still remain. The data are often available in the form of "Waste containing heavy metals", "Waste containing PCBs". etc., that is to say, figures for "mixed" waste, making it difficult or even impossible to derive figures for the quantity of the different substances.

6. URBAN ENVIRONMENTAL QUALITY

Air pollution and noise are serious environmental problems in cities and urban settlements. High concentrations of different air pollutants cause health disorders such as asthma and other respiratory complaints. Local air pollution also causes damage to the vegetation and corrosion of materials in buildings and historic monuments. Air pollution from industry and heating installations has been reduced considerably during the last decades. In the Nordic countries, road traffic is now the dominating source of local air pollution in urban areas.

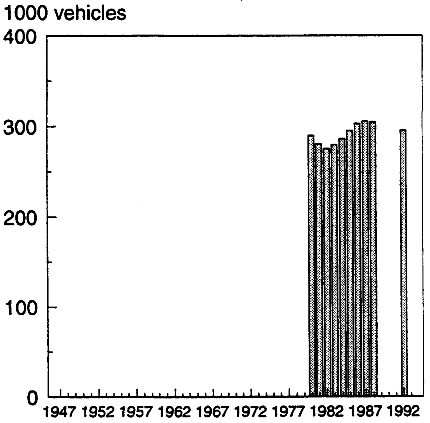
Road traffic - along with other forms of transport - is also the most important source of noise. Noise can lead to reduced contentment and well-being, disturbed sleep and health disorders such as high blood pressure. Noise in the vicinity of the home can also have an indirect effect on health, due to less opening of windows for purposes of ventilation.

Pressure

Number of private cars and light commercial vehicles in the capitals

Road traffic is the most important source of both air pollution and noise in cities and urban settlements. It also has a negative effect on the environment, and on well-being, through the barrier-effects of the roads.

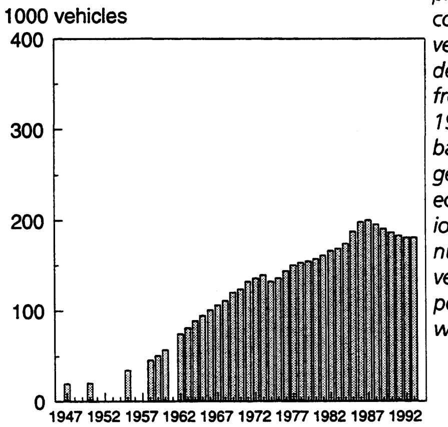
Number of private cars and commercial vehicles. Copenhagen (capital area). 1980-1988 and 1992



Source: Danmarks Statistik

The number of private cars and commercial vehicles within the region constituting the capital increased during the 1980s but, like in the other Nordic capitals, the number decreased in the early 1990s. In 1992, the number of vehicles per person in the capital region was 0.26. In Copenhagen county the number was 0.31 vehicles per person.

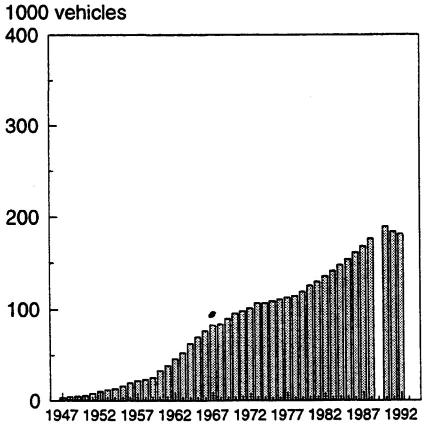
Number of private cars and commercial vehicles. Oslo. 1947-1993



Sources: Directorate of Public Roads and Statistics Norway

The number of private cars and commercial vehicles decreased in Oslo from 1987 to 1993. The probable reasons is general economic recession. In 1993, the number of vehicles per person in Oslo was 0.38.

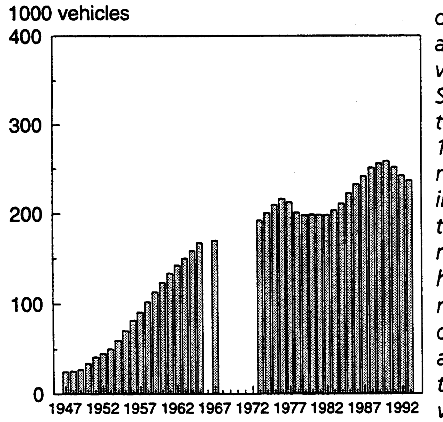
Number of private cars and commercial vehicles. Helsinki. 1947-1993



Sources: Statistics Finland and Helsinki city

Since 1990, the number of private cars and commercial vehicles in Helsinki has decreased. In 1992, the number of vehicles per person was 0.36.

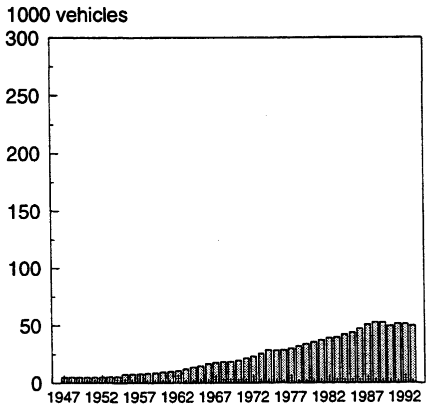
Number of private cars and commercial vehicles. (light trucks). Stockholm. 1947-1993



Source: Statistics Sweden

After a decrease in the number of private cars and commercial vehicles in Stockholm at the end of the 1970s, the number increased during the 1980s. In recent years, however, the number has decreased again. In 1993, the number of vehicles per person in Stockholm was 0.34.

Number of private cars and commercial vehicles. Reykjavik. 1947-1993



Source: Statistical Bureau of Iceland

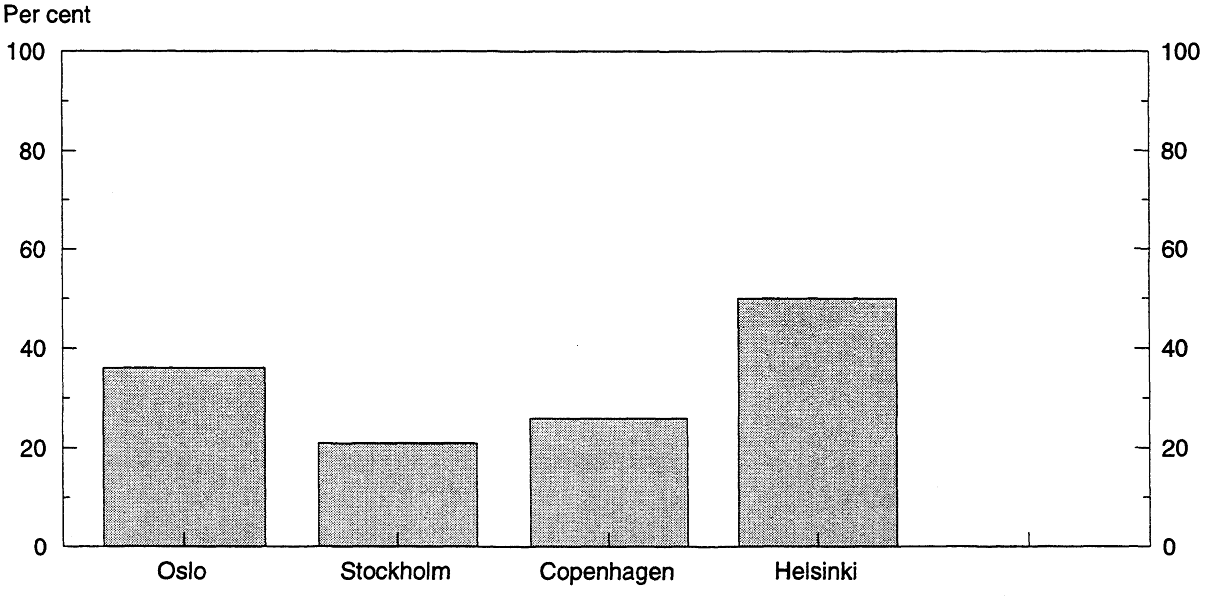
Up to 1988, there was a steady increase in the number of vehicles in Reykjavik, but a decrease in the number has been registered since 1989. In 1988, the number of vehicles per person in Reykjavik was 0.56. In 1993, this figure had dropped to 0.49.

State

Number of persons in the capitals who are exposed to noise from road traffic

Noise is undesired sound. It can have a negative effect on health, generate discontent, lead to changes in behaviour and disturb conversation, and can be generally experienced as a nuisance. The most important source of noise is road traffic, but other major sources are other forms of transport (air traffic in particular), industry, and building and construction. Noise from neighbours is also a widespread problem. As far as road traffic is concerned, the level of noise depends on the amount of traffic, pattern of driving and share of heavy vehicles.

Share of the population in the Nordic capitals who are exposed to road traffic noise exceeding 55 dBA



Sources: Environmental Health Dept. Oslo, Environmental protection Agency (Stockholm), Helsinki city and Ministry of Transport and National Agency of Environmental Protection (Copenhagen)

Copenhagen
In the region comprising the capital, about 350,000 persons are exposed to a level of noise from road traffic exceeding 55 dBA.

Helsinki
About 250,000 persons are exposed to a level of noise from road traffic exceeding 55 dBA. The problem is expected to become more serious, in spite of more stringent requirements in respect of noise.

Oslo
In Oslo, about 170,000 persons (36 per cent) are exposed to a level of noise from road traffic exceeding 55 dBA. About 65,000 of these (14 per cent of the total) are seriously disturbed by noise. For the country as a whole, about 1 million persons in Norway are exposed to noise exceeding 55 dBA.

Stockholm
Noise from road traffic is a nation-wide problem affecting more than 2 million persons in Sweden. The majority of these - about 70 per cent - live in urban areas. However, noise is not only a problem associated with the cities. Only about 15 per cent of the persons exposed to noise levels exceeding 55 dBA live in Stockholm, Gothenburg or Malmö. The number of persons exposed to high levels of noise has been reduced by half in Sweden since the 1960s.

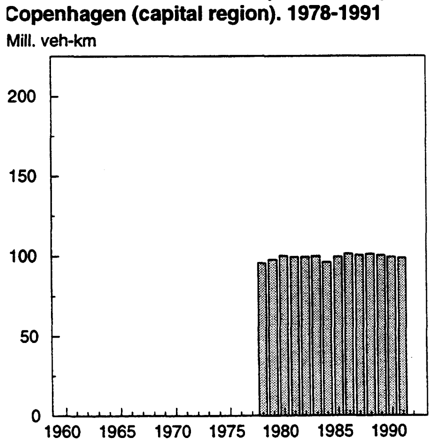
Response

Number of vehicle-kilometres of public transport in the capitals

As yet, Denmark is the only one of the Nordic countries that has introduced national, binding threshold limits for concentrations of air pollution and for noise. Such values must also be defined in the other Nordic countries in connection with EEA/EU.

Measures to reduce the effects of noise from road traffic include screening people from noise by building noise barriers, and insulating windows and walls, but such measures simultaneously increase the barrier effect of the roads. Environmental problems can be reduced, for example, by encouraging increased use of public transport and bicycles, reducing private driving in residential areas by building physical obstacles, improving the combustion technology of the vehicles' engines (catalytic convertors) or gradually increasing the use of electric vehicles as this becomes a realistic alternative to vehicles with a combustion engine.

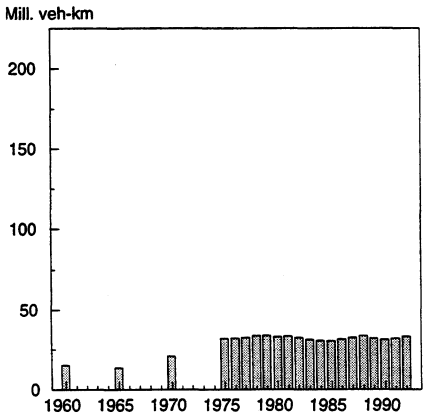
Number vehicle-kilometres public transport. Copenhagen (capital region). 1978-1991



Sources: Copenhagen Region Transport Corporation, Danish State Railways, Danish Private Railways Office

The number of vehicle-kilometres in the region of the capital seems to have remained relatively constant since the end of the 1970s.

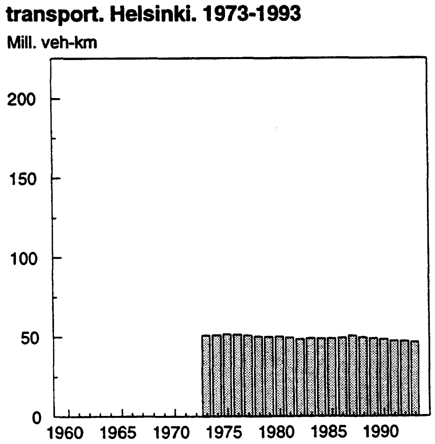
Number vehicle-kilometres public transport Oslo. 1960-1992



Source: Oslo Sporveier

The number of vehicle-kilometres seems to have varied very little since the mid-1970s. The number of passengers has decreased by about 5 per cent during this period.

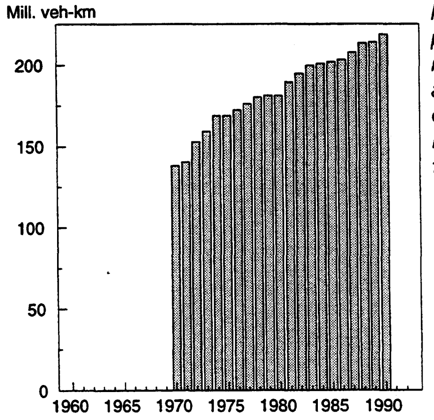
Number vehicle-kilometres public transport. Helsinki. 1973-1993



Source: Helsinki City Transport

Both the number of vehicle-kilometres and number of passenger-kilometres has decreased in recent years in Helsinki. There is no official explanation of the reduction, but it could be a result of a strong increase in unemployment, and consequently less need for use of public transport to get to work.

Number vehicle-kilometres public transport. Stockholm. 1970-1990



Source: Stockholm Transport

The number of vehicle-kilometres of public transport increased by almost 60 per cent in Stockholm from 1970 to 1990.

Notes on the individual indicators - URBAN ENVIRONMENTAL QUALITY

P - Number of private cars and light commercial vehicles in the capitals

Iceland: Definition private car: Up to 1985 inclusive - 0-7 passengers; from 1986 onwards, 0-8 passengers. Up to 1985 inclusive the statistics include only vehicles with a Reykjavik registration number. That is to say, vehicles bought outside the area were not re-registered. From 1986 onwards the vehicles were registered according to the owner's home address. In 1990, a new tax on motor vehicles was introduced which made it more expensive to keep an old vehicle without de-registering it.

Norway: Up to 1973 inclusive the number of vehicles includes vehicles that were de-registered in the course of the year. The figures apply to Oslo municipality.

Finland: For the period 1947-1959 the statistics refer to private cars only. The figures apply only to the city of Helsinki.

Sweden: The figures apply to Stockholm municipality and include private cars and light trucks.

Denmark: The figures apply to the area of the capital (Copenhagen and Fredriksberg municipalities and Copenhagen county). Apply to private cars and commercial vehicles with a total weight of less than 2000 kg.

General: The proposed indicator (number of private cars and commercial vehicles per capita) has been changed. Reason: The number of vehicles may increase steadily with the number of persons. Within the defined region, the originally proposed indicator does not change in this case, but both noise and pollution will increase. In the continued work it should be considered whether an attempt should be made to prepare figures for the share of less noise-generating vehicles and less-polluting vehicles (catalyst vehicles), and perhaps gradually for electrically run vehicles. This would give a true indication of changes, and would clearly be a better indicator than just the total number of vehicles.

S - Number of persons in the capitals who are exposed to noise from road traffic.

Iceland: No statistics available on the number of persons exposed to noise from road traffic.

Norway: The figures apply to Oslo municipality in 1992, and are minimum estimates.

Finland: The figures apply to the city of Helsinki in 1992.

Sweden: The figures apply to the municipality of Stockholm.

Denmark: The figures apply to the area of the capital. The reported figure refers to the number of dwellings exposed to noise, and has been used to estimate the corresponding number of persons.

General: The indicator is defined as the number of persons exposed to noise from road traffic with a 24-hour equivalent level of > 55 dBA (L_{Aeq}) measured at the outside wall of the house.

R - Number of vehicle-kilometres of public transport in the capitals

Iceland: No time series reported, but it is reported that the number of vehicle-kilometres of public transport has amounted to about 7 per cent of the total traffic during the last five years, and that the share was about 2 per cent higher during the period 1985-1987. Public transport in Reykjavik includes only buses.

Finland: The figures apply to Helsinki city itself and cover the following:

- Buses run by the Helsinki transport service
- Contracted bus transport in Helsinki
- Trams
- Underground trains

Not included: Suburban trains, regional buses, ferries.

It is recommended to use the figures for the *whole region constituting the capital* and not just for the city itself. Another recommendation is to use *passenger-kilometres* rather than vehicle-kilometres. It is more common to use passenger-kilometres rather than vehicle-kilometres in Finland.

Norway: The figures cover buses, trams and underground trains. Suburban trains and ferries are not included. Applies to Oslo municipality.

Sweden: The figures cover all route traffic. The figures apply to Stockholm county.

Denmark: The figures apply to the capital region (Copenhagen and Fredriksberg municipalities and Copenhagen, Fredriksborg and Rosenkilde counties). Includes kilometres for bus, tram and train (i.e., for train and tram, this does not mean vehicle-kilometres). Regional trains are not included.

General: It would be best to replace this indicator with *Number of passenger-kilometres*. Figures for passenger-kilometres are reported only for Finland and Sweden. Another alternative could be to replace the R-indicator with e.g. number of passenger-kilometres for suburban trains, trams and scheduled bus routes on national level. It seems to be easier to obtain data on national level than for the capitals. This would still be an "urban indicator".

7. BIODIVERSITY

The United Nations Environment Programme (UNEP) defines the term biodiversity as follows:

- The diversity and variation of all living species or organisms, wild or domesticated, within all taxonomic series, that is to say, all plants, animals and micro-organisms.
- The environment, ecosystems and the ecological processes of which the species or organisms are an integrated part.

The term is used at three levels:

- diversity of species
- genetic variation within the species and the populations
- variation of biotopes and ecosystems and their biological processes

Biological diversity is not an unchangeable dimension. It is changing constantly - at least in the long term - as part of a natural process, where species and populations die out, are changed or appear, but today, human activities are causing extinction of genes, species and biotopes at a much greater rate than occurs through natural processes. Some scientists have estimated that at least 50 species become extinct every day.

Forestry, agriculture, pollution, hydropower development and other physical encroachments in the natural environment are serious threats to biodiversity.

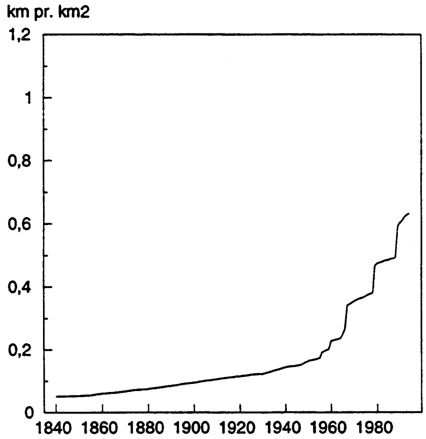
The Convention on Biological Diversity emphasizes that preservation of the biological diversity is the responsibility of the entire human race.

Pressure

Total kilometres of road per unit of land

The areas in the Nordic countries that can be characterized as pristine nature or wilderness have been reduced considerably in the course of this century. One of the main reasons for this is the building of roads. A constantly denser network of roads leads to fragmentation of habitats, and more traffic and disturbance of the environment.

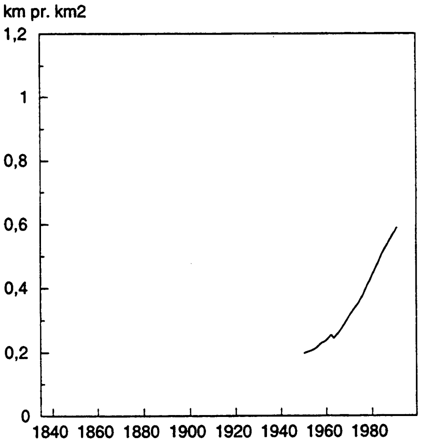
Length of road per km2 land area. Norway



Source: Directorate of Public Roads

Today, Norway has about 100,000 km of forest roads and 90,000 km of public roads. In recent years an average of 2,800 km of forest roads have been built every year. Today, 22 % of the land on the mainland is more than 5 km distance from a road suitable for motor vehicles, as against 50 % at the turn of the century.

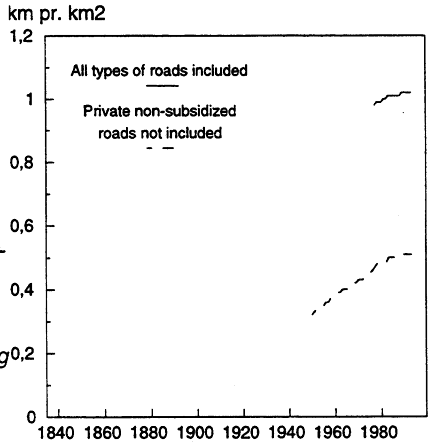
Length of road per km2 land area. Finland



Sources: Statistics Finland and Finnish Forest Research Institute

At the end of the 1980s, Finland had about 88,000 km forest roads and 76,000 km of public roads. The road building has made it possible to reach areas of previously untouched nature. Even in densely built-up southern Finland, road building has had the unfortunate effect of fragmenting the few natural or relatively untouched ecosystems still in existence.

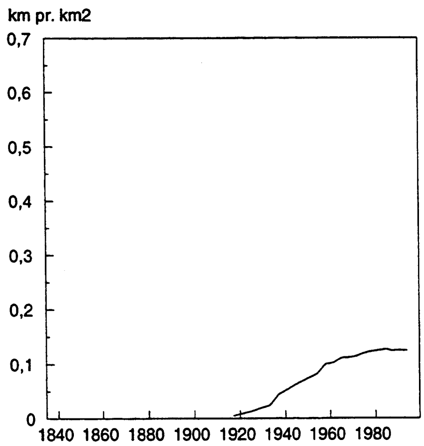
Length of road per km2 land area. Sweden



Source: Statistics Sweden

The forest landscape in Sweden has become fragmented by a network of forest roads. Today, about 200,000 km of road have been built mainly for forestry purposes. In recent years, about 3,500 km of new forest roads have been built annually.

Length of road per km2 land area. Iceland



Source: Statistical Bureau of Iceland

The total length of roads in Iceland has remained relatively stable for the last 15-20 years, and no major changes are expected in the near future. Iceland has just over 0.1 km road per km² land.

State

Endangered and vulnerable species

In all the Nordic countries, all known vascular plants and all known vertebrates (except for marine fishes) have been evaluated to decide threat status. In all the countries except Denmark, the highest share of threatened species is found among the vertebrates. Agriculture and forestry represent major threats to the biological diversity.

Denmark: A report on the overall status of Denmark's flora and fauna in 1990 showed that about 1/3 of the species need to be specially protected. Since 1850, it has been recorded that 353 species have become extinct in Denmark. A total of 456 species are acutely threatened or endangered (E) and 880 are vulnerable (V).

Norway: The Norwegian Red List contains a total of 1839 species. Of these species, 150 are endangered (E) and 279 are vulnerable (V). 45 species are registered as extinct (Ex) in Norway, that is to say, they have not been recorded in the country during the last 50 years.

Sweden: The species included in the Swedish Red List comprise 7 per cent of the total number of species. Since 1850, more than 200 species have been registered as extinct.

Finland: As per 1990, 138 species are registered as extinct (Ex) in Finland. 217 species are recorded as endangered (E) and 308 as vulnerable (V). The Finnish Red List contains a total of 1692 plant and animal species.

Iceland: No official Red List has been published for Iceland as yet, but such a list is expected to be prepared in 1995. Relatively few species are recorded as extinct.

Threatened species in the Nordic countries - includes categories E (endangered) and V (vulnerable)

	Number threatened species	Percentage of number of evaluated species
Finland		
Cryptogams	247	6,7
Vascular plants	88	5,7
Invertebrates	158	1,4
Vertebrates	32	8,6
Sweden		
Cryptogams	344	5,7
Vascular plants	163	8,2
Invertebrates	726	2,4
Vertebrates	43	9,0
Norway		
Cryptogams	254	3,4
Vascular plants	87	6,3
Invertebrates	58	2,9
Vertebrates	30	8,1
Iceland		
Cryptogams	43	3,9
Vascular plants	13	2,7
Invertebrates	7	0,6
Vertebrates	10	11,9
Denmark		
Cryptogams	681	17,5
Vascular plants	117	8,1
Invertebrates	498	12,6
Vertebrates	40	13,7

Sources: Norway: Directorate for Nature Management; Sweden: Environment Protection Agency; Iceland: Museum of Natural History, Institute of Freshwater Fisheries, The Wild Life Management Unit; Finland: Statistics Finland; Denmark: National Forest and Nature Agency (figures taken from the publication *Tal om natur og miljø 1994* (Figures for natural resources and the environment 1994).

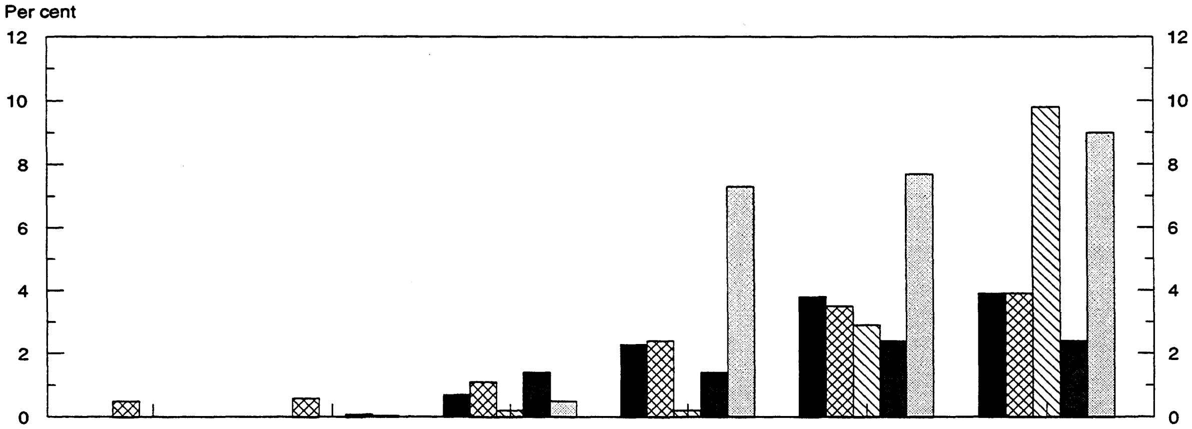
Response

Protected areas

Today, a total of about 4 per cent of the land in the Nordic countries is protected in the form of national parks, nature reserves, landscape protection areas or other protected areas. If protected areas in Svalbard and Greenland are included, as much as 23 per cent of the land is protected. The amount of protected area has increased considerably since the protection work was started seriously in the 1960s and 1970s. Even so, there is some way to go before the recommendation by the World Conservation Union (IUCN) recommendation that all countries should protect 15 per cent of all types of natural environment is realized. The IUCN has recommended, as a preliminary goal, that all countries protect 10 per cent by the end of the year 2000.

Of the Nordic countries, Denmark and Iceland are the ones with the largest share of protected land in relation to total land area, 10 per cent and 9 per cent respectively. The smallest share of protected land, between 2 and 3 per cent, is found in Finland.

Protected area in the Nordic countries. Percentage of the total area (land area incl. fresh water)



	1920	1950	1970	1980	1985	1990
Norway	0,0	0,0	0,7	2,3	3,8	3,9
Sweden	0,5	0,6	1,1	2,4	3,5	3,9
Denmark	0,0	0,0	0,2	0,2	2,9	9,8
Finland	0,0	0,1	1,4	1,4	2,4	2,4
Iceland	0,00	0,04	0,50	7,30	7,70	9,00

Source: OECD - Environmental data

Major protected areas 1990, km²:

Norway	-	12 664
Sweden	-	17 584
Denmark	-	4 225
Finland	-	8 073
Iceland	-	9 264

Notes on the individual indicators - BIODIVERSITY

P - Total kilometres of road per unit of land

Sweden: Several breaks in the time series. The statistics cover national roads (complete time series from 1950), municipal roads (subsidized and non-subsidized, complete time series), private roads (subsidized from 1956; non-subsidized from 1977). The category "private non-subsidized roads" is the largest category, comprising 200,000 km.

Norway: The statistics up to 1925 inclusive cover only public roads outside the cities. From 1927 inclusive, figures are available for public roads inside the cities for the years 1927, 1937, 1947, 1953 and 1957. As from 1965, the statistics refer to the total length of public roads. As from 1950, private forest roads are included for some years (1950, 1956, 1960, 1967, 1979). As from 1967, private tractor roads are included for some years (1967 and 1979). From 1989 inclusive, annual statistics are available for all categories of roads. Up to 1957 the statistics are per 30/6. From 1957 inclusive they are per 1/1.

Finland: The statistics refer to all public roads per 1/1 for the period 1950-1994. Data for forest roads from 1952-1991 (from 1960, forest roads are specified as belonging to industrial companies, the state or private persons).

Iceland: The statistics cover the total length of public roads.

Denmark: Statistics are available for public roads only. It is pointed out that the roads are of considerable importance as regards fragmentation of the landscape. However, it is also pointed out that, since the greater part of Denmark is influenced by human activities, changes in the length of road per unit of land will not necessarily affect the biodiversity.

S - Endangered and vulnerable species as share of known number of species

General: Endangered and vulnerable species refer to the IUCN categories E (endangered) and V (vulnerable). It has not been possible to prepare a time series for this indicator.

Norway: The cryptogams include only fungi, macrolichens and mosses. Algae and crustose lichens have not been evaluated. To the total number of species in Norway must be added a number of non-evaluated groups, e.g. marine invertebrates, and a number of non-evaluated families in the order Coleoptera (beetles). The following groups of invertebrates have been evaluated: freshwater molluscs, leeches, mayflies, stoneflies, dragonflies, grasshoppers and crickets, water bugs, lacewings/scorpion flies, moths and butterflies, caddis flies and beetles. Only 20 per cent of a total of about 3300 beetle species have been evaluated as regards threat status. Marine fishes and whales (except porpoise) have not been evaluated.

Finland: Only 45 per cent of the invertebrates and 25 per cent of the cryptogams have been evaluated.

Sweden: The cryptogams include mosses, macromycetes and lichens.

Iceland: Vertebrates include terrestrial mammals (4 species), freshwater fishes (5 species) and birds (75 species). Endangered and vulnerable species are found only among the birds. Marine fishes are not included and have not been evaluated. The invertebrates include only insects (1245 species). Molluscs (530 species) have not been evaluated as threatened or not. The cryptogams include mosses (about 560 species), lichens (about 550 species), fungi (about 300 species) and marine algae (about 250 species, not including Crysophyceae, Cyanophyceae and Diatoma). The fungi and algae have not been evaluated as threatened or not. The vascular plants comprise 483 species.

Denmark: The cryptogams include only macromycetes and lichens. Invertebrates include the following groups: Mayflies, stoneflies, caddis flies, beetles, butterflies, burnet moths and black flies. Vertebrates include fish, amphibians, reptiles, birds and mammals.

R - Protected area

General, Nordic countries: All the figures (also the national figures) are taken from OECD Environmental Data Compendium 1993. The source is IUCN/OECD, and the areas include the IUCN categories I-V. A minimum limit of 10 km² is defined for protected land, unless the land is an island. This implies, for example, that one national park in Norway (Ormtjernkampen) is not included, since it covers only 8.5 km².

Norway: Svalbard, Jan Mayen and Bouvet Island are not included. If the protected areas here are included, the protected area increased to 47,624 km² in 1990, or 14.7 per cent of Norway's territory.

Denmark: Greenland - with 2 protected areas totalling 710,500 km² is not included.

8. CULTURAL AND NATURAL LANDSCAPES

The expansion of urban settlements, widespread clear-cutting of forested areas, road building, return of natural vegetation to uncultivated land (outfields), changing the course of rivers, drainage (ditching) of wetlands or re-organization of cultivated land from small to large units, are all examples of changes in the landscape which influence our conception of its value. Such changes are often regarded as negative, not only because of their possible effects on biodiversity, but also because they tend to reduce the aesthetic value of the landscape in our eyes - whether this be the natural landscape or the cultural landscape. Landscapes that we conceive as aesthetically valuable are important for recreation and outdoor pursuits, and just knowing that such areas exist can be beneficial in itself.

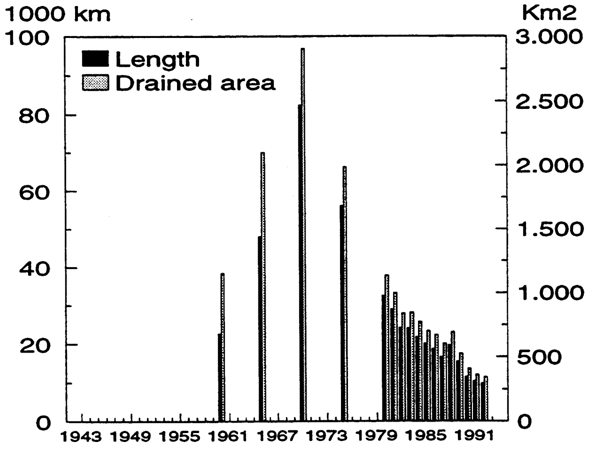
The wetlands, which include marshes, river deltas, tarns, swamps, salt marshes and areas of shallow water along the coast, are the most threatened ecosystems existing today. They are characterized by high biological production and a large diversity of species. Already in the latter half of the 1800s, many of the marshes in southern Scandinavia were drained and put under the plough. In the parts of the Nordic countries most dominated by agriculture, like in Denmark and in Skåne and Mälardalen in Sweden, 90 per cent or more of the original wetlands have disappeared. In Denmark, marshes now account for less than one per cent of the total land area, as against just over one fifth before. The marshes in Iceland have also been subjected to considerable encroachments. In the northern parts of Finland, Norway and Sweden, however, it is possible to find large areas of marsh that are still totally unexploited. These areas belong to Europe's least influenced ecosystems. The Nordic countries also contain more types of marshes than found anywhere else in Europe.

Pressure

Forest ditches and drained land

Ditching and drainage of marshes and other wetlands for forestry and agricultural purposes, and for extraction of peat, has been the factor that has caused the greatest pressure on this type of ecosystem.

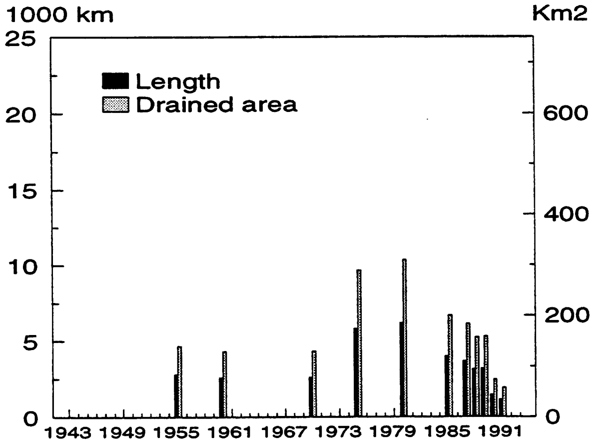
Km forest ditches and drained area. Finland



Source: Finnish Forest Research Institute

In the "heyday" of ditching of marshland at the end of the 1960s, almost one per cent of the land in Finland was affected by ditching annually. Some scientists have pointed out that an estimated 30 per cent of all the ditching has been of no use, for example, ditching of open wetland deficient in nutrients. Compared with drainage for forestry purposes, the extent of drainage for other purposes has been small. No other human activity has influenced the natural environment in Finland as much as ditching of marshes. This ditching has been reduced considerably in recent years.

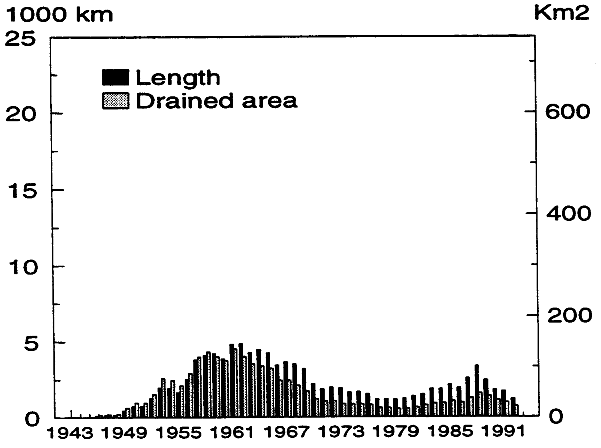
Km forest ditches and drained area. Sweden



Source: National Board of Forestry

Ditching is the activity that has had the greatest negative effect on the flora and fauna of the marsh landscape. In the mid-1980s, about 200 km² wetland were drained every year. A total of about 15,000 km² forest land has been drained by ditching in Sweden. Today, it is mainly wet forest land that is drained, and in Sweden too the ditching has decreased in recent years.

Km forest ditches and drained area. Norway



Source: Statistics Norway

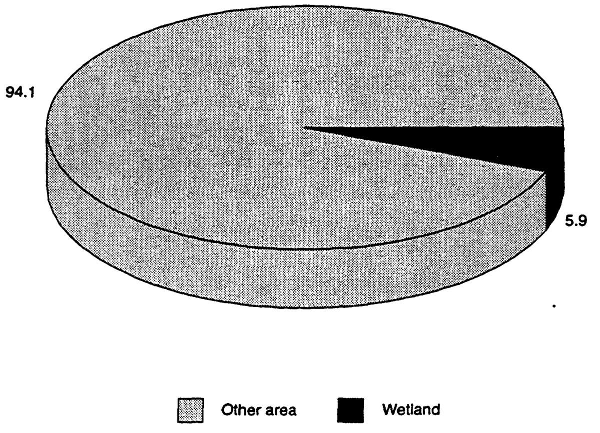
In Norway, ditching of forest land was most intensive in the 1950s and 1960s. Since 1980, the extent of ditching of forest land has decreased, after the government subsidy for ditching of marshland was withdrawn. In 1992, ditching of waterlogged forest land accounted for about 82 per cent of the drained area in 1992, as against 50 per cent in 1988.

State

Total wetland area

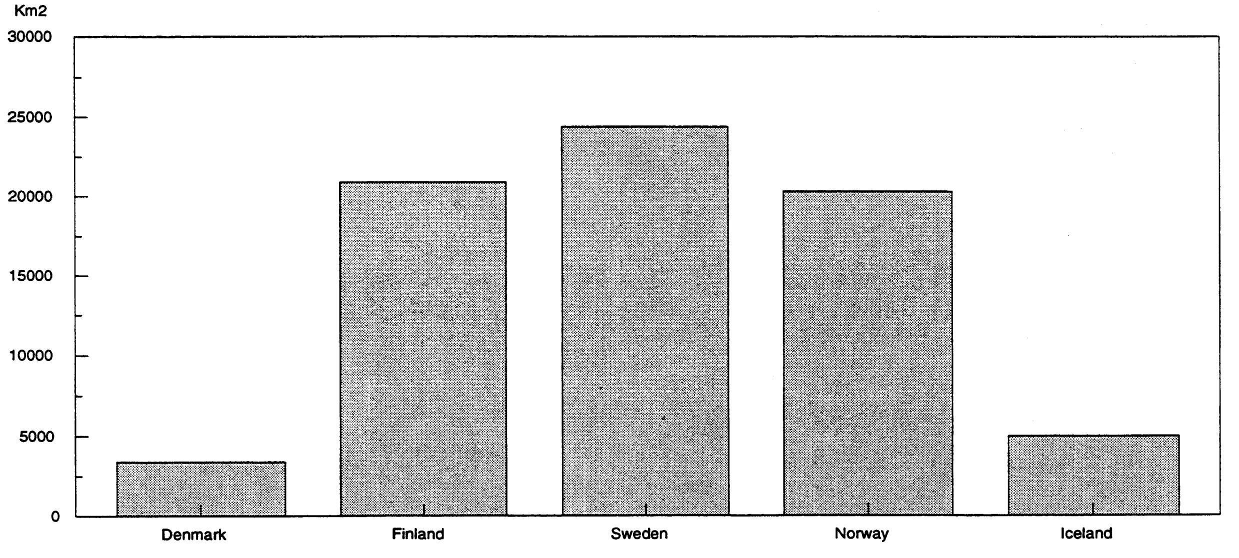
Large parts of the Nordic countries' wetlands have been lost. Good statistics describing the changes in the Nordic countries as a whole are not available. Around 1980, about 6 per cent of the area of the Nordic countries was wetland. The threat to the wetlands was officially recognized when the international convention on wetlands was signed in Ramsar in Iran in 1971. Up to 1989, 23 OECD countries had made 316 wetlands, constituting a total of 19 million hectares, protected areas, which satisfies the requirements of the convention. In spite of this, the total area of wetlands is decreasing steadily.

Wetlands, as a percentage of the total area of the Nordic countries. Per cent. About 1980



Source: OECD Environment Data 1993

Wetland area in the Nordic countries. About 1980



Source: OECD Environmental Data 1993

Denmark: In Denmark, the share of the land occupied by marshes has decreased from just over a fifth to hardly more than one per cent. About 90 per cent of the original wetlands have disappeared.

Finland: Finland is one of the countries in the world most rich in marshes. More than half of the original marshland has disappeared. In Finland, about 7,000 km² of marsh have been converted into meadow; this is about the same amount as in Sweden and Denmark. Even larger areas of marsh and other wetland in Finland have been ditched in order to increase forest production; almost 60,000 km². Wetland areas in Finland decreased by 23 per cent from 1950 to 1990.

Norway: In Norway, as much as 80 per cent of the original marshes are still relatively untouched. However, just over 4,000 km² have been drained for forest production, and about 2,000 km² for agriculture, mainly in coastal areas. Other important wetland areas, however, such as river deltas, are seriously influenced by human activities.

Sweden: Sweden already had about 6,000 km² "peat land", that is to say, marsh that had been cultivated, at the turn of the century. It has been estimated that, a couple of hundred years ago, wetlands accounted for almost 120,000 km², or 30 per cent, of the land in Sweden. Today, only just over three quarters - or 93,000 km² - remain (NB! The above figure shows only marsh areas -bogs and fens- for Sweden and Denmark). Hardly a third of this area is still relatively unaffected by human activity.

Iceland: Earlier on, the marshes probably accounted for about a third of the land in Iceland that had a cover of vegetation. Large parts of these marshes have been used since ancient times for grazing, and almost half of the areas have been ditched to improve the possibilities of grazing.

Response

Restoration of wetlands

As yet, no statistics are available for this proposed indicator.

Notes on the individual indicators - CULTURAL AND NATURAL LANDSCAPES

Introductory text: Much of the introductory text has been taken from the report *Nordens miljø - tilstand, utvikling og trusler* (The Nordic environment - status, changes and threats) (Nord 1993:11, Nordic Council of Ministers).

P - Forest ditches and drained area

Iceland: No forest ditches exist in Iceland. Other ditching has decreased since 1970. About 1,600 km of ditches have been registered, at the most. In recent years the ditching has amounted to: 57.8 km (1990), 32.7 km (1991), 12 km (1992) and 7.8 km (1993).

Denmark: Length of forest ditches is not an important parameter for Denmark, since the main cause of the reduction in wetland area is drainage for agricultural purposes. Data are available for changes in the total area of drained land for the period 1850-1980, and from a survey conducted in 1991.

Sweden: Up to 1982 inclusive, regained area is not calculated, only km ditch. The conversion has been made using the factor 200 m ditch = 1 hectare. Moreover, up to 1982 inclusive, the statistics include protective diking.

S - Total wetland area

Denmark: In the OECD statistics, wetland area is stated as including only bogs and fens.

Sweden: In the OECD statistics, wetland area is stated as including only bogs and fens.

Norway: It is somewhat unclear what kinds of wetland are included in the 20,300 km^2 reported as wetland in the statistics (the figure has been calculated on the basis of point estimates on topographic maps).

R - Restoration of wetlands

Iceland: No organized restoration of wetlands take place. However, a reduction of agricultural activities has led to considerable natural restoration of wetland areas, but no figures are available in this connection.

Sweden: From the beginning of 1994, by authority of the Nature Conservation Act, drainage of wetlands is forbidden in parts of southern and central Sweden with few wetland areas. A permit has to be obtained for ditching of such areas in the rest of the country. The protection is even more stringent in national parks and nature reserves. Today, about 3,000 km^2 mire and other wetland areas are protected in this manner.

Finland: No systematized data are available for restoration of wetland areas. Some management/restoration of wetland areas that are especially important for birds takes place.

Norway: No statistics available on this subject.

General: Few data are available on this subject. Moreover, restoration of wetland areas needs to be clearly defined.

9. WASTE

The amounts of consumer waste, waste from production processes, and hazardous waste increase every year, and landfills occupy relatively large areas of land. Deposition of waste implies a squandering of society's resources and can lead to serious pollution of air, water and the soil. Landfills are also often associated with unpleasant smells, litter and vermin, and are eyesores in the landscape.

Seepage from landfills is a major source of pollution of the environment. The high concentrations in the seepage can cause poisoning and other injury. Decomposition of the waste generates emissions of the greenhouse gases methane and carbon dioxide. Incineration of waste leads to emissions of acidic gases and heavy metals, such as cadmium, mercury and lead, and of traces of organic pollutants such as PCBs, PAHs and dioxins.

Many landfills that are no longer in use, especially landfills that have been used for disposal of industrial waste, may contain hazardous substances that leach out into the surroundings. In many places, illegal dumping of hazardous waste has caused contamination of the ground.

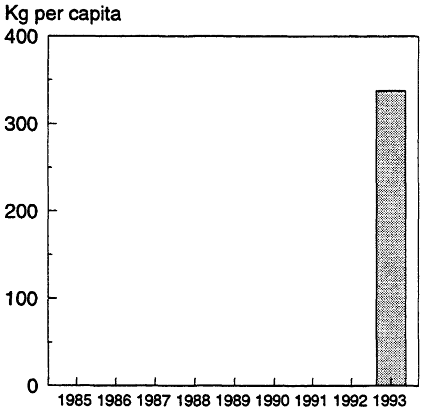
Pressure

Quantity of household waste per capita

The quantities of household waste may be considerable, but are small compared with the total quantities of waste generated. The term waste is not clearly defined, and the different countries - also the Nordic countries - base their reports on very different definitions. This makes it difficult to present comparable figures.

For example, in Finland, it is estimated that a total of 65-70 mill. tonnes of waste is generated each year, and that household waste accounts for only two per cent of this amount.

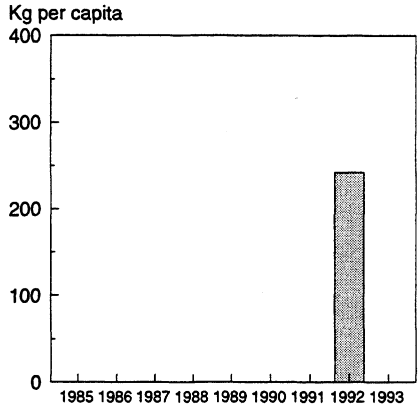
Household waste per capita. Denmark. 1993



Source: National Agency of Environmental Protection

In Denmark, a total of 1.753 mill. tonnes of household waste was generated in 1993, or 340 kg per capita. Of the amount of household waste collected as part of the general system of waste collection, 80 % is incinerated, 9 % is recycled and 11 % is deposited on landfills.

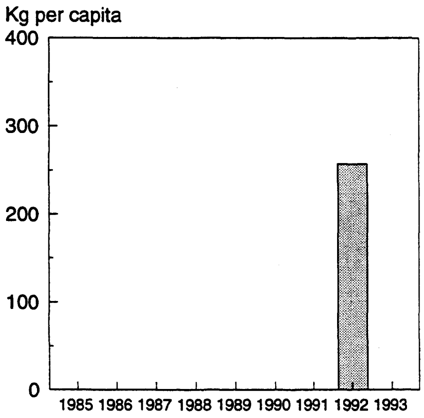
Household waste per capita. Norway. 1992



Source: Statistics Norway

In Norway, 2.2 mill. tonnes of municipal waste was collected in 1992. Of this amount, 1.04 mill. tonnes was household waste, or 242 kg per capita. About 76 % of the total amount of municipal waste is deposited on landfills, 15 % is incinerated, 8 % is delivered for recycling and only small quantities are treated biologically.

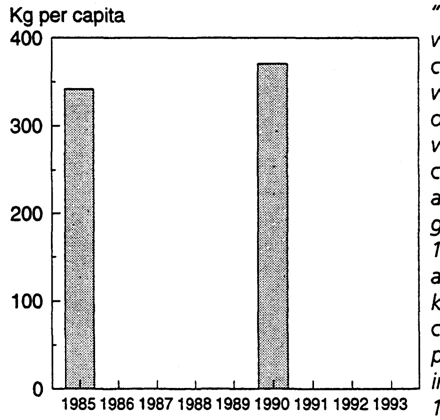
Household waste per capita. Finland. 1992



Source: Statistics Finland

In Finland, about 1.3 mill. tonnes of waste is generated annually by households. This corresponds to about 260 kg per capita.

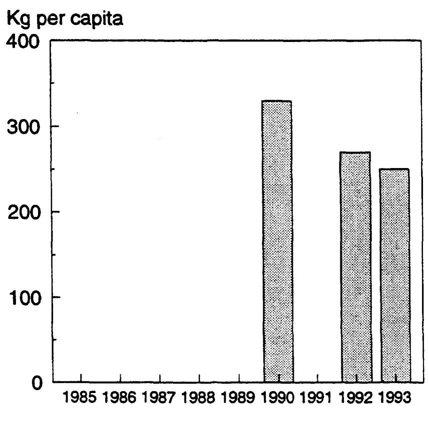
Household waste per capita. Sweden. 1985 and 1990



Source: Statistics Sweden

In Sweden, 3.2 mill. tonnes of "household" waste (also includes similar waste from offices and various forms of commercial activity) was generated in 1990. This amounts to 371 kg of waste per capita. This implies an increase in relation to 1985, when the figure was 342 kg per capita. Just over 40 % of this waste is deposited on landfills, 40 % is incinerated, 3 % is composted and just over 10 % is delivered for recycling.

Household waste per capita. Iceland. 1990, 1992 and 1993



Source: Environment and Food Agency of Iceland

In Iceland, just over 140,000 tonnes of municipal waste was generated in 1993. About 65,000 tonnes of this waste, or 250 kg per capita, was household waste. The quantities of waste have been reduced since 1990.

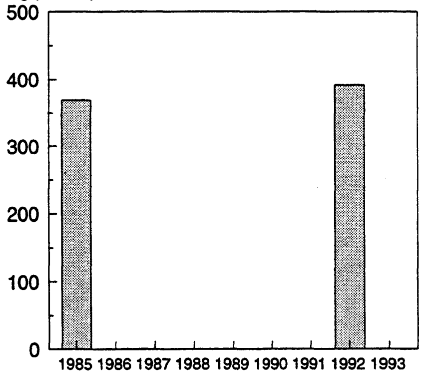
Response

Share of the municipal waste that is deposited on landfills

An important goal in all the Nordic countries is to reduce the quantities of waste, through better recycling, re-use and sorting of waste at the source. To deposit waste on landfills is really to misuse resources. In addition, landfills occupy relatively large areas of land. Waste (or at least large shares of the waste) can be incinerated, with recycling of energy, can be composted, or can be sorted and recycled. Therefore a reduction of the quantity of waste that is deposited on landfills can be regarded as an indicator of more sensible management of waste.

Deposited municipal waste. Norway. 1985 and 1992

Kg per capita

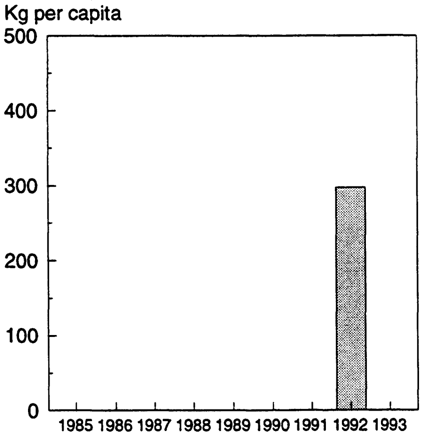


Source: Statistics Norway

In Norway, the number of municipal landfills has been reduced considerably from the end of the 1970s up to today. The trend is towards larger facilities and facilities that receive waste from several municipalities. However, the quantity of deposited waste has increased.

Deposited municipal waste. Finland. 1992

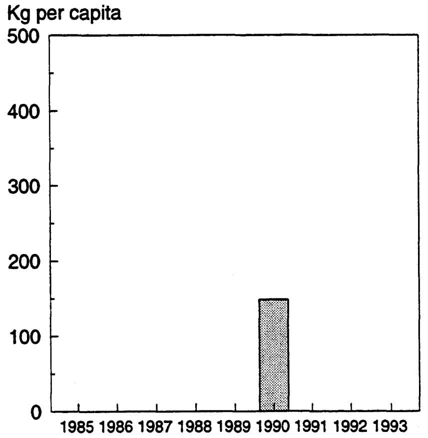
Kg per capita



Source: National Board of Waters and the Environment

Deposited municipal waste. Sweden. 1990

Kg per capita

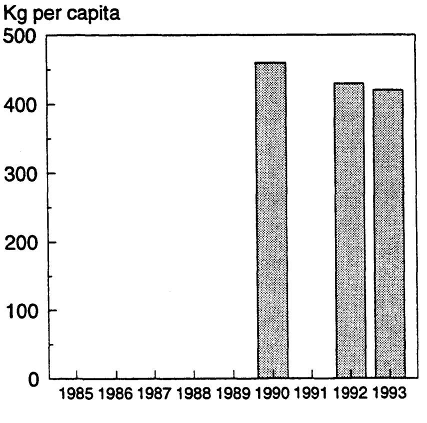


Source: Statistics Sweden

Sweden has about 300 municipal landfills in operation, and about 4,000 that have been closed down.

Deposited municipal waste. Iceland. 1990, 1992 and 1993

Kg per capita



Source: Environment and Food Agency of Iceland

About 75-80 per cent of the municipal waste generated in Iceland is deposited on landfills.

Notes on the individual indicators - WASTE

Introductory text: Large parts of the text are taken from the report *Forurensning i Norge 1994* (Pollution in Norway 1994). Norwegian Pollution Control Authority, Oslo.

Some definitions:

Sweden: Municipal waste is defined as "Household waste and similar waste that originates as a direct consequence of the fact that persons - regardless of purpose or activity - spend time in a building or installation. The group includes waste from different kinds of human activities, e.g. paper waste from newspapers and magazines, refuse, kitchen waste and less bulky garden waste, bulky waste such as discarded furniture etc. and more bulky garden waste, and waste from latrines. Establishments where waste corresponding to household waste may be generated could be: industries, personnel canteens, schools, community premises, hospitals and other institutions of care, business enterprises, restaurants, railway stations, recreation facilities" (National Environment Protection Agency: *Allmänna råd 91/Kommunal avfallsplanering enligt renhållningslagen* (General guidelines 91/Municipal waste management planning in accordance with the legislation on waste collection).

Finland: Municipal waste is defined as follows: Municipal waste is the waste generated in households, as well as waste with corresponding properties and composition generated in industry, services or any other activity.

Norway: Municipal waste means waste delivered directly to a municipal waste reception facility and consumer waste delivered directly for recycling. The figures for municipal waste also include industrial waste which the municipality delivers directly for recycling. Hazardous waste shall not be included. Household waste is defined as waste from the normal activities of the household. It includes food remains, packaging, paper and discarded furniture (Statistics Norway (1994): *Avfalls-statistikk, Kommunalt avfall 1992, NOS C 145* (Waste Statistics, Municipal Waste 1992, Norway's Official Statistics C 145).

P - Household waste per capita

Denmark: Total quantity of household waste reported to be 1.753 mill. tonnes in 1993.

Sweden: Total quantity of household waste (generated amount) reported to be 2.861 mill. tonnes in 1985. This figure is taken from Statistics Sweden: *Naturmiljön i siffor* (Natural environment in figures), fourth edition, table 2.152. The total quantity in 1990 was 3.191 mill. tonnes. If the quantity of household waste that is recycled (about 0.2 mill. tonnes in 1985 and 0.4 mill. tonnes in 1990) is subtracted, the quantity per capita in Sweden is 311 kg in 1985 and 329 kg in 1990.

Norway: Total quantity of household waste in 1992: 1.04 mill. tonnes. This figure has been used to calculate the quantity per capita (242 kg). About 95,000 tonnes (9 %) of the total quantity of household waste was recycled. If this amount is subtracted, then the quantity per capita is about 220 kg.

Iceland: Reported figures already converted into kg per capita. Total quantities of waste not reported. The quantities are calculated on the basis of recordings in the greater Reykjavik area (where 60 % of the inhabitants of Iceland live), "blown up" to national figures.

Finland: Total quantity of household waste in 1992 reported to be about 1.3 mill. tonnes.
Comment from Finland (Statistics Finland): A distinction should be made between municipal waste and industrial waste. Industrial waste should be compared with the volume of production.

General: Difficult to obtain comparable figures. The Norwegian figures for household waste include only waste from households. The Swedish figures for "household waste" also include waste from offices, various commercial activities etc. The Finnish term municipal waste corresponds to the Swedish "household waste". For Norway, good statistics are also available for municipal waste, but these are not comparable either with the Finnish municipal waste or the Swedish "household waste". Norway's figures for municipal waste probably include rather more waste from building and construction and various types of waste from commercial enterprises.
More work will have to be done to ensure that the figures for the quantities of waste generated in the different Nordic countries are comparable. More work is also necessary to establish time series.

S - Share of the municipal waste deposited on landfills

Norway: The following quantities of waste that were deposited on landfills have been used as a basis for the calculations: 1985: 1.524 mill. tonnes (78 % of total quantity of municipal waste). 1992: 1.687 mill. tonnes (76 % of total quantity).

Sweden: Reported from Sweden that about 40 % of the household waste is deposited. This corresponds to about 1.28 mill. tonnes of a total quantity of 3.2 mill. tonnes, or 149 kg deposited per capita.

Denmark: Figures reported for "general collection" from households. Of the total quantity of 1.443 mill. tonnes in 1993, 0.131 mill. tonnes (9 %) was delivered for recycling, 1.158 mill. tonnes (80 %) was incinerated and 0.154 mill. tonnes (11 %) was deposited (about 30 kg per capita). This indicates that in Denmark - seen in relation to the other Nordic countries - only a small share of the waste is deposited.

Finland: Reported that about 1.1 mill. tonnes of "solid municipal waste" was deposited on municipally owned landfills in 1992. For all kinds of landfills (regardless of ownership), the total quantity deposited was about 1.5 mill. tonnes. If this last figure is used as a basis for the calculations, then it is estimated that about 297 kg of solid municipal waste per capita is deposited on landfills in Finland.

Iceland: In Iceland, about 75-80 % of the municipal waste is deposited.

General: Recycling should be considered as a response indicator, e.g. the share of household waste or share of municipal waste recycled, or recycling of different materials (glass, plastic, paper and cardboard etc.), but as yet the statistical basis for such an indicator seems to be rather poor, at least from the point of view of comparisons between countries.

10. FOREST RESOURCES

About half the land in the Nordic countries is covered by forest. The least forest, in both absolute and relative terms, is found in Iceland, which has 1,400 km^2 of forest; slightly more than one per cent of the total land. Sweden has the most forest, with about 280,000 km^2; 68 per cent of the total land area. As much as 77 per cent (234 000 km^2) of the land in Finland is forested (OECD 1993). About 80 per cent of the total forest area in the Nordic countries is productive forest (OECD 1993 and the Yearbook of Nordic Statistics 1994).

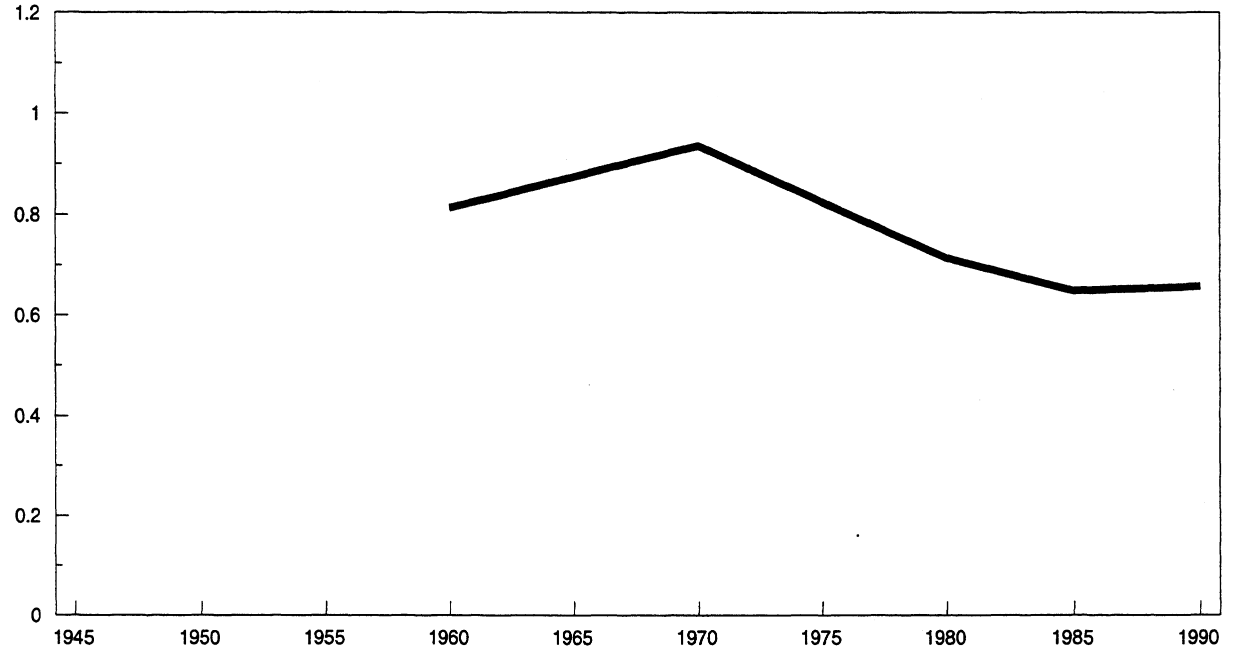
Although the volume of forest has increased considerably since the turn of the century, today's type of forest is very different. Clear-cutting, afforestation, introduction of alien species, ditching, building of forest roads, acidification and pollution are among the factors that are affecting the forest as a natural resource and the biological diversity in the forests. In Sweden the total length of forest roads has now reached 200,000 km. Finland and Norway both contain about 100,000 km of forest roads, and a further 3,000-4,000 km are being built in each of these three countries every year (NORD 1993:11).

Pressure

Removal in relation to increment

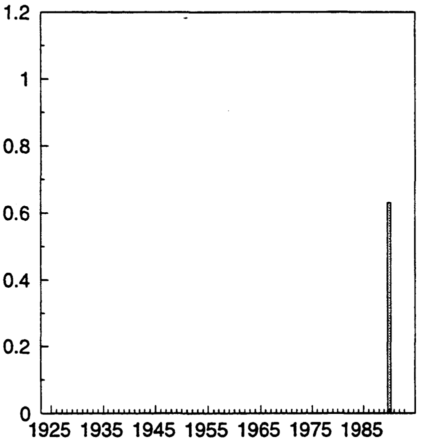
In the richly forested Nordic countries, Finland, Norway and Sweden, the amount of roundwood cut (removal) has been less than the increment for many years. This trend is the same as in most of the OECD countries.

Removal in relation to increment. Nordic countries



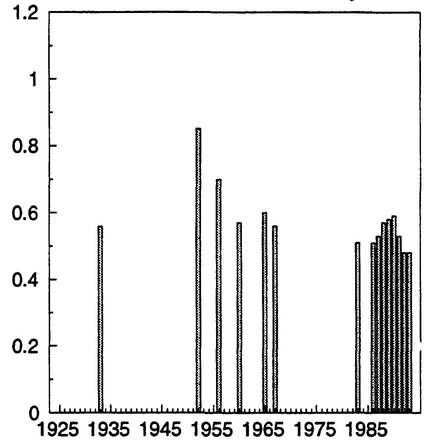
Only Finland, Norway and Sweden are included

Removal in relation to increment. Denmark



Source: Danmarks Statistik

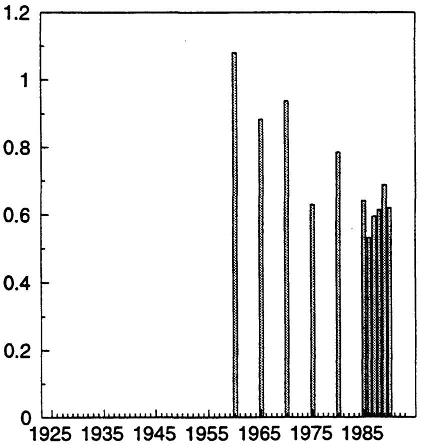
Removal in relation to increment. Norway



Source: Statistics Norway

For many years, the roundwood cut in Norway each year has been less than the annual increment. Intensive management of forest has been carried out with a view to high production of timber, along with extensive planting of trees.

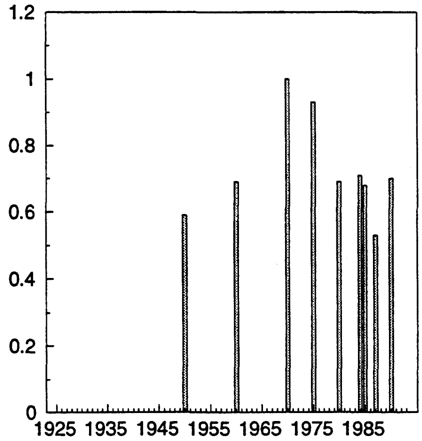
Removal in relation to increment. Finland



Source: Finnish Forest Research Insitute

Throughout the 1980s, much less timber has been felled in Finland than the annual increment to the forest. Much larger quantities could be removed without depleting the forest capital. One aspect of the situation where the forests are now producing more timber than is expected to be exploited is that there should no longer be a need to actively fell trees in areas of old natural forest.

Removal in relation to increment. Sweden



Source: National Board of Forestry

Sweden is a country dominated by forest. More than 65 % of the land is covered by forest. The increment to forest has doubled since the 1920s. About 65-70 % of the annual increment is felled, implying that the volume of forest is steadily increasing.

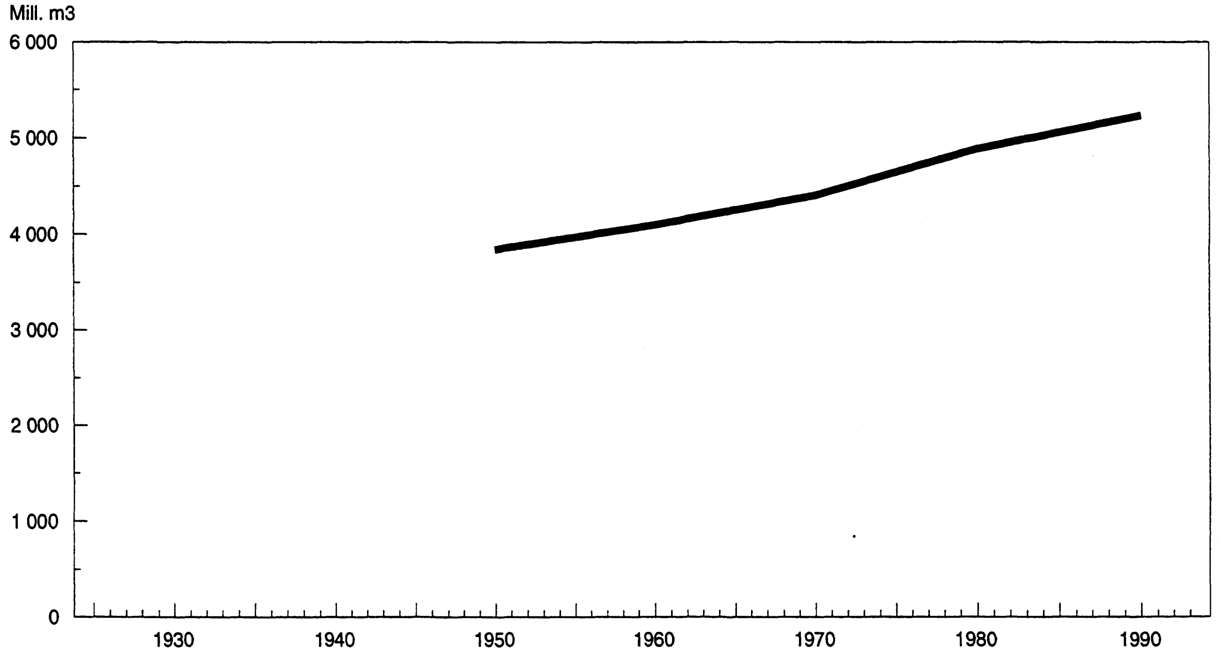
State

Changes in the standing volume

The volume of forest increases as a result of growth of the trees and afforestation, or planting, and decreases as a result of felling and natural loss. The total volume of forest in the Nordic countries has increased by about 36 per cent since the 1950s. The increase can be put down to many factors; intensive forest management, afforestation, return of the natural vegetation to uncultivated land and fertilization (also fertilization from long-range transport of nitrogen in the precipitation).

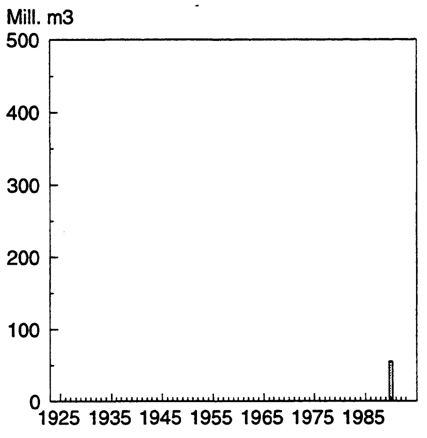
The increase in standing volume during this century is in marked contrast to the situation at the end of the last century. At that time the timber removed far exceeded the increment in the Nordic countries.

Changes in standing volume. Nordic countries. 1950-1990



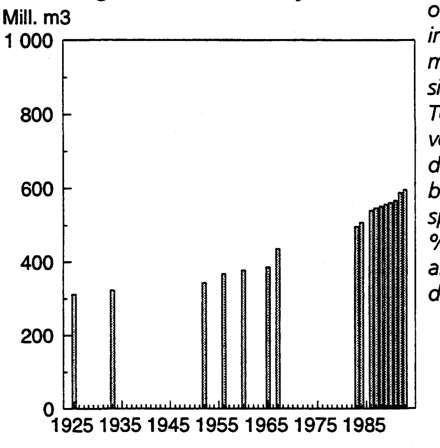
Only Finland, Norway and Sweden are included.

Standing volume. Denmark



Source: Danmarks Statistik

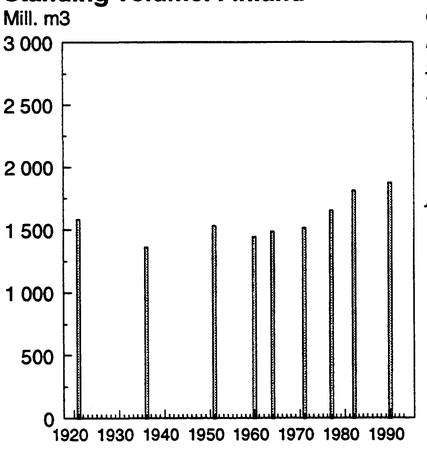
Standing volume. Norway



The cubic mass of forest has increased by as much as 90 % since 1925. Today the volume is distributed between 46 % spruce forest, 33 % pine forest and 21 % deciduous forest.

Source: Statistics Norway

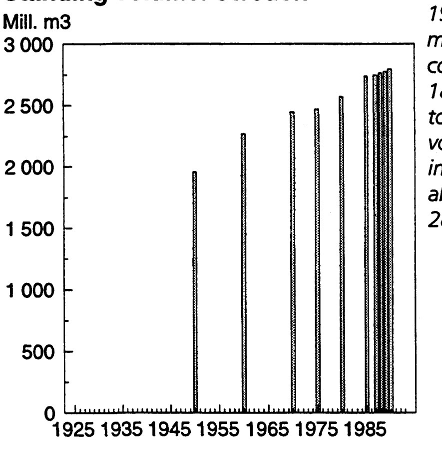
Standing volume. Finland



The cubic mass of forest has increased substantially in Finland too. Since the end of the 1930s the increase has been just less than 40 %. Not at any time during this century has the increment and cubic mass of the Finnish forests been as great as it is today.

Source: Finnish Forest Research Institute

Standing volume. Sweden



At the end of the 1920s, the cubic mass of forest comprised about 1800 mill. m^3. Up to today, the volume has increased by about 55 % to 2800 mill. m^3.

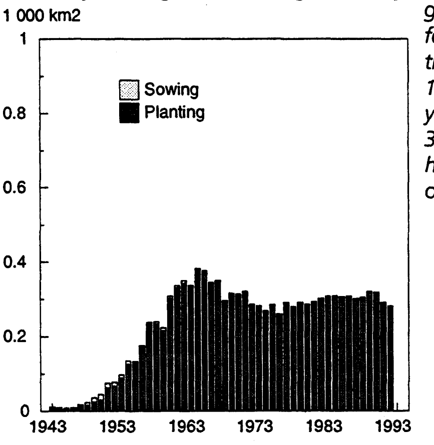
Source: Statistics Sweden

Response

Forest planting and sowing

If we regard forest as a purely material resource, afforestation is a positive means of increasing or maintaining the stock of forest. However, planting may have major impacts on the biological diversity. The trees that are planted are often spruce, and the density of the fauna and flora in planted spruce forest is much lower than found in the naturally regenerated forest. This implies that planting is therefore not only a positive measure.

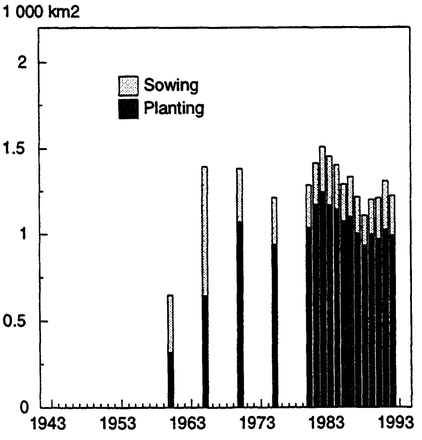
Forest planting and sowing. Norway



Source: Statistics Norway

The Government granted subsidies for forest planting as early as 1863. In recent years, just over 300 km² forest has been planted or sown annually.

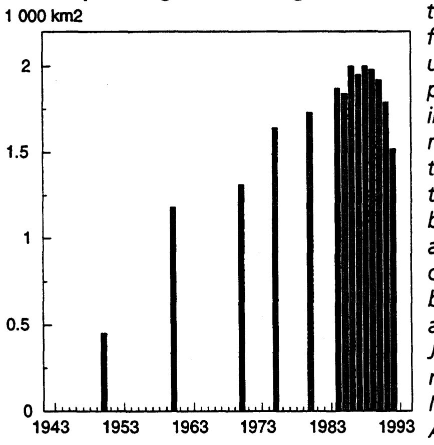
Forest planting and sowing. Finland



Source: Finnish Forest Research Institute

Planting and sowing of forest has decreased in Finland in recent years. Natural regeneration - partly by leaving seeding trees standing in the cutting area - is becoming more common. Only recently have environmental issues started to influence the planting.

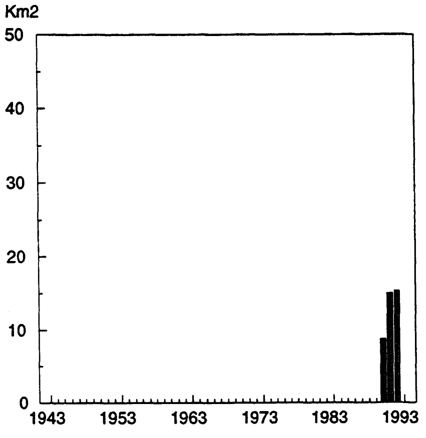
Forest planting and sowing. Sweden



Source: National Board of Forestry

After felling of trees, new forest can grow up through planting, sowing and natural regeneration. In the course of the last decade, between 1500 and 2000 km² of forest have been planted annually. On 1 January 1994, a new Forest Management Act came into force in Sweden and, in accordance with this Act, all forestry shall be carried out in an ecologically sound manner.

Forest planting. Iceland



Source: Iceland Forestry Service

Planting of forest has increased in Iceland in recent years, and now amounts to 15 km² annually.

Notes on the individual indicators - FOREST RESOURCES

P - Removal in relation to increment

Sweden: Calculated on the basis of *gross fellings*. (Additional information: in 1970, 16.4 mill. m^3 timber felled by storms and in 1971, 6.9 mill. m^3.).

Norway: Removal obtained from the Forestry Statistics (Roundwood cut for sale and industrial production), does not include wood and timber for personal use. Waste from the felling (i.e. branches, tips etc. that are not removed from the forest - amounting to about 6 % of the total removal) and natural loss (about 10 % of the total removal) are not included. Up to 1986, the figures for increment and standing volume are taken from the forest inventories that were completed during the year in which the increment is placed (the inventories are carried out by county over a period of several years). Therefore, given increasing increment and volume, the figures are an underestimate.

The surveys from 1964/-76 and 1964/-76 - 1981/-83 give lower figures than earlier inventories. This does not conform with the picture of a forest with increasing standing volume and increment. For this reason, the figures from these inventories have been omitted. The last figures used (from the inventory 1981/-83 - 1982/-87) are entered for 1983, in order to achieve a gliding transition to figures calculated for each year.

From 1986 to 1993, the figures refer to calculated figures for annual increment and standing volume. The method of calculation uses extrapolations of the inventory figures for counties where inventories have not been conducted in recent years.

Finland: Removals are defined as total roundwood cut, including wood cut for household heating.

Iceland: No statistics are available. In reality, there is no forestry in Iceland.

S - Changes in standing volume

Finland: The standing volume of forest in Finland for the survey period 1921-1924 (1588 million m^3) is calculated for Finland's earlier area of land and cannot be compared with later figures for standing volume. The figure for 1990 is an updated figure based on statistics and models, and is not a figure from an inventory.

Norway: See comments under *Pressure*.

Iceland: The forests in Iceland cannot be compared with those in Norway, Finland and Sweden. The forest in Iceland consists of birch. The total forest area is estimated to 1,400 km^2. Taking into account the height (in large parts of the forest the trees are less than 5 m high) and international standards, hardly more than 250 km^2 can be regarded as forest.

Denmark: No time series available.

R - Forest planting and sowing

Sweden: Up to 1985 inclusive, sowing is included. Since 1985, no figures for sowing have been prepared, but according to the National Board of Forestry the level is around 2,000 hectares (20 km^2) per year.

Denmark: Annual new planting is not recorded in the statistics. In Denmark, the intention is to double the forest area in the course of one tree generation (corresponds to an increment of 5,000 hectares annually for 80-100 years). About 2,500 hectares of forest are now established each year in Denmark. Of this amount, less than 1,000 hectares is administered by the public authorities, the rest is administered privately.

Norway: Only land entitled to a government grant is included in the statistics. Forest is also planted and sown privately.

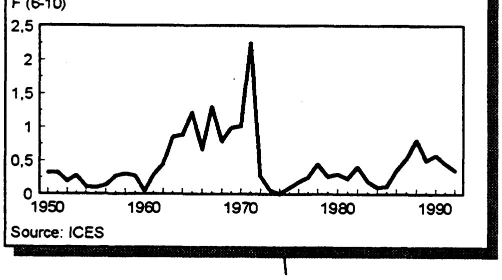
11. FISH RESOURCES

Herring is a key species in several marine areas. These fish consume large quantities of plankton organisms and are themselves an important source of food for organisms higher up in the food chain, such as cod and other fish species, birds and marine mammals. We can take Norwegian spring spawning herring as an example. Earlier on, this herring stock showed a regular pattern of migration from spawning grounds along the Norwegian coast to feeding grounds in the Norwegian Sea. During the period when the spawning stock - and the products of the spawning - of Norwegian spring spawning herring remain in Norwegian waters, the supply of food for fish, birds and marine mammals is improved considerably. The waters along the Norwegian coast do not, in themselves, possess the production potential to maintain large populations of these groups of species, but depend on the supply of food represented by herring from the Norwegian Sea. The herring stopped functioning as a link between the Norwegian Sea and the coast when the stock became strongly depleted at the end of the 1960s. When the herring disappeared, parts of the feeding grounds in the Norwegian Sea were taken over by blue whiting, and to some extent mackerel. This meant that the biomass was transferred southwards instead of to the Norwegian coast. Since 1986/87, herring have again begun to feed on the rich masses of plankton in the Norwegian Sea.

The fisheries affect the fish stocks through the degree of taxation (fishing mortality) and the pattern of taxation. Large variations in the stock will always occur, but the fisheries can intensify the effects of these changes. Over-taxation of one species can affect other species. In recent years, multi-stock management, where the management units are ecosystems and not single stocks, has become a topic of increasing importance. The objective of this kind of management strategy is to maximize economic gain within the framework of what is ecologically acceptable.

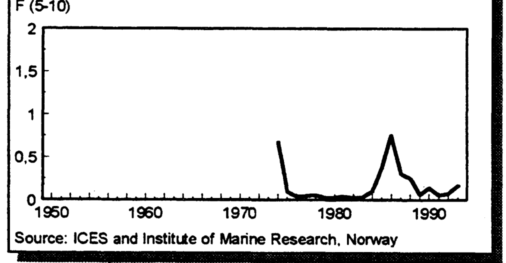
Pressure

Taxation - Fishing mortality

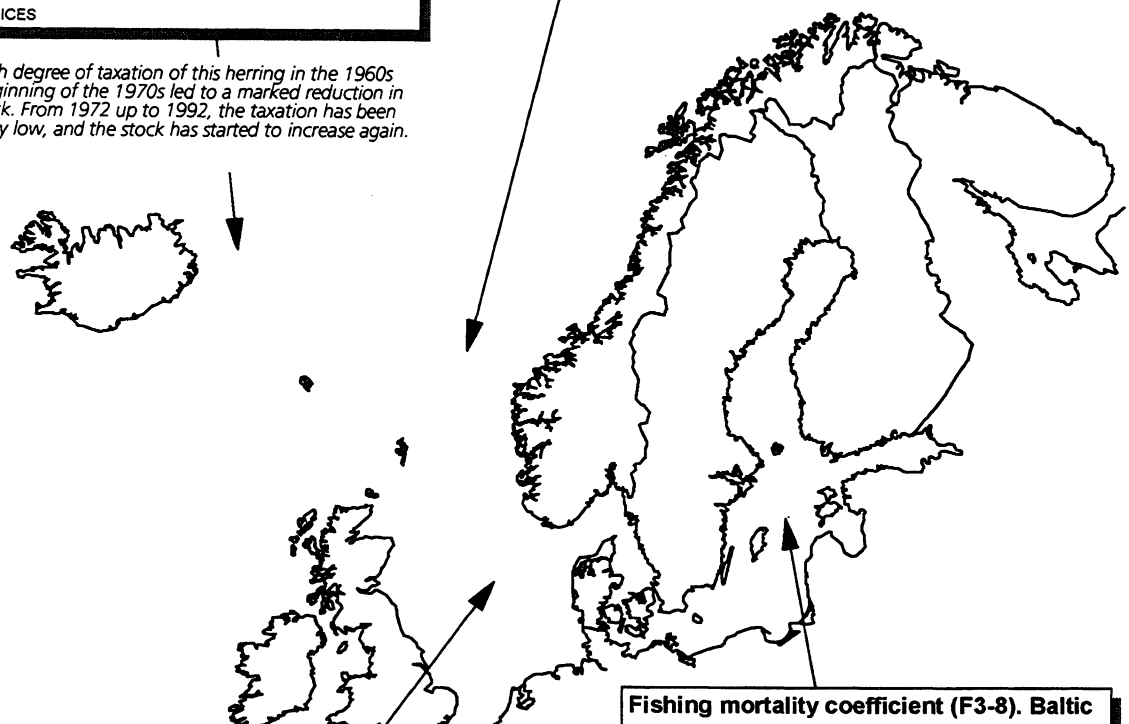


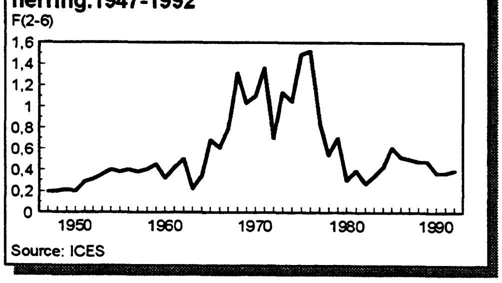
Fishing mortality coefficient (F6-10). Icelandic summer-spawning herring. 1950-1992

The high degree of taxation of this herring in the 1960s and beginning of the 1970s led to a marked reduction in the stock. From 1972 up to 1992, the taxation has been relatively low, and the stock has started to increase again.



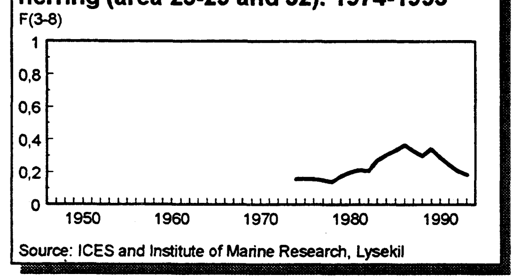
Fishing mortality coefficient (F5-10). Norwegian spring-spawning herring. 1974-1993





Fishing mortality coefficient (F2-6). North sea herring.1947-1992

The taxation of North Sea herring increased considerably during the 1960s. In 1965, the catch amounted to more than 1.4 million tonnes.

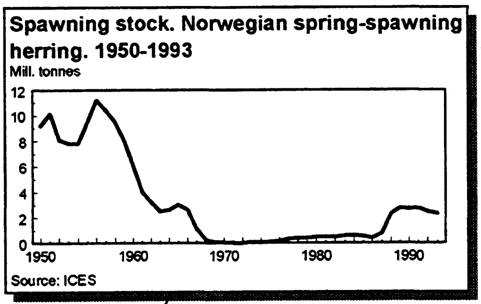


Fishing mortality coefficient (F3-8). Baltic herring (area 25-29 and 32). 1974-1993

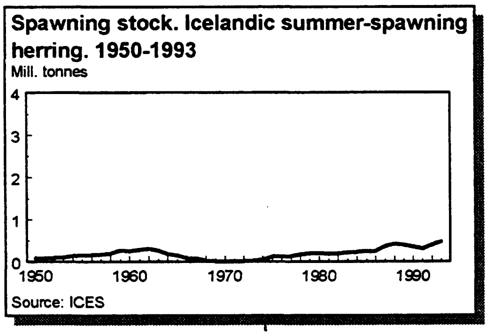
Taxation of the herring stock in the Baltic Sea is relatively moderate. The catch in the specified areas has varied between 250,000 and 325,000 tonnes.

State

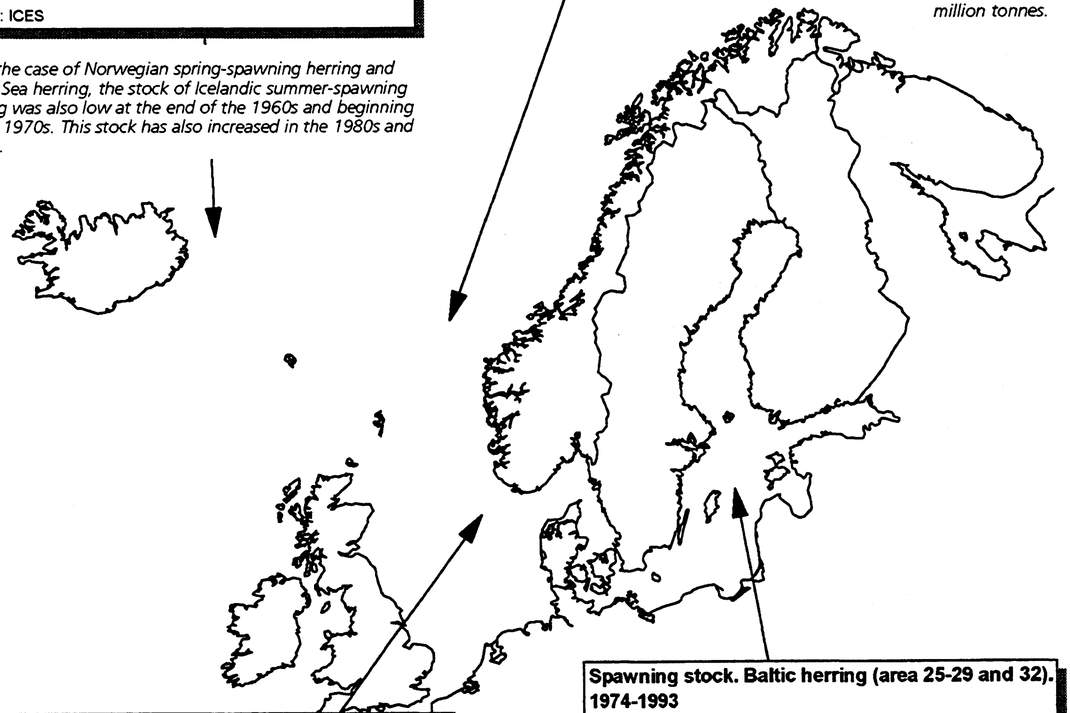
Spawning stock development

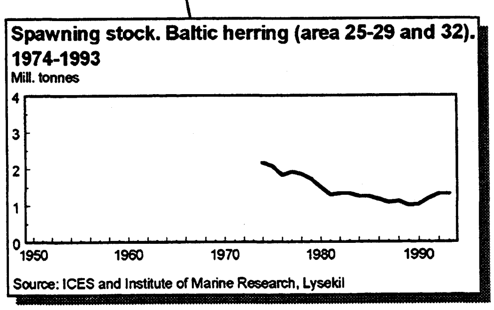


In the 1950s, the spawning stock of Norwegian spring-spawning herring was 7-10 million tonnes. The higher taxation in the 1960s of a stock that had reached a low level led, around 1970, to the herring stock being fished right down. The herring's migration pattern broke down, and from about 1970, the stock remained almost entirely in Norwegian coastal waters for the whole of the year. Since the mid-1970s, the stock has increased, and the spawning stock has now reached the minimum level that marine scientists consider it should have; 2.5 million tonnes.

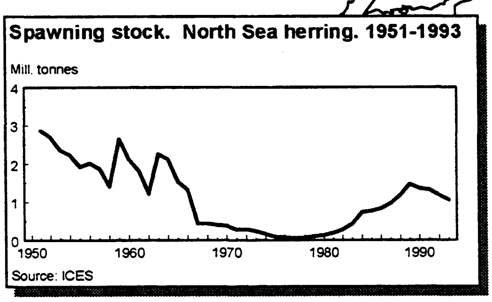


As in the case of Norwegian spring-spawning herring and North Sea herring, the stock of Icelandic summer-spawning herring was also low at the end of the 1960s and beginning of the 1970s. This stock has also increased in the 1980s and 1990s.





The situation of the herring stock in this area can be regarded as good, even if the spawning stock has decreased slightly in relation to its level in the mid-1970s.



The stock of North Sea herring was also fished down considerably in the 1960s. Since 1980, the stock has increased, although the growth has not been as strong in recent years, and the stock seems to have declined slightly.

Response

Quotas

Today the fisheries are regulated by *regulation on input factors* (licences, number of boats, types of gear etc.) and *regulation of the catch* (different quotas, minimum sizes and regulations connected to fishing grounds). Total quotas, distribution of these between countries and transfer of fishing rights are agreed in the annual fisheries negotiations. Problems may arise if the stocks also inhabit international waters.

Norwegian spring-spawning herring

Up to 1971 inclusive, when the greater part of this fish stock had been fished right down, there was no restriction on the quantity of the catch of this fish but, from 1969, regulations were introduced limiting the mesh of the nets and specifying a minimum size for the fish caught, as well as a ban on delivery for fish oil/fish meal production. In 1972 a ban was imposed on catching sexually mature herring. Later in the 1970s, fishing was strictly regulated, and it was not until around the mid-1980s that the stock increased to a level that justified definition of reasonably sized quotas.

Icelandic summer-spawning herring

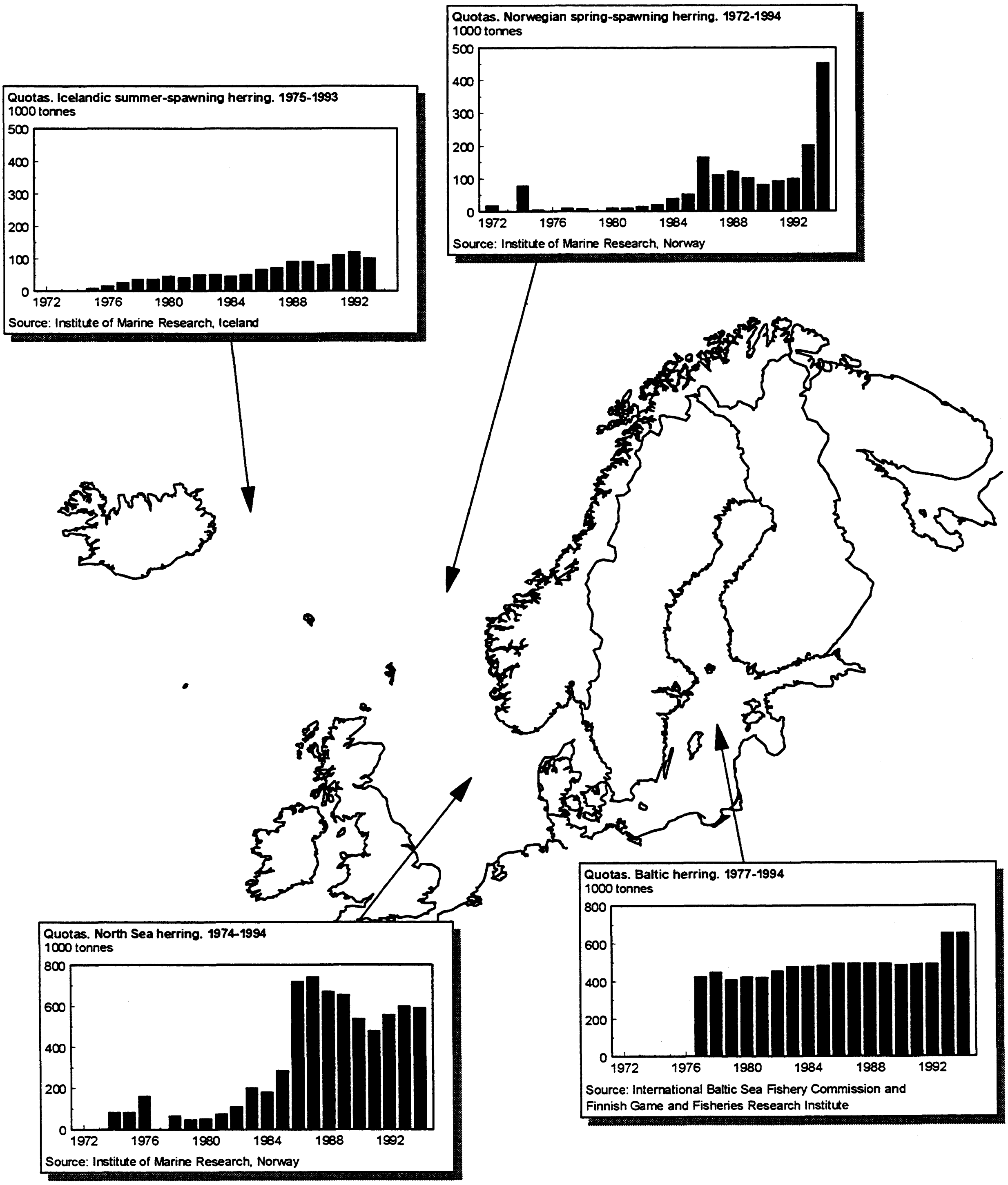
The stock was protected during the period 1972-1974. Since 1975 the stock has been regulated through quotas per boat. In addition, the fishing season has been restricted to 3-5 months per year.

Baltic herring

During the period 1977 to 1992, the quotas for Baltic herring amounted to 400,000 and 500,000 tonnes per year. In 1993 and 1994, the total quota in the Baltic Sea was increased to 650,000 tonnes.

North Sea herring

After a period of protection, introduced in March 1977 (a ban on direct fishing), fishing in the southern part of the North Sea was permitted again in 1981 and in the northern and central parts of the North Sea in 1983. The total quotas for the catch of North Sea herring have at times been higher than recommended by marine scientists.


Quotas. Norwegian spring-spawning herring. 1972-1994
1000 tonnes
500
400
300
200
100
0
1972
1976
1980
1984
1988
1992
Source: Institute of Marine Research, Norway
Quotas. Icelandic summer-spawning herring. 1975-1993
1000 tonnes
500
400
300
200
100
0
1972
1976
1980
1984
1988
1992
Source: Institute of Marine Research, Iceland
Quotas. Baltic herring. 1977-1994
1000 tonnes
800
600
400
200
0
1972
1976
1980
1984
1988
1992
Source: International Baltic Sea Fishery Commission and Finnish Game and Fisheries Research Institute
Quotas. North Sea herring. 1974-1994
1000 tonnes
800
600
400
200
0
1972
1976
1980
1984
1988
1992
Source: Institute of Marine Research, Norway

Notes on the individual indicators - FISH RESOURCES

Stocks:

North Sea Herring: ICES areas IV (a-c) and IIIa.
Icelandic summer-spawning herring: ICES area Va.
Baltic herring: Areas 25-29 and 32

P - Fishing mortality coefficient:

The degree of taxation of a fish stock is usually described by the *fishing mortality coefficient (F)*. This expresses how much of a year class is caught in relation to the total number of the year class at any time.

For low values of fishing mortality F, the yield per recruit will increase with increasing F. The increase will be reduced as fishing mortality increases up to the time one reaches a maximum yield per recruit at a certain level of fishing mortality F_{max}. If F is increased beyond this value, then the yield per recruit will decrease. The stock is then taxed so hard that the growth potential of the fish is not exploited (too many are fished before the fish grow to a reasonable size). (Fisken og Havet (Fish and the Sea). Special edition 1, *Ressursoversikt 1994* (Overview of resources 1994), Institute of Marine Research, Bergen).

North Sea herring:	F(2-6) 1947-1970 from ICES C.M. 1987/Assess:19 F(2-6) 1971-1992 from ICES C.M. 1993/Assess:15
Norwegian spring spawners:	F(5-10) 1974-1993 from Institute of Marine Research (unpublished). Longer time series must be prepared, but input data to VPA are being revised and new coefficients back to 1950 cannot be presented as yet.

Icelandic summer-spawning herring: F(6-10) 1950-1992 from ICES C.M. 1994/Assess:8

R - Quotas

North Sea herring: Some additional information: 1971: Ban on fishing in May and from 20 August to 30 September; 1972: Ban on fishing from 1 April to 15 June in the North Sea and Skagerrak; 1973: Ban on fishing from 1 February to 15 June; 1974: Same prohibitions as in 1973 and a quota of 80,000 tonnes after the protection period; 1975 and 1976: Ban on fishing of herring for delivery for fish oil and fish meal production; 1977: North Sea herring protected from 1 March (applied until July 1981); 1978-1980: Quotas only in Skagerrak/Kattegat; 1981 and 1982: Quota in southern part of North Sea. In Skagerrak/Kattegat a quota was recommended, but the parties did not reach agreement, implying that in practice fishing was unrestricted; 1983: Quota also in central and northern parts of the North Sea; 1984: For Skagerrak/Kattegat, a quota was recommended (30-40,000 tonnes), but no agreement reached between Norway-Sweden and EEC; 1985: Recommended quota for the North Sea, but no agreement reached between Norway and EEC.

Icelandic summer-spawning herring: Stock protected in the years 1972-1974.

Norwegian spring-spawning herring: In addition to the provisions concerning quotas and protection of the stock, regulations have been imposed for size of mesh, minimum size of fish caught, ban on fishing of herring for delivery for fish oil and fish meal production, ban on catching of sexually mature fish, dispensation for fishing for research purposes and for fish used for bait/consumption.

Baltic herring: Whole Baltic, Total TAC (Baltic Main Basin and MU3).

APPENDICES

EXAMPLE OF AN ALTERNATIVE INDICATOR PRESENTATION

Response

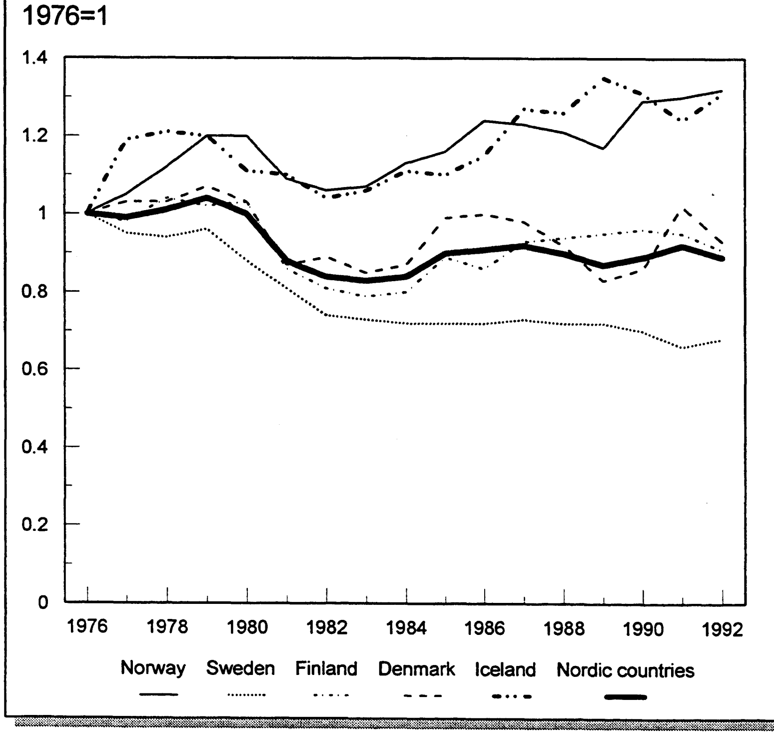
Changes in the use of fossil fuels

It is a global task to take steps to counteract possible changes in climate. In the UN Convention on Climate Change, all industrial countries undertake to work to reduce anthropogenic emissions of greenhouse gases and, at the same time, to preserve greenhouse gas sinks (e.g. forests).

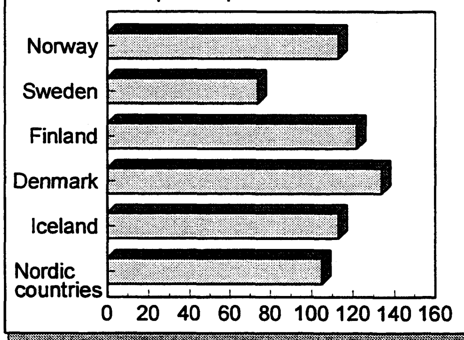
The main Norwegian target is that, from the year 2000 onwards, emissions of carbon dioxide (CO_2) shall not be higher than in 1989. The target is the same in Iceland and Sweden, except that the base year is 1990. In Denmark, the target is to reduce emissions from the energy and transport sectors combined by 20 per cent in relation to 1988 by the year 2005. Finland has not defined any national target over and above its commitment in accordance with the UN Convention on Climate Change.

The greater part of the anthropogenic emissions of CO_2 originate from combustion of fossil fuels. The Nordic countries, with the exception of Iceland - Denmark (from 1992), Norway and Sweden (from 1991), Finland (from 1990) - introduced a special CO_2-tax on fossil fuels as a means of stabilizing or reducing consumption.

Use of fossil fuels in the Nordic countries. Index, 1976=1



Use of fossil fuels
GJ per capita in 1992



Norway
Consumption of fossil fuels increased in Norway from 1976 to 1993. The increase was caused mainly by increased consumption in the energy sectors (extraction of oil and gas). There are now signs that consumption of fossil fuels is increasing in other sectors of society as well, after a decrease during the period 1990-1991.

Sweden
Emissions from combustion processes decreased by almost 50 per cent during the 1980s. This can be explained by energy-saving, changes in the industrial structure and development of nuclear power. Oil's share of energy sources within the energy sector decreased from 70 to 20 per cent during this period, partly because of an active policy to substitute oil by other sources of energy.

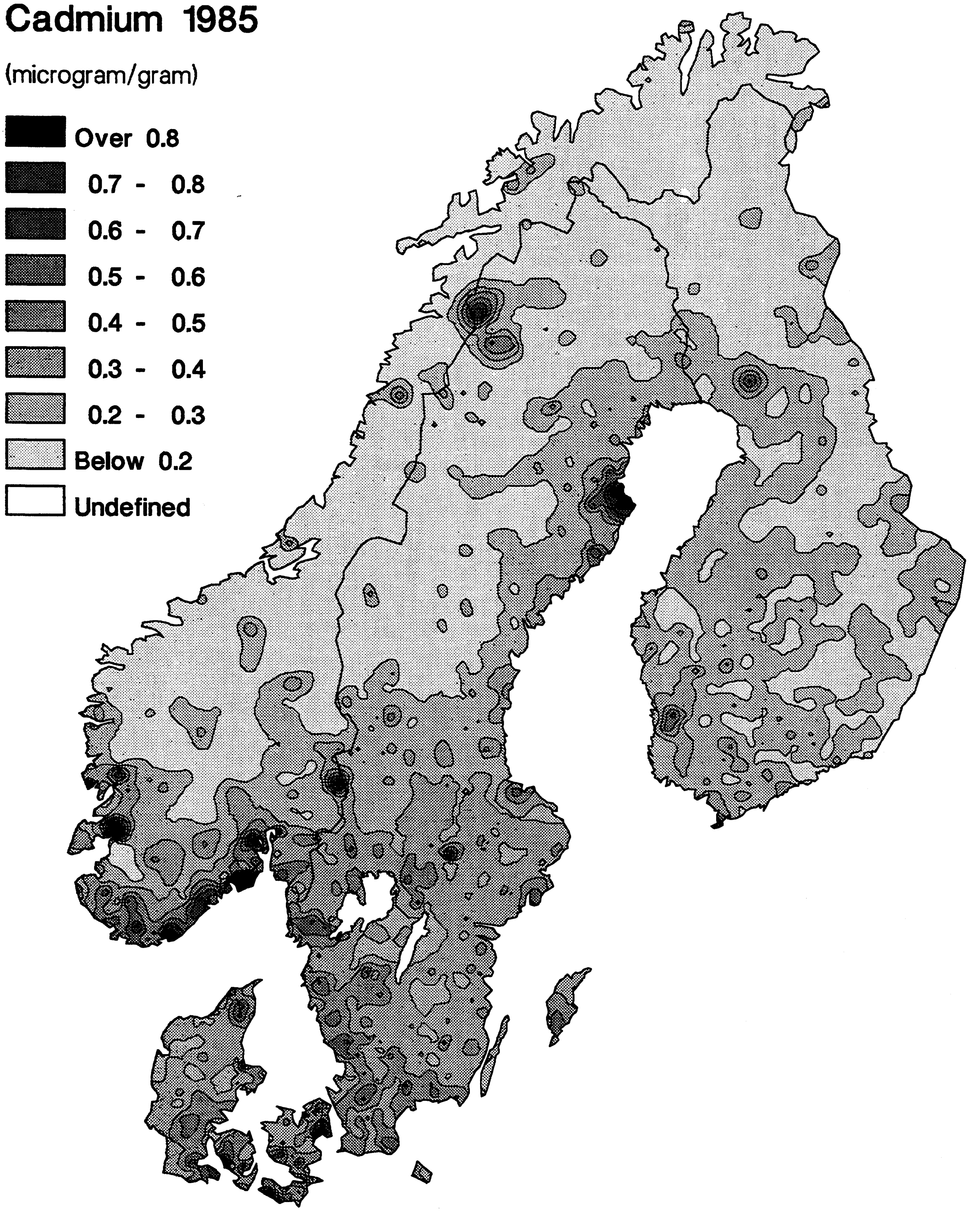
Finland
Use of fossil fuels in Finland decreased at the end of the 1970s, when Finland started to use nuclear power. Since the mid-1980s, the use of fossil fuels has shown an increasing tendency - oil consumption has decreased, but there has been an increase in consumption of natural gas.

Iceland
Consumption of fossil fuels has increased in Iceland during the period 1970-1993. Petrol consumption has increased most, but a substantial increase has also taken place in the use of heavy oils. Coal consumption has increased since 1979, owing to the opening of a ferrosilicon factory that year.

	1976		1985		1992	
	PJ	GJ/capita	PJ	GJ/capita	PJ	GJ/capita
Norway	368	92	426	102	486	113
Sweden	956	117	689	82	645	74
Finland	681	149	607	124	619	122
Denmark	743	149	736	144	692	134
Iceland	23	105	26	107	31	116
Nordic countries	2772	126	2483	109	2473	105

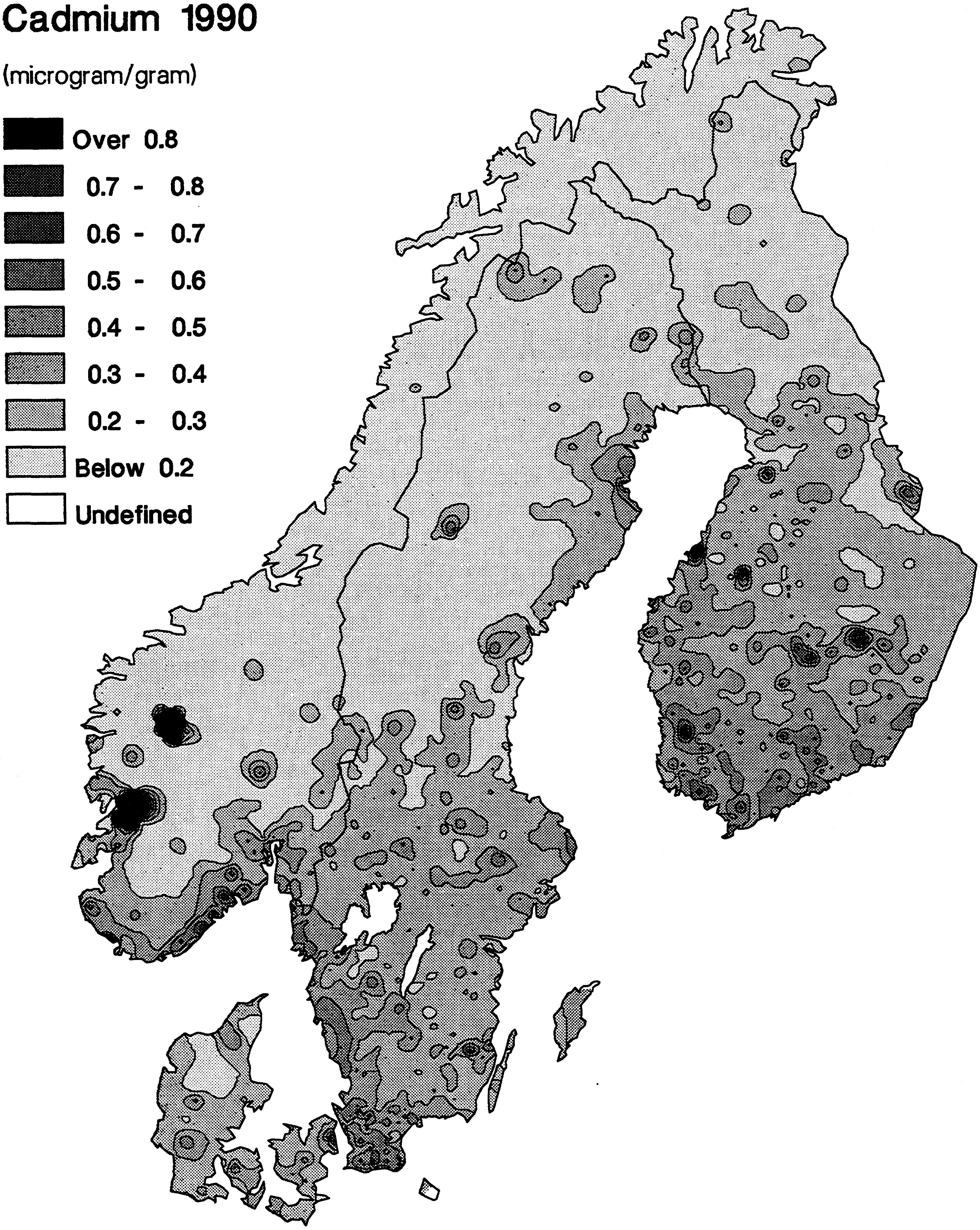
Cadmium 1985

(microgram/gram)



Cadmium 1990

(microgram/gram)



Appendix III

Specification of the Nordic report on the state of the environment - indicators per 15 April 1994. Proposal from the Nordic Indicator Group (NIG)

P: Pressure indicators
S: State indicators
R: Response indicators

Climate change:

P: EMISSIONS OF CO_2
Data: IPCC method
Emissions of CO_2, including oxidized CO, CH_4 and NMVOC.
Only anthropogenic emissions.
Not including emissions from biomass (combustion of wood etc.) and biological processes (fermentation, putrefaction).
Time series should include at least 1973-1993.

S: GLOBAL MEAN TEMPERATURE (responsibility: Norway)
Annual mean temperatures measured near/in the capitals.
Data: Time series if possible 1850-1993

R: CHANGES IN USE OF FOSSIL FUELS
Data: Consumption of fossil fuel in tonnes of oil equivalents.
State also conversion factors used for calculation of oil equivalents.
Time series should include at least 1973-1993.

Ozone layer depletion:

P: CONSUMPTION OF OZONE-DEPLETING SUBSTANCES IN ODP-TONS (or CFC-11 equivalents). Time series.
Data: Consumption of substances specified in tonnes per substance for each year.
Editor converts into ODP-tons.

S: TOTAL OZONE
Data: In Dobson units (Lowest monthly mean per year).
All available monitoring stations.
Data series since start of measurements.

R: COLLECTED QUANTITY OF OZONE-DEPLETING SUBSTANCES. Time series
Data: Collected quantity in tonnes, specified for each substance,
Converted by editor into ODP-tons (or CFC-11 equivalents).

Eutrophication:

P: NET CONSUMPTION OF COMMERCIAL FERTILIZER AND MANURE. Tonnes N and tonnes P. Time series.
Data: Consumption of N and P minus quantity removed by crops.

S, LAKES: ALGAL CHLOROPHYLL (A) IN A POLLUTED LAKE (AGRICULTURAL AREA). Time series.
S, FJORDS: LIGHT PENETRATION (SECCHI) IN A FJORD/COASTAL WATER. Time series.

R, LAKES: "WINTER GREEN" AGRICULTURAL AREA/TOTAL AGRICULTURAL AREA. Time series.
R, FJORDS: SHARE OF THE POPULATION CONNECTED TO WASTE WATER TREATMENT PLANTS WITH MINIMUM CHEMICAL TREATMENT. Time series.

Acidification:

P: DEPOSITION OF ACIDIFYING SUBSTANCES (N AND S). Time series
Data: N and S in terms of acid equivalents. Total for the whole land area. Taken directly from the EMEP report by the Nordic editor.

S: AREA WHERE THE CRITICAL LOADS HAVE BEEN EXCEEDED, AS % OF TOTAL LAND AREA. [Time series]

R: QUANTITY OF LIME USED. Whole country. Time series

Toxic contamination:

P: CONTENT OF Cd IN MOSS. Time series for a selected monitoring station in each country. (Possible production of map of the Nordic countries. Responsibility: Norway)
Data: Microgram/gram dry weight.

S: Cd IN MOOSE AT ONE LOCALITY IN SWEDEN (Responsibility: Sweden. Time series.
Cd IN HERRING (OR OTHER FISH) IN THE BALTIC SEA (Responsibility: Finland). Time series.
Hg IN HERRING (OR OTHER FISH) IN KATTEGAT (Responsibility: Denmark). Time series.
SHELL THICKNESS OF BIRD EGGS (Norway). Time series.

R: COLLECTION OF Hg, Cd, PCB IN TONNES. Time series.

Urban environmental quality:

P: NUMBER OF PRIVATE CARS AND LIGHT COMMERCIAL VEHICLES PER CAPITA. Time series. In the capitals.

S: NUMBER OF PERSONS EXPOSED TO NOISE LEVEL $L_{24\text{-HOUR EQUIVALENT}} > 55$ DBA AT THE EXTERNAL WALL OF THE DWELLING.
Nordic method of calculation. [Time series]. Same built-up area as above.

R: PUBLIC TRANSPORT'S PERCENTAGE SHARE OF TOTAL PERSON-KILOMETRES, OR TOTAL VEHICLE-KILOMETRES, FOR THE BUILT-UP AREA CHOSEN UNDER P. [Time series]

Biodiversity:

P: TOTAL KILOMETRES OF ROADS/AREA (km/km^2). Including forest roads (all-year round roads). Time series, long.

S: ENDANGERED AND VULNERABLE SPECIES AS A SHARE OF THE NUMBER OF KNOWN SPECIES. Status in 1993.
In accordance with IUCN's definitions.

R: PROTECTED AREAS AS A PERCENTAGE OF TOTAL LAND AREA. In accordance with IUCN's definitions.
Time series.

Cultural and natural landscapes:

P: NEW DITCHES (KM).

S: TOTAL WETLAND AREA. Time series.

R: RESTORED WETLAND IN KM^2. Time series

Waste:

P: QUANTITY OF WASTE DELIVERED TO PUBLIC WASTE RECEPTION FACILITIES.
In tonnes/per capita. Time series

R: SHARE OF THE QUANTITY OF WASTE THAT IS RECYCLED OR USED AS A SOURCE OF ENERGY.
Time series.

Forest resources:

P: REMOVAL IN RELATION TO INCREMENT. Time series.
Data: Removal in m^3, increment in m^3.

S: CHANGES IN THE STANDING VOLUME. Time series.
Data: Annual standing volume in m^3.

R: FOREST PLANTING IN KM^2. Time series.
Data: Annual planting of new forest.

Fish resources:

P: TOTAL CATCH (ALL NATIONS) IN RELATION TO TOTAL STOCK (in %). Time series.
Data: E.g. catch and stock of herring in the Baltic Sea (responsibility Sweden/Finland), herring in the North Sea (responsibility: Denmark) and herring in the Norwegian Sea (responsibility: Norway), in tonnes.

S: SPAWNING STOCK DEVELOPMENT (as for P). Time series.

R: QUOTAS FOR THESE STOCKS. Time series.

Appendix IV

EXTRACT FROM OECD'S SET OF INDICATORS FOR ENVIRONMENTAL PERFORMANCE REVIEWS

DEFINITIONS OF TERMS:

INDICATOR A parameter, or a value derived from parameters, which points to/provides information about/describes the state of a phenomenon/environment/area with a significance extending beyond that directly assosiated with a parameter value.

INDEX A set of aggregated or weighted parameters or indicators.

PARAMETER A property that is measured or observed.

INDICATORS OF ENVIRONMENTAL CONDITIONS
Correspond to "state" box of the Pressure-State-Response framework. They comprise environmental quality and aspects of quantity and quality of natural resources.

INDICATORS OF ENVIRONMENTAL PRESSURES
Correspond to "pressure" box of the Pressure-State-Response framework. They describe pressures on the environment caused by human activities. They comprise *indicators of proximate pressure* (stress indicators) and *indicators of indirect pressure* (background indicators).

RESPONSE INDICATORS
Correspond to "response" box of the Pressure-State-Response framework. In the present context, the word "response" is used only for *societal* (not ecosystem) *response.*

INDICATORS FOR USE IN PERFORMANCE EVALUATION
Selected and/or aggregated indicators of environmental conditions, indicators of environmental pressures and indicators of societal responses for the purpose of environmental performance evaluation.

ENVIRONMENTAL INDICATORS
Comprise all indicators in the Pressure-State-Response framework, i.e. indicators of environmental pressures, conditions and responses.

CRITERIA FOR INDICATOR SELECTION:

POLICY RELEVANCE AND UTILITY FOR USERS

AN ENVIRONMENTAL INDICATOR SHOULD

- Provide a *representative picture* of environmental conditions, pressures on the environment or society's responses
- Be simple, *easy to interpret* and able to show *trends over time*
- Be *responsive to changes* in the environment and related human activities
- Provide a basis for *international comparisons*
- Be either *national in scope* or applicable to regional environmental issues of national significance
- Have a *threshold or reference value* against which to compare it so that users are able to assess the significance of the values associated with it.

ANALYTICAL SOUNDNESS

AN ENVIRONMENTAL INDICATOR SHOULD

- Be theoretically *well founded* in technical and scientific terms
- Be based on international standards and *international consensus* about its validity
- Lend itself to being linked to economic models, forecasting and information systems

MEASURABILITY

THE DATA REQUIRED TO SUPPORT THE INDICATOR SHOULD BE

- Readily available or made available *at a reasonable cost/benefit ratio*
- Adequately *documented* and of *known quality*
- *Updated* at regular intervals in accordance with reliable procedures

Figure 1a. **Pressure - State - Response Framework**

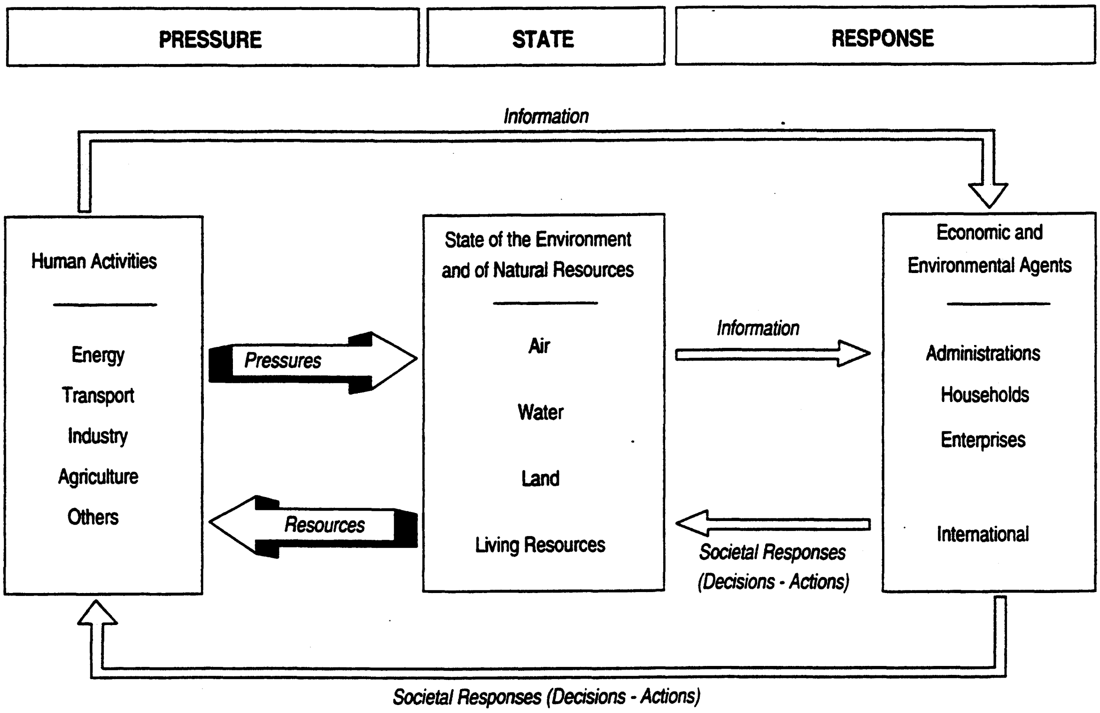
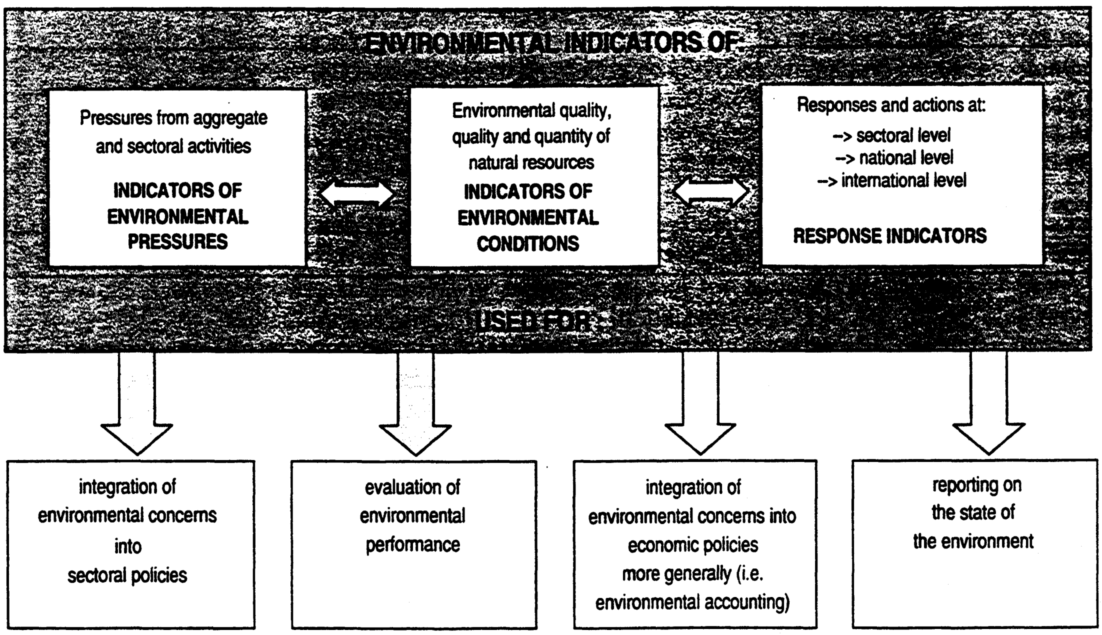


Figure 1b. **Nature and Use of Environmental Indicators**



OCDE Indicateurs d'environnement *OECD Environmental Indicators*

Table 2. **Summary of OECD Indicators[a] by Environmental Issue**

Issues	PRESSURE Indicators of environmental pressures		STATE Indicators of environmental conditions		RESPONSE Indicators of societal responses	
Climate change	◆ Index of greenhouse gas emissions ** ◆ *CO_2 emissions*	M S	◆ *Atmospheric concentrations of greenhouse gases* ** ◆ Global mean temperature **	S S	◆ Energy efficiency ** ◆ *Energy intensity* ◆ Economic and fiscal instruments	M/L S M
Ozone layer depletion	◆ Index of apparent consumption of ozone depleting substances ** ◆ *Apparent consumption of CFCs and halons*	M S/M	◆ *Atmospheric concentrations of ozone depleting substances* ** ◆ Ground level UV-B radiation **	S/M M	◆ CFC recovery rate **	M
Eutrophication	◆ Emissions of N and P in water and soil (--> nutrient balance) ** ◆ *N from fertilizer use and from livestock* ◆ P from fertilizer use and from livestock	L S S	◆ *BOD/DO, concentration of N and P in inland waters* ** and in marine waters **	 S/M M/L	◆ % of population connected to biological and/or chemical sewage treatment plants ** ◆ *% of population connected to sewage treatment plants* ◆ User charges for waste water treatment ◆ Market share of phosphate-free detergents	M/L S M S/M
Acidification	◆ Index of acidifying substances ** ◆ *Emissions of NOx and SOx*	M/L S	◆ Exceedance of critical loads of pH in water and soil ** ◆ *Concentrations in acid precipitation*	M/L S	◆ % of car fleet equipped with catalytic converters ** ◆ Capacity of SOx and NOx abatement equipment of stationary sources **	S/M M/L
Toxic contamination	◆ Emissions of heavy metals ** ◆ Emissions of organic compounds ** ◆ *Consumption of pesticides*	M/L L S/M	◆ Concentration of heavy metals and organic compounds in env. media and in living species ** ◆ *Concentration of heavy metals in rivers*	L S/M	◆ Changes of toxic contents in products production and processes ** ◆ *Market share of unleaded petrol*	L S
Urban environmental quality	◆ Urban air emissions: SOx, NOx, VOC ** ◆ *Traffic density* – urban – *national* ◆ Degree of urbanisation	M/L M S S/M	◆ Population exposure to: – air pollution ** – noise ** ◆ Ambient water conditions in urban areas **	 L M M/L	◆ Green space ** ◆ Economic, fiscal and regulatory instruments ** ◆ Water treatment and noise abatement expenditures	M/L M S/M
Biodiversity / landscape	◆ Habitat alteration and land conversion from natural state **	L	◆ *Threatened or extinct species as a share of total species known* **	S	◆ *Protected areas as % of national territory* ** and by type of ecosystem **	S L
Waste	◆ *Waste generation:* ** – *municipal* – *industrial* – *nuclear* – *hazardous*	 S S S S/M	Not applicable		◆ Waste minimisation ** ◆ *Recycling rate* ◆ Economic and fiscal instruments, expenditures	L S/M M

../...

Table 2. Summary of OECD Indicators[a] by Environmental Issue (continued)

Issues	PRESSURE Indicators of environmental pressures		STATE Indicators of environmental conditions		RESPONSE Indicators of societal responses	
Water resources	◆ *Intensity of use of water resources* **	S	◆ Frequency, duration and extent of water shortages **	M/L	◆ Water prices and user charges for sewage treatment **	M
Forest resources	◆ *Actual harvest/productive capacity* **	M	◆ Area, volume and structure of forests **	S/M	◆ Forest area management and protection **	M/L
Fish resources	◆ *Fish catches* **	S	◆ Size of spawning stocks **	M	◆ Regulation of stocks (quotas)	M
Soil degradation (desertification & erosion)	◆ Erosion risks: potential and actual land use for agriculture ** ◆ *Change in land use*	L S	◆ Degree of top soil losses **	M/L	◆ Rehabilitated areas **	M/L
General indicators, not attributable to specific issues	◆ *Population growth & density* ** ◆ *Growth of GDP*** ◆ *Private final consumption expenditure* ** ◆ *Industrial production* ** ◆ *Structure of energy supply* ** ◆ *Road traffic volumes* ** ◆ *Stock of road vehicles*** ◆ *Agricultural production* **	S S S S S S S S	Not applicable		◆ Environmental expenditures** ◆ *Pollution control and abatement expenditures* ◆ Public opinion **	M/L S/M S

a) This table summarises the indicators of the core set proposed by the OECD Group on the State of the Environment. It presents "main" indicators (pointed out by a double asterisk), complementary indicators to accompany the message conveyed by "main" indicators, and proxy indicators when the "main" indicator is currently not measurable. The indicators included in this publication are printed in italics. Each indicator is followed by a character specifying its availability:

S = short term, basic data currently available for a majority of OECD countries;

M = medium term, basic data partially available, but calling for a supplementary effort to improve their quality (consistency, comparability) and their geographical coverage (number of countries covered);

L = long term, basic data not available for a majority OECD of countries, calling for a sustained data collection and conceptual efforts.

Appendix V

SUMMARY OF IMPORTANT COMMENTS FROM NORDIC AND NORWEGIAN ORGANIZATIONS/ INSTITUTIONS BASED ON A QUESTIONNAIRE ENCLOSED WITH THE REPORT

This summary includes only the most important general comments. It does not contain the comments on the individual indicators.

The report was sent to a total of 52 institutions or departments for comment. 26 of these responded. Only 2 Non-Governmental Organizations (NGOs) responded. Otherwise a reply was received from only one institution without a scientific interest in the topic.
The report was sent to 7 Nordic groups; one responded.
The report was sent to 6 Nordic administrative agencies: 2 responded.

1.1 MAIN IMPRESSION

Reply: Useful/good design: 77 % Useful/poor design: 14 % Of no use: 9 %

Conclusions and main points of view

* In general, the respondents are of the opinion that the report was a positive initiative, and that the general result is good. The report should be further developed and improved.
* Some of the indicators must be improved, scientifically and technically.
* The report should be better designed for educational purposes.
* The use of more indicators/data series for some of the issues would make the presentations more informative.
* It is important to choose good indicators. A poor environmental indicator would channel resources to areas where little or no effect is seen, and would therefore work against the interests of nature management.
* When possible, the indicators should show overall impacts instead of examples from specific recipients, or only one of several important pressure factors.
* The report has brought to light the need for standardization. This applies to methods, classification and definition of geographical areas.
* The indicators seem to be of considerable interest for teaching purposes.
* The need for international reporting must not become an obstacle to choosing indicators/data series that provide the best picture of conditions in the Nordic countries.
* The issues *Soil resources* and *Water resources* should also be included in the Nordic set of indicators (cf. the OECD set of indicators).

1.2 GENERAL LEVEL OF INFORMATION

Reply: Good: 32 % Too general: 20 % Too detailed: 12 % Varies: 36 %

Conclusions and main points of view

* The respondents were satisfied, but tend to think that the report is too general.
* It is important to relate the indicators to (political) objectives or more generally to threshold values (critical loads) or reference values when feasible or relevant.
* Some of the respondents state that it is important to express the indicators in terms of units of measurement, and not as relative values or indices. Others underline that it is more important to show trends than to give absolute values. Therefore, if possible, the set of indicators should take both these needs into account.
* It might be useful to include key figures (per capita, per unit GDP, per unit of land etc.) to a greater degree. This should be considered.
* It is necessary to be more explicit about the background/reasons for choosing the indicators of changes in natural resources (fish and forest resources).
* In the case of several of the indicators, priority must be given to obtaining longer time series.
* The interval for updating the different indicators must be carefully evaluated. In certain fields the changes occur slowly, and annual reporting is therefore of little or no interest.

1.3 GRAPHIC ILLUSTRATIONS

Reply: Generally good: 57 % Need to be improved: 43 %

Conclusions and main points of view

* The graphic design should be improved.
* It is important to standardize the presentations. This applies to both figures (illustrations) and text.
* Colours should be used.

1.4 CONTENT OF THE TEXT/ANALYSES

Reply: Good: 64 % Few analyses/inadequate conclusions: 27 % Too much text: 0 %
Too little explanation: 9 %

Conclusions and main points of view

* The respondents were reasonably satisfied, but improvements are needed.
* There were many detailed comments. These have been handed on to the next editorial committee.
* It is necessary to explain more clearly the reasons for choosing the different indicators.
* For some of the issues, the thematic connection between pressure, state and respons must be more clearly described.
* When possible, a P-S-R set with a clear thematic connection between pressure, state and respons should be developed, either in the short or the long term.
* The reason for choosing the P-S-R set for the different issues should be explained more clearly.
* The text must be reviewed, taking into account both the scientific content and standardization of the presentations.

1.5 THE INDIVIDUAL INDICATORS

1. CLIMATE CHANGE

State

- An additional indicator should be developed: *Extreme weather conditions.*
- Annual mean temperatures in the Nordic capitals will be excluded from the indicator set.

Response

- The response indicator should be altered to: *Consumption of renewable energy compared with total cônsumption of energy.*

2. OZONE LAYER DEPLETION

- The indicators describing this issue will be adjusted on the basis of comments from relevant experts.

3. EUTROPHICATION

- The indicators describing this issue will be further developed, probably into separate sets of indicators for fresh water and marine environment.

4. ACIDIFICATION

Pressure

- An additional (supplementary) indicator will be introduced: *Emissions of* NO_x *and* SO_2.

Response

- The response indicator will be altered to: *Ratification of international agreements. Measures of high priority in the Nordic countries.*

6. URBAN ENVIRONMENTAL QUALITY

Pressure and Response

- Indicators are still being developed. Suggestions include: (P) *Vehicle-kilometres per unit of area.* (R) *Vehicle- or passenger-kilometres removed from city surfaces.*

State

- The state indicator will be altered to: *Concentration of NOx compared with threshold values.*

7. BIODIVERSITY

- Indicators for this issue are still being developed.

8. CULTURAL AND NATURAL LANDSCAPES

- Indicators for this issue are still being developed.

10. FOREST RESOURCES

- To avoid confusion with other resource aspects of forests, this issue will be renamed *Timber resources.*

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95/4 *Nordic Indicator Group (1995):* Nordic Environmental Indicators. Draft document. English version with main points from comments received.

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