ICELAND´S NATIONAL PROGRAMME OF ACTION

for the protection of the marine environment from land-based activities

REPORT ON THE IMPLEMENTATION
OF THE GLOBAL PROGRAMME OF ACTION 2001–2006 IN ICELAND

ICELAND'S NATIONAL PROGRAMME OF ACTION

for the protection of the marine environment from land-based activities

REPORT ON THE IMPLEMENTATION
OF THE GLOBAL PROGRAMME OF ACTION 2001-2006 IN ICELAND

GuðjónÓ – vistvæn prentsmiðja

Preface

Jónína Bjartmarz
Minister for the Environment

The Global Programme of Action for the protection of the marine environment from land-based activities (GPA) is of great importance to Iceland. The Government of Iceland supported the preparation process of the Washington Conference in 1995 which adopted the GPA and has supported the GPA coordination office in The Hague that supervises the Global Programme of Action. The Ministry for the Environment has implemented various measures in all the GPA pollutant categories in order to minimize as much as possible the negative effects of the pollution of the ocean from land-based activities.

The Icelandic government regards the protection of the marine environment from pollution as one of the high priority matters regarding global environmental challenges. Healthy seas sustain the productivity of the ocean and diminish the effects of global warming. The ocean is a very important source of food for many countries and a sustainable use of the ocean's resources forms the base of the economic welfare of many nations. As 80% of the marine pollution is believed to originate from land-based activities, it is clear that the implementation of the Global Programme of Action is an important milestone towards sustainable development. Implementation of the GPA is also an important contribution to reach many of the Millenium Development Goals

This report evaluates the status of the Icelandic National Programme of Action and the progress achieved in all the GPA pollutant categories since the National Programme of Action was initiated in 2001. It gives me a great pleasure to communicate on the progress that has been made in Iceland in the last few years. However, there is still work to be done in order to secure the coastal and marine environment.

I would like to congratulate the United Nations Environment Programme for the success accomplished up to now, in the implementation of the Global Programme of Action. At the same time I hope that the world's nations will put more emphasis on the protection of the ocean from pollution and increase their efforts to promote actions against marine pollution from land-based activities.

Summary and conclusions

This report forms a part of a large-scale project launched by the United Nations Environment Programme designed to protect the sea from pollution from land-based sources. The project was introduced and approved in Washington in 1995 under the title, the Global Programme of Action for the Protection of the Marine Environment from Land-based Activities (GPA).

This project is of major significance for Icelandic interests, and a task-force was subsequently formed by the Ministry for the Environment to prepare an Icelandic Action Programme. The report of the committee on a Programme of Action for the Protection of the Marine Environment from Land-based Activities was subsequently published in 2001. The Report suggested proposals on actions for improvement in all the pollutant categories covered by the Programme. The actions were divided into immediate projects and long-term projects. The situation as regards each issue was assessed and the issues prioritised in accordance with Icelandic conditions, which does not necessarily reflect their general importance in the world or in neighbouring countries [1]. For many issues limited knowledge was available, and therefore in some cases further studies were needed. The Report also contains a review and assessment of individual issues falling within the Programme of Action. The Report also includes proposals for continued measures within each issue based on the proposals already made and the changes which have occurred as regards the separate issues.

The Minister for the environment instructed the Steering committee on actions against pollution from land-based activities to prepare the present report. The Report is intended to shed a light on the progress of the Programme of Action over the years from the time that the national programme was presented in 2001. The content of the Report is derived from numerous sources, but a large part of the information is obtained from staff members of the Environment and Food Agency, the Icelandic Fisheries Laboratory, the Marine Research Institute, the Icelandic Radiation Protection Institute, the Municipal Health Committees, the National Planning Agency, the Technological Institute of Iceland and the Ministry for the Environment.

The Icelandic government has taken various measures to prevent pollution of the marine environment by land-based activities in recent years. Many of the projects presented in the Icelandic National Programme of Action for the Protection of the Marine Environment from Land-based Activities have been implemented, while other are in the late stages of preparation. Other actions taken by government authorities for the protection of the marine environment include enactment of domestic legislation and participation in various international cooperation designed for the protection of marine and coastal areas.

The most significant changes have occurred in the sewage situation in Iceland, and sewage treatment has increased substantially. In 2001 the proportion of inhabitants with sewage treatment was approximately 40%, but in 2006 this proportion is approximately 70%. Open incineration of waste has been discontinued, and this has significantly reduced the release of dioxin into the atmosphere. New legislation on the prevention of marine and coastal pollution was enacted in 2004, and Iceland also signed an agreement banning the use and release of twelve persistent pollutants in 2001; both are important factors in the struggle against marine and coastal pollution.
Even though much has been achieved in environmental matters in recent years and numerous important initiatives taken there is still room for improvement in various spheres. Environmental matters are a dynamic issue and conditions can change in a relatively short time. Recently a report was issued by the Ministry of Foreign affairs forecasting huge increases in shipping in the Arctic Ocean in the coming years; preparations are in progress for prospective oil exploration and an increase is foreseen in the visits of cruising liners to Iceland. These are all matters that call for a variety of preparations and increased environmental research by government authorities and stakeholders.

Even though the pollution situation in the marine and coastal areas around Iceland is in good order, it is important for Icelanders to monitor and study the marine ecosystem. This is the only way to remain constantly alert and react to any potential changes in the marine environment with regard to pollution.

In the coming years, work will continue on environmental solutions and improvements relating to marine and coastal areas. Projects already begun need to be completed and work needs to be started on the implementation of the projects that have been in preparation.

Table of Contents

1. Introduction 6

1.1 Marine pollution 6
1.2 The Global Programme of Action 6
1.3 The National Action Programme 6
1.4 Main Conclusions 7
1.5 Implementation of the Programme and work of the Steering Committee 7

2 Overview of project status 8

2.1 General 8
2.2 Sewage 9
2.3 Persistent organic pollutants 11
2.4 Radioactive substances 15
2.5 Heavy metals 16
2.6 Oils 17
2.7 Nutrients 19
2.8 Sediment mobilisation and pollution 21
2.9 Litter 22
2.10 Impact on habitats 23
2.11 Handling and Monitoring of Harmful Substances 26

3. Order of priority 27

3.1 Introduction 27
3.2 Group I 28
3.3 Group II 28
3.4 Group III 29

4. Strategic planning and objectives 29

4.1 Current actions 30
4.2 Pathways to stated objectives 30

5. Actions 32

5.1 Group I 32
5.2 Group II 34
5.3 Group III 36

6. List of References 37

1 Introduction

1.1 Marine pollution

Almost all pollutants that are released into the environment end up in the sea at some point owing to the constant circulation of water, which transports to the sea the substances which are released on land, either into the atmosphere or into rivers and lakes. About 80% of all pollution that reaches the sea has its origins on land. In order to prevent pollution of the marine and coastal environment it is therefore important to attack the root of the problem and prevent the release of pollutants on land.

Pollutants are carried throughout the world by air and ocean currents. Organic materials have a tendency to evaporate at their sources, particularly in warm climates, and because of the stability of persistent organic compounds they can be carried over long distances. They fall to the earth with falling temperatures, but can then evaporate again and be carried still further. The Gulf Stream brings warm surface water to Iceland from the south, which becomes cold deep-sea water and flows southwards. Iceland lies at the juncture of currents flowing from the south and the north [22].

Because of the way that pollutants are transported between regions of the globe, it is necessary for the nations of the world to work together on the protection of the sea through international co-operation. The OSPAR Convention is an extremely important international instrument for Iceland, and it marks the starting point of the reduction in pollution which has now become measurable in the Northeast Atlantic according to OSPAR reports. This success clearly illustrates the importance of such co-operation. [31] The objective of the Convention is to reduce pollution from land-based sources, reduce pollution caused by dumping and incineration and reduce pollution from offshore sources. [23] The Stockholm Convention is another important instrument which has the purpose of protecting human health and the environment from persistent organic pollutants. It entered into effect on 17 May 2004 and work is now in progress on its implementation, e.g. through national programmes.

Iceland is a party to other agreements designed to protect the sea, such as the agreement of the International Maritime Organisation, MARPOL which has the objectives of reducing pollution from ships and preventing the discharge of waste and pollutants. A few agreements address oil pollution specifically and provide for international co-operation in the case of serious incidents.

1.2 The Global Programme of Action

The Global Programme of Action which was approved in 1995 has proved its worth beyond any doubt. The Programme was devised for the purpose of serving as an ideological and practical instrument for nations that wish to protect the marine environment from pollution of all kinds. In an international context, approximately 80% of the goals set at the first intergovernmental review meeting in Montreal, Canada, have been achieved. Over eighty nations have formed their own action programmes in accordance with the Global Programme of Action and in keeping with the situation in each respective country.

The second Intergovernmental Review Meeting will be held in the autumn of 2006, in China. At the meeting, the nations of the world will come together to assess the results that have been achieved in the implementation of the Programme and to seek ways of enhancing these results still further, focusing on the action programmes of the individual countries. Also, the strategy for the years 2007 to 1010 will be formulated based on the common approach decided at the United Nations Conference on Sustainable Development held in Johannesburg 1992. [24]

1.3 The National Action Programme

Clearly, each country has its special position, and Iceland has based its Programme to a large extent on a similar programme prepared by the Arctic Council for the Arctic Region. That programme is based on a regional programme for the entire Arctic Region, including Iceland. [1] The Icelandic Action Programme is intended to serve as a

platform for policymaking that the state government, municipalities, organisations, the industries, the tourist industry, agricultural sector and other stakeholders can refer to in all planning and work relating to marine and coastal areas.

In the report on the Action Programme published in 2001 the following objectives were established:

- Protection of human health;
- Reduction and prevention of the decline of the marine environment and coastal areas;
- Restoration of polluted areas;
- Support of conservation and sustainable utilisation of marine resources;
- Maintenance of biodiversity; and
- Maintenance of cultural assets.

These objectives were used as guidelines, together with the international obligations that had already been undertaken by Iceland at the time that the National Action Programme was created. [1] The National Action Programmes of individual countries are intended to provide a comprehensive framework for the co-ordination of the actions, policy and objectives of all those who are involved in one way or another in the protection of the marine environment.

The National Action Programme Report assessed the following pollutant categories:

- Sewage
- Persistent Organic Pollutants
- Radioactive Substances
- Heavy Metals
- Oils
- Nutrients
- Sediment Mobilisation and Pollution
- Litter
- Physical alterations and destruction of habitats
- Handling and Monitoring of Harmful Substances.

Individual pollution categories were arranged in order of priority, based on actual circumstances in Iceland and programmes were established concerning measures to reduce marine pollution from land-based activities in the categories where such measures were needed. [1]

1.4 Main Conclusions

The sections below provide an account of the principal actions taken in each pollutant category. The status of each category was studied and re-assessed as necessary.

The municipalities around the country, environmental authorities and stakeholders have worked together on the implementation of the programme. It is safe to say that considerable progress has been made in issues relating to the protection of the marine and coastal environment of Iceland from the time of publication of the Action Programme in 2001. Huge changes have been made in sewage matters, waste collection has been increased, legislation has been enacted on the protection of the marine and coastal environment and numerous government regulations have been issued with the objective of fostering improved practices as regards the marine environment. Coral fields have been protected, studies of marine habitats have been launched and work on a co-ordinated evaluation of the receiving water around Iceland is in its advanced stages and monitoring of nutrients in the bay of Faxaflói has begun with a report scheduled for the autumn of this year.

1.5 Implementation of the Programme and work of the Steering Committee

The Minister for the Environment has set up a Steering Committee which has the role of following up the implementation of the National Programme of Action. The Committee is composed of representatives from the industries, the Union of Local Authorities in Iceland, the Ministry for the Environment, the Ministry of Fisheries, the Ministry of Industry and Commerce and the Environment and Food Agency of Iceland. The Committee meets regularly and has reviewed and arranged by priority the actions outlined in the Report of 2001 and defined in further detail selected proposals and assessed the cost of their implementation. The Committee also designated the parties responsible for the implementation of selected proposals as well as the division of responsibilities where more than one party is involved. The Committee is intended to make decisions concerning database content and structure, supervision of communications between parties submitting data for the database which is planned for the future. The Committee is required to submit annually to the

Ministry suggestions, interim reports and proposals on budget allocations to implement the Programme.

In the preparation of the Action Programme and the proposed measures it contained opinions were sought from a number of parties in order to obtain the widest possible perspective. The Committee approached government agencies, individuals, private enterprises and associations of stakeholders in order to enhance the quality of the Programme to the extent possible. [1] The Committee will continue its work until 2011, or until the project is completed.

2 Overview of project status

2.1 General

The Action Programme included an analysis and assessment of the scope of the problem at hand in Iceland, together with a detailed plan on improvements and the tasks relating to each issue. The principal emphasis was on persistent organic pollutants, heavy metals, radioactive substances, waste, and treatment and monitoring of harmful substances.

Increased knowledge of the ecosystem and the interaction of its various components, such as the interaction of species and the impact of pollution on their reproduction and other aspects of the ecosystem, has had the results that marine research is now more frequently based on the ecosystem approach, which aims at studying the marine environment from a comprehensive point of view. This has resulted in proposals from states that international agreements should cover a wider scope than currently included within their frameworks. At the same time, there has been increased integration of various agreements relating to matters of the sea. [23]

Statistical facts on Iceland

Iceland covers an area of approximately 103.000 km² and the coastline is approximately 6.000 km long. The continental shelf up to a depth of 200 metres is approximately 115.000 km², and the exclusive economic zone (EEZ) is in total approximately 758,000 km². The exclusive economic zone also constitutes Iceland's jurisdiction as regards pollution control. The country is sparsely populated, with the population of approximately 300,000 inhabitants concentrated to a large extent in the south-western part of the country. The populated areas of the country are largely spread along the coastline all around the country; [1] only 15 urban areas have over 2000 inhabitants, while five urban areas have over 10,000 inhabitants. [25]

Pollution in the sea around Iceland

The sea around Iceland is among the least polluted ocean areas in the world. This is largely due to the geographical location of the country, the small size of the population and a relatively small presence of polluting industries. Pollution of the marine environment around Iceland derives partly from activities in Iceland, e.g. nutrients and oil. Contamination from persistent organic pollutants, radioactivity and heavy metals, such as mercury, is derived largely from overseas sources. [1]

Assets at stake

Icelanders base their economy largely on marine resources. Fisheries have been conducted in Iceland from its settlement and a large part of the export revenues of the country derive from utilisation of marine resources. Iceland's struggle for full sovereignty over the ocean area around the country was long and arduous, but its success laid the foundation for the prosperity and development of the Icelandic population. The ocean is extremely important to Icelanders for communications and shipping. Numerous industries base their survival partly or entirely on the sea and its resources. Enterprises engaged in fisheries, fish processing, fish farming, tourist services, whale watching, nature excursions, cruising, sport fishing, biotechnology, manufacturing of equipments and instruments relating to fisheries and fish processing, software development and production relating to fisheries and fish processing, shipbuilding, shipping and transport services and their support sectors all depend on the ocean around Iceland. The marine wildlife around the country is diverse. In addition to rich fishing grounds, there is an abundance of seals and whales, as well as large colonies of seabirds which are of global importance. The recreational value of the coastline for the Icelandic public and tourists is also great. It is clear, that there are significant assets at stake and it is important to protect the ocean from pollution in order to continue sustainable use of the resources of the sea and coastline in the future.

Measurements

Measurements and monitoring of the concentration of pollutants in the marine ecosystem around Iceland have been increasing in recent years. Monitoring and

measurements in the Arctic Region began with the Arctic Monitoring and Assessment Programme (AMAP) in 1991, which formed a part of the Arctic Environmental Protection Strategy. The conclusions of the measurements were that the Arctic Region is relatively pure. Measurements made of the concentration of persistent organic compounds in the marine ecosystem around Iceland have revealed that their concentration is very low compared with measurements in nearby marine areas in the North Atlantic. [23] Measurements conducted by the Icelandic Fisheries Laboratories of fish caught on Icelandic fishing grounds have revealed that the concentration of pollutants is low and well below the limit values set by the European Union for permitted quantities in these products. In certain seasons of the year, however, the quantity of persistent organic pollutants has been measured above the EU's established critical limits in fish products such as fish oil and fish meal for animal feed. [5]

2.2 Sewage

Introduction

Sewage contains numerous pollutants and chemical compounds. However, the polluting effects of sewage depend to a large extent on the capability of the receiving water to dilute or eliminate the pollution released into it. [1] The sewage situation in Iceland has undergone a major transformation and the volume of untreated sewage discharged into the sea has fallen significantly in recent years. Almost all sewage from the area of the capital has been treated since 2005. [2]

Actions

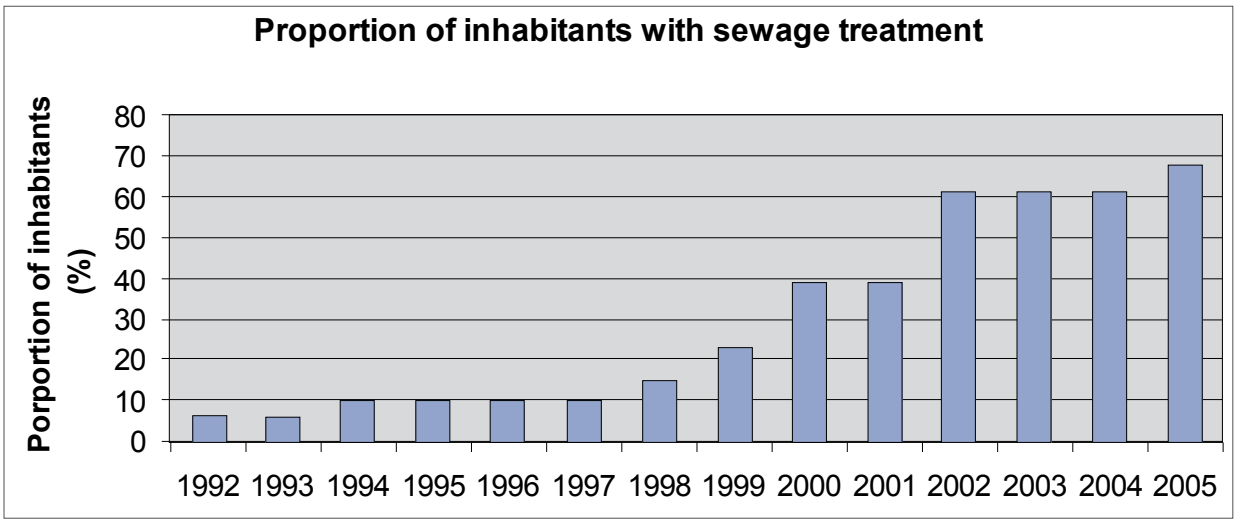
Treatment of sewage in accordance with current legislation

Treatment of sewage has increased all around the country. Figure 1 shows the trend in sewage treatment since 1992. In 1994 requirements were established concerning treatment of sewage from urban areas. The most significant developments have occurred in the metropolitan area of the capital, where 70% of the inhabitants currently have acceptable sewage treatment. Some municipalities around the coastline still discharge untreated sewage into the sea.

In order to promote increased treatment, legislation on financial support for municipal sewage development (Act No. 53/1995) was extended by three years to meet the needs of municipalities in their development of sewage treatment facilities. This means that developments undertaken prior to 2008 will have state support.

Sewage treatment is mostly conducted as primary treatment, which is permitted in less sensitive coastal areas. Secondary treatment is required inland and by the seaside in areas which have not been classified as less sensitive. Septic tanks are used for sewage from individual houses where there is no public sewage system; a septic tank together with a drain field which distributes the waste water through the soil is defined as secondary treatment. [28]

Figure 1. Proportion of inhabitants in Iceland with sewage treatment



Mapping of the emission of pollutants from drains in various places in Iceland

Organic material, nutrients, bacteria, medicinal residues, fire retardant materials and hormones are the principal materials originating in residential areas. Industrial waste water also contains various other substances, such as oils, heavy metals and persistent organic pollutants. A comprehensive mapping of the release of pollutants from waste water has not been completed in many places around the country, but the municipal health committees, which are appointed by the municipal governments, measure the release of pollutants from waste water all around the country. Regular measurements are made of the quantity of colibacillae all around the country. Measurements of pollutants from waste water are also conducted in the metropolitan area of the capital city.

Co-ordinated evaluation of the receiving water around Iceland

It is important to have a co-ordinated evaluation of the receiving water around the country. In order to promote this, the Sewerage Committee of the Ministry of the Environment, in co-operation with the Marine Research Institute, has launched a study of the nutrient situation in the sea around Iceland. Authorisation has been legislated for a budget allocation for the study of the receiving water of sewage systems.

Issue of environmental operating licences for drainage systems

Several sewage systems have been issued environmental operating licences in recent years. The local health committees are required to report on the issue of environmental operating licences for sewage systems to the Environment and Food Agency, but no general overview is available of the number of such licences.

Issue of environmental operating licences for larger industrial companies

All the largest industrial enterprises have been issued environmental operating licences.

Continued treatment of sewage

Work will continue on the treatment of sewage all around the coastline. In many places municipal development work is in good progress and good results have been achieved in reducing the number of drainages in urban areas. The extension of legislation on financial support for municipal development of sewage systems (Act No. 53/1995) over the next three years will make it easier for municipal governments to develop sewage systems in compliance with requirements. [21]

Active monitoring of concentrations of pollutants in drains from industrial companies in accordance with environmental operating licences

Measurements are conducted in compliance with environmental operating licences by the enterprises themselves as well as regulatory agencies. On the one hand, measurements are taken in the drainage systems and on the other hand in the receiving water. Environmental limits for the receiving water are laid down in a government regulation on measures to prevent water pollution and in a regulation on drainage systems and sewage. Release limits have not been defined in any detail as yet in Iceland. Where the receiving water is less sensitive, the concentration of pollutants normally measures within environmental limits when measurements are taken outside dilution areas. Nevertheless, bacterial pollution in excess of environmental limits have occasionally been measured in the Reykjavík coast and in the neighbouring coastline area of Kjós.

Monitoring of certain substances and substance groups in specific drainage systems in accordance with EEA Agreement requirements

Monitoring measurements are conducted of drainage from treatment facilities in the metropolitan area of the capital. The flow is recorded by an automatic recorder, as well as the acidity and temperature, every fifteen minutes. COD and suspended particulates are measured twice a month. Mercury, cadmium, lead, zinc and copper are measured. Nutrients, faecal coliforms and faecal streptococci are measured. Also, the total quantity of phosphorus and nitrogen is measured.

Assessment - review

The coastline around the country is kept under close observation and the number of faecal coliforms and faecal streptococci is monitored in coastal waters by the municipal health committees. Improvements have been made in sewage matters all around the country with 70% of the population now enjoying adequate waste water treatment in compliance with government regulations. In spite of the improvements in sewage matters, some untreated waste water still enters the sea, and measurements of faecal bacteria have revealed occasionally contamination in the vicinity of Reykjavík. Changes in the sewage systems are

proposed in the near future, which will prevent pollution of this kind. Sewage treatment will increase still further in the near future around the coastline as work is currently in progress on improvements in municipalities where the sewage situation is inadequate.

When the conclusions of the studies conducted by the Marine Research Institute on nutrients in the sea around Iceland are available and a co-ordinated evaluation of the receiving water has been concluded a clearer picture can be obtained of the current situation, which will be useful for strategic planning and further improvement of the sewage situation in Iceland. On the basis of these studies a monitoring plan will be prepared and important data will be collected which can be used to lay a firmer foundation for the methodology which is appropriate in sewage matters in the conditions that prevail in Iceland. Also, the conclusions will be useful in defining the receiving water where sewage is fed into coastal waters and they will be useful for the municipalities in their studies of the receiving water and decision making on the treatment of sewage from urban centres on the coast.

A comprehensive mapping of the release of pollutants around the country has not yet taken place, but data on the release of pollutants are preserved by the municipal health committees and they need to be collected into a single database in order to obtain a comprehensive overview of the current situation.

2.3 Persistent organic pollutants

Introduction

The Icelandic authorities have long been concerned about persistent organic pollutants that could pose a threat to Icelandic fish products if no measures are taken to limit the distribution and release of such substances. Pollution from persistent organic pollutants around Iceland can largely be traced to overseas sources, but these compounds are also released into the atmosphere in Iceland, albeit in small quantities. Because of the significant interests at stake it is important to Iceland that the release and distribution of these substances, in Iceland and elsewhere, are restricted. The Stockholm Convention, which took effect in 2004, was a milestone in the struggle against pollution from persistent organic pollutants. The Convention attacks the root of the problem by prohibiting the production and use of persistent organic pollutants which degrade slowly in nature and can be transported over long distances. Iceland ratified the Convention in 2002, and 151 states have now signed the Convention and 59 have ratified it. The Convention covers twelve anthropogenic compounds which have been shown to be capable of having an serious negative impact on nature as well as serious consequences for human health. The Stockholm Convention provides for extensive co-operation with the developing countries, where these compounds are still in use. [3]

Research in this field has been gradually increasing. In 2003, the Icelandic Fisheries Laboratories began extensive measurements of undesirable substances in marine products which will continue at least until 2006. The Environment and Food Agency also began a study of the release of persistent organic pollutants falling within the scope of the Stockholm Convention.

Actions

Mapping of polluted areas and previous sources of pollution

Probable pollution sites have been investigated in co-operation with the municipal health surveillance authorities. Fifty-five landfill sites for municipal solid waste have been identified as potentially polluted; this assessment is based on the fact that little is known of the waste disposed of in these landfills. [4] Chemical analyses have been carried out in some places and the sites have been dealt with in accordance with their condition as regards pollution.

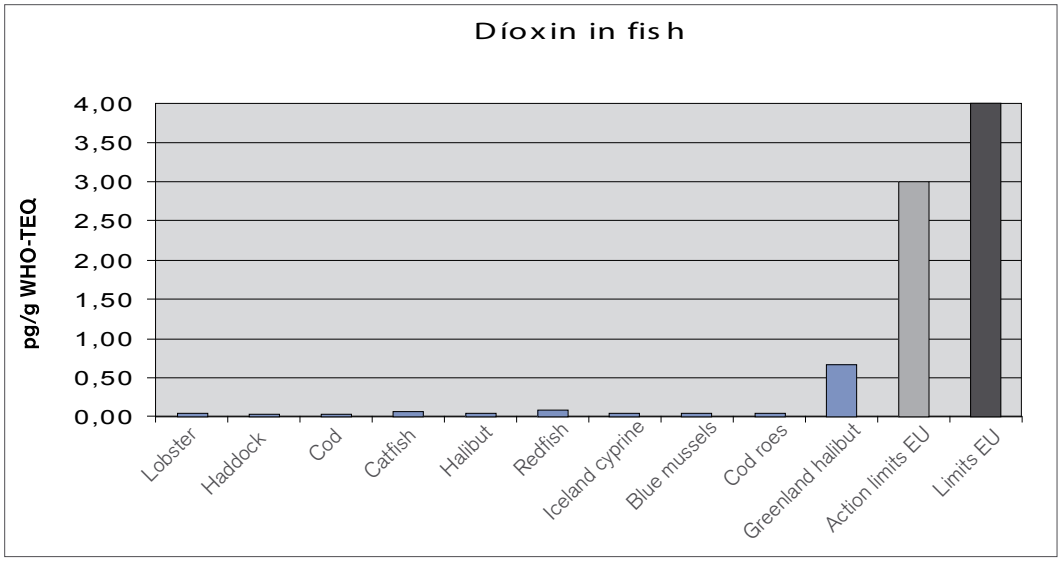
Evaluation of emissions

The Environment and Food Agency has begun a study of the release and emission of persistent compounds from activities and undertakings in Iceland and collected information on the principal sources. The Environment and Food Agency will continue to compile a database containing information on the release of pollutants. [4]

Measurements of dioxin and furans

Measurements of dioxin began in 2003. The Icelandic Fisheries laboratories measured dioxin in Icelandic fish catches and the results showed that Icelandic fish product intended for human consumption contain extremely small quantities of dioxin-like PCBs, as shown in Figure 2. Fish meal and fish oil intended for the production of animal feed proved in some cases to contain a rather high concentration of dioxin, although the concentrations were invariably within the limits permitted by the European Union. This underlines the need for constant and active monitoring. [5]

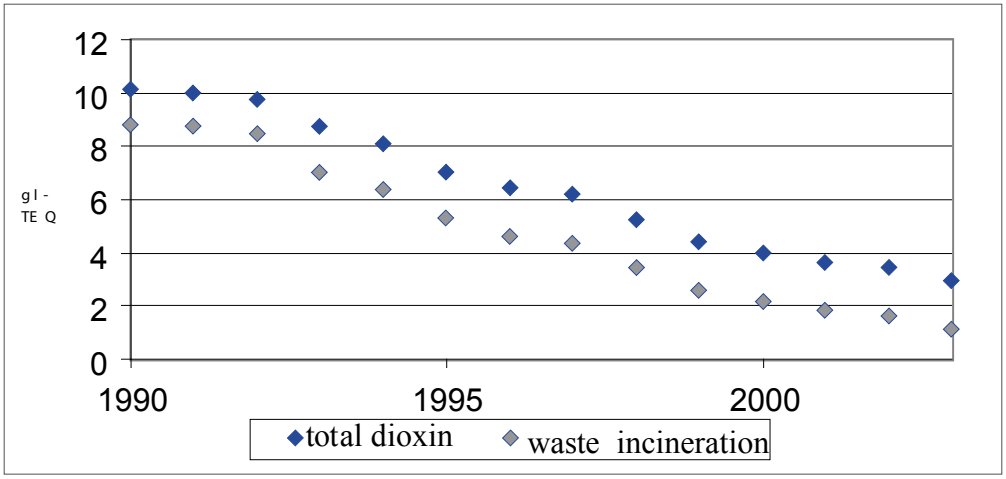
Figure 2. Quantities of dioxin in fish in Iceland



Emissions of dioxin

In Iceland, the total emissions of dioxin have fallen from just over 10 g I-TEQ in 1990 to just under 3 g I-TEQ in 2003, according to the assessment of the Environment and Food Agency. As shown in Figure 3, the decline in dioxin emissions shows a close correlation to the decline in waste incineration. Open incineration of waste has also been discontinued, which was a factor in the emission of dioxin into the atmosphere. [4]

Figure 3. Estimated changes in the release of dioxin into the atmosphere in 1990 to 2003.



The discharge of dioxin from the fishing fleet represents a considerable factor in the total dioxin releases into the atmosphere, and in fact it is believed that the formation of dioxin is increased when the air used in combustion contains salt. [4]

Measurements of endosulfan

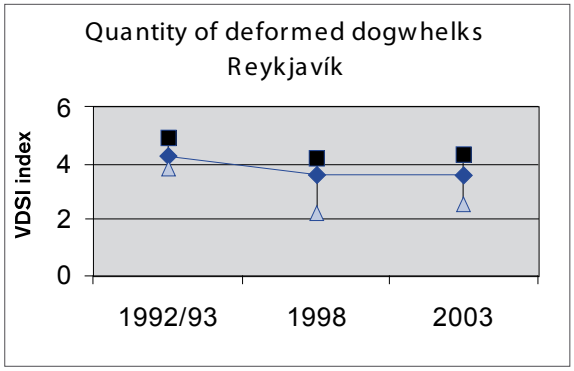
Endosulfan is an insecticide which has been discovered in small quantities in fish caught in the ocean around Iceland. This is not a very persistent compound in comparison with numerous other insecticides. The chemical is hazardous for fish and its limits in fish feed and fodder components are therefore low. There are no EU limits for this chemical in marine products for human consumption. The chemicals were measured in very small quantities in fish catches in 2003 – 2004, in the range of 0.1µg/kg – 3.6µg/kg wet weight. [6, 5]

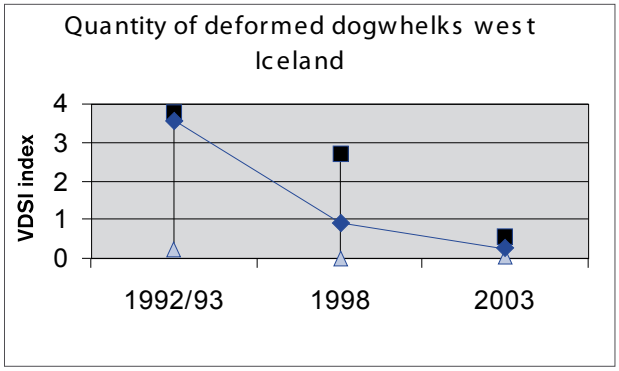
Measurements of concentrations of Tributyltin (TBT) in the Icelandic environment

Tributyltin contamination was first studied in Iceland in 1992 by using marine gastropods as bioindicators. At that time, deformed dogwhelks had been found in various locations off the southwest coast. The biological impact of

TBT pollution in Iceland has been assessed every five years since 1992, and the next measurements have been scheduled for 2008. The greatest proportion of deformed dogwhelk was found in the vicinity of the larger ports in south-western Iceland, but also off western and north-western Iceland. The deformation is assessed based on the so-called Vas Deference Sequence Index, VDSI, a six-stage measurement scale for the extent of deformity. [37]

Figure 4. Quantity of deformed dogwhelks off Iceland





In 1990, all use of tributyltin antifouling was prohibited in Iceland for vessels under 25 metres. In most European countries the use of antifouling containing TBT was banned in 2003 and in Iceland all use, manufacturing and import was prohibited in 2002.

Issue and review of environmental operating licences

All large industrial enterprises have been issued licences. However, records of environmental operating licences of sewage facilities are lacking.

Audit of locations and scope of release

The Environmental and Food Agency of Iceland has conducted an initial assessment of the sources and discharge of persistent organic pollutants from land-based sources into the sea. The sources of persistent organic pollutants in Iceland, which are specified in the Stockholm Convention are the following:

- **Waste incinerators**

It is estimated that approximately 22,000 tons of waste are incinerated in Icelandic incinerators each year. It is estimated that up to 1% of the waste incinerated is released into the atmosphere in the form of ash. Dioxins that can be formed by the incineration has a tendency to bind to soot particles. There is no direct discharge of chemicals into water from incinerators or through leaching from landfills used for the disposal of ashes from flue-gas treatment.

- **Cement kilns firing hazardous waste**

Waste oils and organic solvents are used in part as fuel, and waste from the photographic industry is also disposed at high temperature of in Iceland Cement Factory in Akranes. The maximum limit of PCB in raw materials is 50mg/kg. There is a risk of the release of dioxin and furans into the atmosphere from activities of this kind. Three are no indications of any direct discharge into the sea of PCB, HCB or dioxin/furans from the cement production.

- **Primary production of aluminium**

Primary production of aluminium has not been regarded as a significant source of dioxin and furans, but it is possible that the electrodes, which are made of carbon, and fumes from aluminium foundries, where chlorine is used for off-gassing are a potential source of releases into the atmosphere. There are no indications of discharges of PCB, CHB or dioxin and furans into the sea.

- **Residential combustion sources**

Only 1% of houses in Iceland are heated by combustion of oil, and fireplaces are generally not used for residential heating. Releases of persistent organic pollutants into the atmosphere from such combustion is possible, but in very small quantities.

- **Fossil fired boilers**

Industrial fossil-fired boilers are used for the production of steam, e.g. in the manufacture of fish meal. Releases of persistent organic pollutants into the atmosphere from these sources are possible.

- **Crematoria**

There is one crematorium in the country where 300-500 corpses are cremated annually. The crematorium is not equipped with treatment facilities for its emissions, and it is therefore possible that there may be some emissions of persistent compounds from the crematorium.

- **Motor vehicles, particularly those burning leaded gasoline**

Dioxin and furans are formed by the combustion of fossil fuel in engines, and they are released into the environment with exhaust fumes. The use of leaded gasoline leads to greater releases of these substances than lead-free gasoline, although catalysers and dust filters in diesel cars reduce the emissions. Lead-free gasoline was introduced in the Icelandic market in 1988, and the sale of leaded gasoline was discontinued in 1996. Direct releases of persistent organic pollutants is believed to occur from these sources into the atmosphere.

- **Shredder plants for the treatment of end-of-life vehicles**

It is believed that dioxin, furan and PCB pollution is caused by oils and other substances in discarded vehicles and other waste which is released by shredding or formed through combustion. Insufficient information is available to assess the release of persistent organic pollutants into water from activities of this kind in Iceland.[4]

Increased scope of general monitoring

General monitoring has been increased and the Icelandic Fisheries Laboratories launched extensive measurements of fish catches in 2003, which will continue until 2006 at least. Pollution from persistent organic pollutants around the country is observed in connection with harbour construction activities. When harbours are dredged, the persistent organic pollutants in the sediments are measured, and in some harbours these chemicals are monitored. [7]

Cessation of low-temperature incineration of waste

Low-temperature incineration of waste has now been discontinued, which has significantly reduced the release of pollutants.

Administrative reforms, particularly as regards environmental operating licences

Administrative reforms as regards landfills and incineration of waste were put into effect with the enactment of legislation concerning waste management in 2003. The purpose of the legislation is to minimize the undesirable impact of waste handling on the environment and prevent pollution of water, soil and atmosphere, as well as to reduce the potential risks of waste disposal for human and animal health.

Assessment - review

Research into the scope of pollution and distribution of persistent organic pollutants is currently in progress. It is known with some certainty that the only persistent organic pollutants released in Iceland after 1990 are HCB, PCB and HCH, which has not been used in Iceland since 1996. The first assessment of the release of persistent compounds on land shows that the release is very limited. [4]

Release of pesticides falling within the scope of the Stockholm Convention is believed to be limited in Iceland. Five of the eight chemicals covered by the Convention are not known to have ever been used in Iceland at all, i.e. dieldrin, endrin, heptachlor, mirex and toxaphene. Two of the chemicals, aldrin and chlordane, were probably used before 1979, but were never registered and were prohibited in 1996. DDT was used as a pesticide before 1975, but it was never registered and prohibited in 1996.

The conclusions of the Icelandic Fisheries Laboratories show that Icelandic fish products intended for human consumption contain small quantities of persistent organic pollutants, such as dioxin and dioxin-like PCBs and pesticides, and their concentration is far short of the limits permitted under EU rules. The concentration of PCBs is also very low in the parts of the fish used for human consumption with concentrations falling far short of the limits for the permitted quantities of these chemicals set in Germany, the Netherlands, Sweden and Iceland. The concentration of mercury is also well within the limits set by the European Union and in most cases the concentration is at least ten times lower than the permitted limits. The concentrations of persistent organic pollutants in fish meal and fish oil are in most cases within the permitted EU limits. Measurements have shown that the level of persistent organic pollutants in fish meal and fish oils vary greatly by season. Measurements of fish meal and fish oil have shown that the concentrations of substances such as dioxins and dioxin-like PCBs, toxaphenes and chloredanes can exceed permitted EU limits in the spawning season. At that time pelagic fish have little fat, which makes the concentration of the chemicals in the fat proportionally higher. It is important to keep these facts in mind and monitor the condition of the products at certain times of the year. [5,35]

The Icelandic government has made efforts to limit the dissemination of persistent organic pollutants on land using various measures. Low temperature incineration of waste has been discontinued and high-temperature waste

incinerators have been introduced equipped with flue gas treatment which prevents these chemicals from being transported by air currents. The importation of many persistent pollutants is restricted by law. The Icelandic government is also combating the production and release of these chemicals internationally and has ratified the Stockholm Convention, which is intended to limit pollution from persistent organic compounds.

Even though the release of persistent organic pollutants into the atmosphere and pollution from these chemicals is limited in Iceland, it is very important observe very carefully any changes in the situation. Persistent organic pollutants have contaminated soil in Reykjavík at the site of the Hringrás recycling plant but that soil has now been exported and will be treated. In rural areas there are landfills which might be polluted, and it is necessary to investigate whether any pollution can be observed in those areas. It is an urgent matter to designate a special landfill site for the treatment and disposal of contaminated soil and other hazardous waste. Work is currently in progress on the preparation of such a site.

2.4 Radioactive substances

Introduction

The radioactivity which is measured in the sea around Iceland is carried there by ocean currents, mostly from the recycling plant at Sellafield. The Icelandic Radiation Protection Institute is responsible for investigating and monitoring radioactive substances in foodstuffs and the environment pursuant to Act No. 44/2002. Regular measurements of radioactivity around Iceland are conducted on fish and seaweed and seawater, with sea samples taken three times a year.

The nuclear reprocessing plant at Sellafield has in recent years reduced is discharges of caesium (C-137) but significantly increased its discharges of technetium (Tc-99). The concentration of caesium (Cs-137) in the sea was measured in the range of 2.3-3.6 Bq/m^3 in 2003-2004. The highest concentration was measured in the polar sea off the western and north-western coasts. The concentration of caesium measured in the range of 0.1-0.3 Bq/kg in seaweed and 0,1-0,6 Bq/kg in fish.

Actions

Measuring of Tc-99 in the sea around Iceland

Measurements of Tc-99 (technetium-99) were begun in 2003 to ascertain whether the impact of the significant increase in discharges of the substance from Sellafield was felt in waters off Iceland. The concentration of Tc-99 measured in the range of 0.04-0.2 Bq/m^3 and therefore appears to have increased slightly since measurements were begun. The vast majority of the measuring values are below 0.1 Bq/m^3 with the concentrations of TC-99 at their highest level off the western coast of the country, by Látrabjarg, at 0.2 Bq/m^3 [8].

Table 1. Concentration of Cs-137 (Caesium) and Tc-99 (technetium) in the sea around Iceland.

Date	Sampling place	Cs-137/ Bq/m3	Tc-99/ Bq/m3
02.2000	Kögur	5.9	*
02.2000	Siglunes	3.9	*
02.2000	Langanes NA	5.0	*
02.2001	Kögur	2.1	*
02.2001	Siglunes	3.0	*
02.2001	Langanes NA	5.3	*
05.2002	Kögur	2.2	*
02.2002	Siglunes	3.0	*
02.2002	Langanes	2.6	*
02.2003	Kögur	2.0	0.04
02.2003	Siglunes	3.7	0.05
02.2003	Langanes NA	2.7	0.05
05.2004	Kögur	3.3	0.1
05.2004	Siglunes	2.5	0.06
02.2005	Kögur	**	0.10
02.2005	Siglunes	**	0.07
02.2005	Látrabjarg	**	0.2

*No measurements
**Results of measurements not available

Continuous long-term monitoring to maintain overview of the issue

Pursuant to legislation on radiation protection, long-term monitoring will continue to maintain an overview of the issue.

Renewal and maintenance of reaction plans

It is assumed that the renewal and maintenance of reaction plans will continue in the future.

Assessment - review

Radioactivity in the sea around Iceland is minimal and no changes have been observed in recent years. The results of measurements show that in spite of the significantly increased discharge of technetium from Sellafield, limited changes have been observed in the concentration of radioactive substances in the ocean around Iceland in recent years. The concentration of caesium (Cs-137) measures far below international guidelines on permitted concentrations of the substance in food, which provide for an upper limit of 1000Bq/kg. Measurements of Tc-99 in the sea around Iceland will continue in the coming years. Increased TC-99 pollution is to be expected, as the Sellafield nuclear reprocessing plant has greatly increased its discharge of the substance and changes in its concentration needs to be monitored in the future. It is important for Iceland that the decision of the OSPAR ministerial meeting on a 2020 deadline to cease the discharge of radioactive substance is met. No decision has been made on a date for the closure of the Sellafield nuclear plant, but the position of the Icelandic government is that all discharges of radioactive materials into the sea should be ceased.

2.5 Heavy metals

Heavy metals are elements found in the sea, usually in low concentrations. Their natural concentration varies from one area to the next and depends on the geology and marine chemistry of the area in question. The hazardous heavy metals are cadmium (Cd), lead (Pb) and mercury (Hg), but chrome (Cr), copper (Cu), nickel (Ni), and zinc (Zn) can also cause negative effects on the environment. Arsenic (As) is usually also included in discussions of heavy metals. [1]

Monitoring of the concentration of heavy metals in the marine ecosystem around Iceland began in 1989, and measurements have shown that the concentration of heavy metals is generally low. [29] However, the concentration of cadmium has been measured high in some places for unknown reasons. The principal industrial sources of heavy metals in Iceland are shipyards, tanneries (there is one tannery in Iceland) and a metal coating plant (zinc and chrome), aluminium plants and ferrosilicon plants. [1] Foreign studies indicate that a high percentage of heavy metals is released into the sea by air and in this way heavy metals can be transported far from their place of discharge. This applies to mercury pollution, which is a cause of concern for the Icelandic government, which has called for special consideration of the matter in the United Nations Environment Programme (UNEP). [23]

Actions

Mapping of primary release points

Mapping of primary release points is scheduled for the autumn of 2006.

Study of the geochemistry of cadmium (Cd)

The concentration of cadmium has been measured at relatively high levels in the ecosystem around Iceland. The reasons for this are unclear, and the decision was made to investigate the extent and reasons for cadmium pollution in fish. Samples have been taken and are in the process of being measured. A report on the project is expected in December 2006.

Survey of mercury (Hg) concentrations in the atmosphere

Measurements of mercury in the atmosphere were conducted by the Environment and Food Agency and the Icelandic Meteorological Office. Measurements were made in two locations in the country, at Stórhöfði in the Vestmanna Islands and at Nesjavellir.

In 2004, mercury measured in the range of 2-6 ng/m^3 at Stórhöfði. In one case the concentration of mercury increased more than one hundredfold in a short period of time, probably in connection with an earthquake which had its epicentre in the seabed southwest of Reykjanes. In 2006, measurements were begun at the power development site at Nesjavellir for the purpose of ascertaining whether mercury is released from the drilled wells and hot springs in the area. The average concentration was measured 1.5 ng/m^3 .

In comparison, it is estimated that the average concentration of mercury in the atmosphere in the world is approximately 1.5 ng/m^3 and the values in Northern Europe generally lie in the range of 1.3-2.1 ng/m^3. The values at Stórhöfði are therefore higher than might be expected, while the Nesjavellir values are close to the expected values for Northern Europe. [28]

Evaluation of emissions

A comprehensive assessment of the release of heavy metals has not been made in Iceland. Monitoring of heavy metals in selected rivers is in progress. This monitoring has been used to assess the discharge of heavy metals into the sea by rivers. The discharge of heavy metals from

rivers was measured in 1998-2005 in ten rivers in eastern and southern Iceland. On the basis of these measurements it was estimated that approximately 0.5 tons of cadmium, 3.8 tons of lead and 0.5 tons of mercury are carried to the sea by stream sediments in the country as a whole. [28]

Issue and review of environmental operating licences for industries

All the largest industrial enterprises have been issued licences. However, records of environmental operating licences of sewage facilities are still lacking.

Research on impact of anthropogenic activities as compared to natural sources

Studies of heavy metals in moss are currently being conducted by the Icelandic Institute of Natural History. The purpose of the studies is to determine the quantity of heavy metals transported to Iceland through the atmosphere. Sources of heavy metal pollution will be pinpointed and the size of polluted areas determined. The method is based on the fact that heavy metals brought to Iceland by precipitation and dust accumulate in the moss. The moss was collected at 115 places around the country and analysed. Concentrations of cadmium, chrome, copper, iron, nickel, lead, vanadium, zinc, arsenic and mercury will be measured. The study is a joint project of the Nordic countries and other European countries. The results of the studies will be displayed on maps showing the concentration of heavy metals in different places. [30]

Monitoring of the concentrations of heavy metals in the Icelandic environment

Monitoring of the concentration of heavy metals in the Icelandic environment is conducted in many places with numerous research institutions involved. Monitoring of heavy metals is conducted in Icelandic fish catches, and the intention is to continue this work over the coming years. It is assumed that the scope of the monitoring will be similar to that of recent years. Chemical monitoring is also carried out in streams where regular measurements are taken of numerous heavy metals.

Assessment - review

The report of the OSPAR Committee published in 2005 reveals that according to the assessment of monitoring measurements, the concentration of pollutants in the Northeast Atlantic in general is falling.

In the years that heavy metals have been monitored in Iceland, research and measurements have revealed that heavy metal contamination in living organisms does not appear to be a problem in the sea around Iceland. There is no heavy industry in Iceland which releases heavy metal into fresh water in any significant quantities. The release is therefore mostly from small-scale industry and vehicle traffic. The low concentration of these substances which is measured in fresh water in Iceland therefore represents the natural background values of these substances in Iceland.

A report recently published by the Icelandic Fisheries Laboratories reveals that the concentrations of heavy metals in cod and mussels in Iceland are usually close to or below the reference values of the International Council for the Exploration of the Sea (ICES), although with some exceptions. Thus, cadmium is, as before, measured at relatively high levels in the marine ecosystem in Iceland, which appears to stem from natural causes, as nothing has emerged to indicate cadmium pollution from anthropogenic sources. The concentration of mercury is among the lowest measured in the Northeast Atlantic and has not increased since measurements began.

The OSPAR Report of 2005 reveals that in Iceland the concentration of arsenic and cadmium has increased since the time of the last measurements. The concentration of arsenic increased in Álftafjord in the northwest, and the concentration of cadmium has increased by 6-10% over a 12-year period in Hvalfjord in the southwest.[31] There is a need to study the reasons for this increasing concentration in greater detail.

A more detailed assessment is proposed of the data concerning the release of mercury into the atmosphere as well as a summary of its results [28] as a considerable quantity of data is now available in Icelandic research institutions responsible for measurement of heavy metals and persistent organic compounds. In order to comment on the changes in the concentration of these substances in the environment over a longer period detailed statistical calculations will need to be made of the available data. It is likely that some mercury is released into the atmosphere by the crematorium and research on that issue are already begun.

2.6 Oils

Introduction

Considerable progress has been made on this issue in recent years. Of principal note is the fact that Act No. 33/2004 on the prevention of marine and coastal pollution

addresses many of the issues that relate to potential oil pollution. A government regulation was issued in 2004 with a view to ensuring that shifting oil between vessels on the open sea is done using methods that will not threaten the environment. Shifting oil between vessels is now banned in large areas of the ocean around Iceland except with the special government permission.

Actions

Creation of reaction plans for serious pollution accidents

Act No. 33/2004 on the prevention of marine and coastal pollution addresses the preparation of reaction plans in the event of acute pollution which may be caused by industrial activity, providing that such plans must be prepared before the issue of an environmental operating licence. The plans must be based on risk assessments which take into account, among other things, the issues outlined in an annex to the Act and provided for in a government regulation.

Complete the issue of environmental operating licences for petrol stations and other operations where oil is handled in significant quantities

Petrol stations now all have environmental operating licences. Oil supply depots are required to have an environmental operating licence, and all of them have such a licence with the exception of two depots operating on an exemption.

Obligation to report accidents on land

Act No. 33/2004 provides that owners or officers of vessels and owners or operators of offshore work or drilling platforms must immediately notify the headquarters of the Icelandic Coast Guard of all discharge, dumping or pollution covered by the Act within the pollution jurisdiction of Iceland, as well as on coasts, except in the case of discharges which are specifically permitted under the Act. A polluter is liable for all acute pollution damage if the pollution is the result of transportation of oil, toxic materials, hazardous materials or certain economic activities. This liability, which is objective, covers damage amounting to up to SDR 1 million. Parties transporting oil, toxic materials or hazardous materials are required to take out liability insurance or submit other insurance considered adequate by the Environment and Food Agency in the amount of 1 million SDR. A government regulation has also been issued concerning acute pollution insurance of ships and land-based activities.

The creation of risk maps with regard to potential oil pollution of coastlines

A sensitivity map and contingency plan has been prepared for south-western Iceland, and there are plans for such maps to cover the entire country in the future. Such map displays information on natural features and other assets which could be placed at risk in the event of a pollution disaster in the area in question. Potential pollutants are recorded, assessed and defined for the ocean and coastal area in question. Information concerning climate, currents, communications, disaster response organisations, experts, agencies etc. is linked in order to improve the efficiency of actions and responses when there is an impending risk of acute pollution. The sensitivity map and contingency plan is intended to be the principal aid for response organisations when and if events of acute pollution occur calling for complex information gathering, organisation and management. [9]

Maintenance of reaction plans for serious pollution accidents

It is assumed that reaction plans for acute pollution accidents will be maintained for the future.

Assessment - review

Oil transport carries risk and oil pollution accidents can cause extensive damage to the environment, as oil can both have acute toxic effects and serious long-term consequences for the marine ecosystem. The risk of oil pollution is caused not only by ships transporting oil, but also by land-based sources, such as urban sewage, river sediments, oil transportation on land and in loading and unloading oil in the ports around the country.

The changes that have been made in the legal environment in recent years are important for improved defences against potential oil pollution. The preparation of sensitivity map and contingency plan is also important to enable correct responses in the event of oil pollution accidents.

It is assumed that the passage of vessels through the Arctic Ocean will increase substantially in the coming years owing to oil transportation and the economic development of coastal areas in Siberia. The shipping route through the Arctic Ocean between the North Atlantic and Pacific Oceans will in all probability open up to reinforced ice-breaking cargo vessels in the future, which will radically change the shipping routes in the northern hemisphere. Improved navigation techniques and continuous satellite information will in all probability open the route to international shipping earlier than previously

anticipated. The Arctic ecosystem is extremely sensitive to any adverse events. If these predictions prove correct it is necessary to take measures to prevent environmental damage. The principal concerns relating to increased shipping relate to acute pollution resulting from accidents, rather than normal traffic of vessels. Pollution from large-scale oil spills in the Arctic could reach the country within months, borne by ocean currents. It is important to assess the risk of such accidents and prepare responses to them.[10]

2.7 Nutrients

Introduction

The nutrients phosphate and nitrate are necessary to marine algae and dissolved silica is necessary to silica algae. However, large quantities of nutrients in the sea can result in a dangerous chain reaction. Great quantities of nutrients can cause an explosive growth of algae, which eventually sink to the bottom where they rot without benefiting other life forms as food. The rotting can cause eutrophication if mixing is not sufficient, which in turn causes the death of sedentary species. The lack of oxygen can also lead to the deoxidation of dissolved sulphate, which causes the formation of hydrogen sulphide, which has a powerful toxic effect on living organisms. Also, it is believed that eutrophication can lead to increased frequency of blooms of toxic algae. The primary anthropogenic sources of nutrients are sewage, waste water from the food industry, animal husbandry as well as leaching of synthetic fertilizers.

Concentrations of nutrients in rivers during the summer are lower than the mean concentrations in the sea at the same time. For this reason effluence from land does not have an impact on the concentration of the chemicals in the sea. Localised impacts cannot be excluded, as large quantities of nutrients may on occasion be released quickly into the environment from activities such as those of slaughterhouses. [1]

Actions

Chemical analyses around major outfalls and streams/rivers

Releases of nutrients with sewage and from commercial activities have been estimated, and prior to 2002, the release of nitrogen and phosphorous from residences, fisheries and agriculture was estimated at 1,739 million pollution equivalents on an annual basis, as shown in Table 2 on estimated nutrient release.

Table 2. Estimated total release of nitrogen and phosphorous from residents and commercial activities (fisheries and agriculture) in 2002.

Measurements conducted on the treatment of sewage from the metropolitan area of Reykjavík have indicated an approximately 20% removal of organic substances (such as COD_{Cr}) and approximately 15% removal of particulate content. An estimate of discharges, based on measurements of untreated sewage from Reykjavík, indicates that the total discharge of nitrogen is approximately 6.8 tons per day, or 2482 tons per year. The total discharge of phosphorous is approximately 0.64 tons per day, or 233

	Nitrogen release	Phosphorous release	Calculated pollution equivalents
Metropolitan Reykjavik Area	1,729 tons	323 tons	568,636 thousand
Western Iceland	388 tons	67 tons	123,313 thousand
West fjords	183 tons	32 tons	58,473 thousand
Northwest Iceland	290 tons	50 tons	92,106 thousand
Northeast Iceland	723 tons	124 tons	229,119 thousand
East Iceland	1,526 tons	254 tons	477,547 thousand
South Iceland	600 tons	103 tons	190,215 thousand
Total:	5,439 tons	953 tons	1,739 million

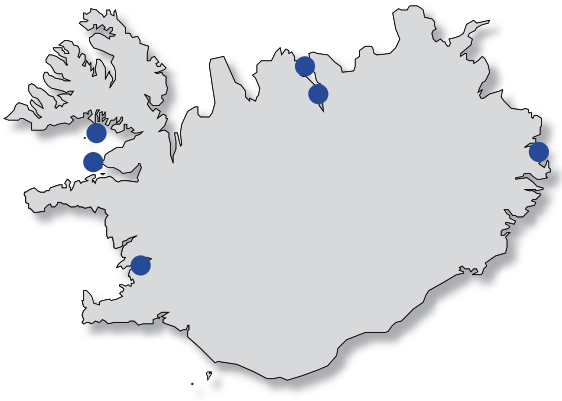
tons in total of phosphorous per year. [36] Pollution equivalents are calculated based on 16 g/day for nitrogen and 3.5 g/day for phosphorous in sludge water, and the total quantity is shown in tons per year.

Monitoring and registration of the frequency of algal blooms around Iceland

The Marine Research Institute monitors the annual trends of phytoplankton in the ocean around Iceland. Work is in progress on a simulation model where telemetry, as well as measurements at sea, will be used to display phytoplankton trends in the sea and to calibrate the telemetering work.

Some marine phytoplankton can produce toxins which can cause toxic reaction in humans, but phytoplankton can also cause fish mortality, particularly in fish farming. With the increasing scope of fish farming and shellfish cultivation demand has been steadily increasing for monitoring of the growth of toxic algae and their toxic impact. For this reason the Directorate of Fisheries, in co-operation with the Marine Research Institute, Institute of Freshwater Fisheries, the Environment and Food Agency, fishermen fishing for shellfish and mussel cultivators, have decided to monitor toxic phytoplankton in several areas around the country. Areas in Hvalfjord and Breiðafjord in the west, Eyjafjord in the north and Mjóifjord in the east are monitored with the number of toxic phytoplankton observed on a weekly basis from the spring and into the autumn. In 2006 there have been signs of species at most monitoring sites which can cause shellfish poisoning, such as Dinophysis species and Pseudo-nitzschia pseudodelcatissima, which can both cause poisoning. In July 2006, the quantity of Dinophysis species was measured at 3,380 cells per litre, and Pseudo-nitzschia pseudodelcatissima at 8,959,680 cells per litre, which are both far above reference limits. For this reason, regular warnings concerning shellfish consumption have had to be released in the summer of 2006 following measurements. [32]

Figure 5. Areas where toxic algae are monitored



Monitoring of the chemical content of streams

One of the monitoring projects conducted by the Ministry of the Environment is monitoring of the chemical content of streams. Regular measurements are conducted of various factors, including minerals and nutrients. The discharge of nitrogen and phosphorous into the ocean by streams in 1997 to 2001 was assessed to be in the order of 3400 tons of total nitrogen and approximately 2900 tons of total phosphorous per year. [28]

Monitoring of nutrient conditions in surface water in accordance with EEA undertakings

Monitoring of nutrient conditions in surface water in accordance with EEA undertakings is linked to government regulation 804/1998 on the prevention of water pollution caused by nitrogen compounds from agriculture and other industrial activities, and covers both surface water and groundwater. The monitoring results from streams, as well as measurements of potable water and other occasional measurements, are used to assess the nutrient situation in surface water. Icelanders obtain their potable water to a large extent (95%) from springs, i.e. as groundwater, and surface water is rarely used for human consumption (5%). [28] The surface water that is used as potable water is from mountain lakes and shows no signs of nitrate pollution.

Studies and classification of lakes with regard to nutrient situation are currently in progress in Iceland. In 1997-2000, nitrogen compounds were measured in 59 lakes. In 49 lakes, the concentration of nitrate nitrogen (NO_3-N) measured less than 0.005mg/l, and in all the lakes the concentration of nitrate nitrogen (NO_3-N) was measured as less than 0.05mg/l.

Table 3. The table shows the total quantity of nitrogen and phosphorous measured in 59 lakes in the country.

No. of lakes	Total quantity of nitrogen in mg/l	No. of lakes	Total quantity of phosphorous in mg/l
52	< 0.3	36	< 0.01
5	0.3-0.75	12	0.010-0.025
2	0.75-1.5	4	0.025-0.050
		7	0.050-0.125

Assessment - review

The results of studies show that nutrients do not appear to be a pollution problem in the coastal areas of Iceland and there are no indications of eutrophication in the streams and lakes in Iceland. The volume of estimated nutrient discharges into the sea is not significant in comparison with larger countries. However, it is necessary to conduct studies to measure effluence from land, and the Agricultural University of Iceland has begun this work. Measurement data from the streams indicate that estimates of the effluence of nutrients has been too high. Further research will reveal new criteria for the measurement of effluence which may possibly reduce the effluence figures. It is necessary to analyse further the data collected in recent years and subsequently it will be possible to assess the discharge of nutrients more precisely than has been possible to date. However, increased fish farming on the coast could increase the discharge of nutrients off the coasts of Iceland in the future.

There have been considerable signs of toxic algae in Iceland since measurements began, and across the world there have been indications of an increased spread of toxic algae. The reason is not clear, but various explanations have been proposed. Increased shipping and discharges of liquid ballast are cited as possible explanations, while others believe that the increase is the result of increased quantities of nutrients being carried into the sea as a result of human activity, which increases the growth of algae. Still others believe that increased knowledge and vastly increased monitoring has the effect that blooms of harmful algae are more often reported.

It is not long since the monitoring of toxic algae began, and it is impossible to see whether the frequency of toxic algae in mussels is increasing, decreasing or stable. The contextual link between the discharge of nutrients and toxic algae is also very unclear, but increased monitoring and research will perhaps shed a light on whether there is such a link.

2.8 Sediment mobilisation and pollution

Introduction

Marine sediment around Iceland has to a large extent been formed by stream sediment loads and by glacial erosion. The impact of construction and development can cause a disturbance in natural sediment shifts and also the concentration of pollutants in the sediment may increase. Natural sediment mobilisation is important for coastal areas, and changes in the mobilisation can disturb the equilibrium. Excessive sediment can spoil habitats on the seabed and increased quantities of suspended particles can decrease the amount of light carried down into the water. Too little sedimentation can also have negative effects on natural balances.[1]

Various elements can influence sediment mobilisation. Altered land use, dredging and construction of harbours, large civil engineering works in coastal areas and damming of streams and bridging of fjords are all factors which can affect sediment mobilisation. Pollutants can be carried into the sediment through drainage systems, streams and rivers or directly from commercial operations in and close to harbours. Dredging can pollute sediment and shift it to unpolluted areas. Pollutants in sediment are mainly heavy metals and persistent organic pollutants. They are usually more common in fine sediment, which is richer in organic carbons to which pollutants have a tendency to adhere. [1]

Contamination in surface sediments has been measured in limited areas near harbours and shipyards in the Reykjavík area and larger rural ports. This contamination is thought to originate both from vessels and from the operation of shipyards ashore. The contamination involves tributyltin (TBT), heavy metals, persistent organic pollutants and oils. TBT pollution is discussed in greater detail in the section on persistent organic pollutants.

Actions

Study the impact of activities (damming of streams, bridging of fjords, harbour construction, coastal installations) on natural sediment shifts and other environmental aspects

All major civil engineering work is preceded by studies of the impact of the work on sediment mobilisation and other environmental factors. In the case of work in areas where polluting activities have already been conducted, e.g. in harbour areas, the sediment is studied with regard to pollutants such as TBT, oils, PAHs (Polycyclic Aromatic Hydrocarbons), heavy metals and persistent organic pollutants. If the sediment is shown to be contaminated, it is removed and sealed off in landfills in order to prevent pollutants from being distributed to uncontaminated areas and damaging the marine and coastal environment. During the time that work is in progress an attempt is made to minimise turbidity by restricting the work to limited areas at each time.[33]

Study the natural flow of pollutants to the sea on suspended particles and in turbid water

A study conducted by the Marine Research Institute in the river Thjórsá revealed that when the stream water mixes with the sea metals and nutrients are released from suspended particles and the ions are dissolved at a certain level of salinity, which is a well known phenomenon. The heavy metals cadmium, zinc and copper, which were at low concentrations in the river, were detached from the suspended particles and their concentration increased in the salty sea. The concentration reached maximum levels in the mixture of fresh water and sea water and was then diluted and fell with the increasing salinity.

Acquire an overview of natural sediment transportation into the sea

Considerable research has been done in this area, and a significant amount of information is available on chemical erosion in Iceland. A comprehensive overview of natural sediment transportation into the sea, however, does not exist. Studies have been made of sediments and the composition of sediments in connection with work on sewer projects.

Follow up on the implementation of rules on the dumping of dredging materials

Harbours are often dredged in the course of maintenance and alterations. Some of the dredged material can be contaminated by heavy metals, persistent organic pollutants or other pollutants. According to the OSPAR Convention on the protection of the North-eastern Atlantic dredged material of this kind cannot be dumped into the ocean without a special permit. Provisions to this effect were passed into law by Act No. 33/2004 on the prevention of marine and coastal pollution. The Act stipulates that dumping of dredged material into the sea off Iceland is not permitted except with the special permission of the Environment and Food Agency following an investigation of the level of contamination of the material and the proposed dumping site. The Agency has issued guidelines on the handling of dredged material and, among other things, established reference limits for the concentration of substances in dredged material and appropriate measures. [28]

Legislation on environmental imp act assessment should also cover dredging and seabed mining

According to the Environmental Impact Assessment Act No. 206/2005, mineral extraction on land and in the seabed where the proposed extraction disturbs an area of 50,000 m^2 or more or involves a volume of 150,000 m^3 or more is always subject to environmental impact assessment. If the prospective extraction disturbs an area of 25,000 m^2 or more or involves a volume of 50.000 m^3 or more the decision on whether the work requires an environmental impact assessment is made on a case-by-case basis.

Evaluate the long-term impact of activities on sediment shifts and pollution at the planning stage

The long-term impact of work on sediment mobilisation and pollution has not been investigated specifically, but such an investigation is under consideration.

Assessment - review

The natural mobilisation of sediment by streams is extensive and has been the subject of considerable research. The impact of this sediment on the marine ecosystem, however, has not been extensively studied.

In the course of harbour construction work it has been revealed that contamination can be present in superficial sediments. Dredged material measured as contaminated is often used in landfills or measures are taken to prevent pollutants from being distributed and damaging the marine environment in any other way. Pollution of this kind has not been detected in the ecosystem and the disposal of dredged material is acceptable.

The type of sediment in the seabed determines to a large extent the composition of animal life in the respective places, and knowledge of the distribution of particle size in the seabed sediments provides important information of benthos habitats. Studies of sediments are connected with studies of habitats, and both involve time-consuming research as the ocean area around Iceland is large. Research of sedentary species in the ocean around Iceland is in its early stages and therefore it is difficult to assess the impact of sediment mobilisation on the ecosystem. The Marine Research Institute has been mapping the seabed since the year 2000 using multibeam echosounding.

2.9 Litter

Introduction

Litter can cause damage to the marine biosphere and can have various negative effects on habitats or destroy them. Litter on coastlines also causes visual pollution. Incineration of waste can cause emissions of persistent organic

pollutants, e.g. polychlorinated dioxins and furans, heavy metals, fire-retardant materials, PAHs, substances with hormonal action and oils, which can then be carried to the sea. If landfill leachate reaches the sea it can cause pollution. The main sources of waste materials in the sea and on coasts are poorly managed landfills, waste carried by wind from urban areas and waste carried by drainage systems and rivers into the sea.

Significant progress has been made in waste management in Iceland in recent years. Municipalities have increased their co-operation on waste disposal with the result that there are fewer waste disposal sites. The recycling of waste materials has more than doubled over the past 10 years. A reduction of total volume of waste for final disposal has however not yet been achieved as the volume of waste has grown faster than the rate of recycling. In order to achieve the targets of the National Plan on Waste Treatment, recycling of organic waste, packaging waste and waste from electrical appliances will need to be increased. [16]

Actions

Issue of environmental operating licences for disposal installations

All waste management is now subject to the issue of an environmental operating licence. A collection system has been established for toxic and hazardous chemicals and the public and enterprises can dispose sorted waste at collection centres.

Closure of disposal installations that do not have an environmental operating licence

Landfills now generally have an environmental operating licence and disposal sites without environmental operating licences have been closed.

Monitoring and cleanup of areas where litter accumulates

Most of the municipalities around the country are engaged in organised clearing of litter, e.g. from coasts. Also, volunteers and NGOs around the country have launched campaigns concerning these issues. The Ministry of the Environment supports Worldwide Friends (WF), an international voluntary organisation which has presented a plan for a massive campaign to clean up the Icelandic coastline. The plan is to clean up the coastline in the years 2006 to 2011, a total of 4,950 km. The organisation plans to remove all loose litter, map larger objects and make plans on how to remove those in the future. Volunteers of the organisation, which is supported by the YOUTH Plan of the European Union, among other sponsors, will arrive in the country in 2006 to work on the preparation and implementation of the project. A number of volunteers will participate in the undertaking, Icelandic as well as foreign. [14]

Removal of shipwrecks from coasts

A working group organised by the Ministry of the Environment addressed the problem of clearing the coasts and harbour areas of wrecks and abandoned vessels and the resulting costs. The Group assessed the need for actions based on Act No. 33/2004 on the prevention of marine and coastal pollution A review was conducted of the shipwrecks around the country. Shipwrecks were mapped, their condition assessed and possibilities explored of their removal.[15] It is clear that the sea and coasts are not threatened by pollution from all the shipwrecks lying around the coastline, most of which have been lying at their present sites for years. The Act contains provisions stipulating that ship-owners must remove ships that run aground at the latest six months following the grounding. The Act is intended to prevent ships from being abandoned on the coastline in the future.

Assessment - review

Much has been achieved with regard to this issue in recent years, in particular with the reformed and co-ordinated regulatory environment. Regulations have been issued in the last two years which are intended to prevent litter pollution from vessels and reduce the dumping of waste and residual cargo into the sea from ships by providing facilities in harbours to accept waste from ships. Open incineration has been discontinued and replaced by high-temperature incineration with sophisticated treatment facilities designed to minimise pollution.

In recent years increasing attention has been focused on minimising the use of raw material and energy in manufacturing activities, and addition attempts have been made to reduce the production of waste to the extent possible. The Icelandic Recycling Fund was launched on 1 January 2003; the Fund has the goal of minimising waste formation and channelling waste into reuse and recovery. The Fund is intended to use economic incentives to promote maximum re-use and recycling. The Recycling Fund pay for the reception of tyres, hazardous wastes, packaging, fishing gear and vehicles. [11,12] The Recycling Fund took over this work from the Hazardous Waste Committee that used to organize the reception of hazardous waste.
The Act on Waste Handling entered into force in 2003

(Act No. 55/2003) and government regulations on waste were reviewed. The Act contains instructions to the Environment and Food Agency to prepare a general plan for a term of at least 12 years on waste management. The "National Plan on Waste Handling for the Years 2004 – 2016" was issued in 2004 by the Environment and Food Agency. The National Plan will be reviewed every three years. The Act places increased responsibilities and obligations on municipal governments concerning waste management. [13] Following the Act, an increased demands has been made on management at disposal sites i.e. monitoring will be increased. Work is in progress on updating all management of waste in compliance with the law and environmental licences have to be renewed for all the disposal sites before the year 2009.

Following the issue of regulations banning the dumping of litter into the sea and by providing for facilities in harbours to receive and process waste from ships, better practices may be expected to reduce the quantity of waste in the sea from land-based sources.

2.10 Impact on habitats

Introduction

Research in recent years has shown increasingly the importance of environmental factors for the reproduction of the exploitable marine stocks and the need to exercise caution and to use the ecosystem approach in their utilisation.

There are now 21 costal and ocean areas which are protected on the basis of the Nature Conservation Act; in addition seven islands, three capes, eleven beach areas and nine sites adjacent to the sea are protected. Furthermore, one area on the bottom of Eyjafjord has been protected based on the Nature Conservation Act; these are the hydrothermal vents in Eyjafjord, which were protected in 2001 and the area was enlarged in 2006. Protection of islands, capes, coastal areas and beaches generally extends approximately 100 metres from the low-water line, but in some cases the protection will extend two kilometres from islands, as in the case of the islands Eldey, Surtsey and Melrakkaey. A number of coastal areas are recorded in the natural features database, which gives them a degree of protection under the Nature Conservation Act, in particular against disruption from civil engineering work.

At a meeting of the Parties to the Convention on Marine and Coastal Biodiversity (Jakarta Mandate) in 2004, a new work plan was approved concerning protected areas in general. According to the plan, the parties are required, among other things, to promote the protection of ecosystems, natural habitats and to maintain the viability of species in their natural habitats In the OSPAR Convention, Annex V addresses the protection and conservation of the ecosystems and biological diversity of the maritime area, including the protection of species and habitats in the maritime area covered by the OSPAR Convention. The OSPAR Programme on biodiversity and ecosystems is broad in scope and calls, among other things, for an assessment of threatened and/or declining species and habitats. The habitats on the OSPAR I list are: intertidal mudflats, coral reefs *(Lophelia pertusa)*, seamounts and zostera beds *(Zostera sp.)*.[18]

Actions

Mapping of habitats close to land

The Marine Research Institute has studied the historical and present distribution of coral fields and assessed their condition in Icelandic waters. Coral fields are regarded as important habitats for various species of marine animals who live among the corals, where they find both food and shelter. If a coral field suffers damage, e.g. as a result of trawling, this can have severe consequences for the animals using it has a habitat, such as demersal fish and benthos, as renewal of the coral field can take centuries. [19]

In order to protect these coral fields the Ministry of Fisheries issued a regulation on the protection of five sensitive maritime areas off the southern coast of Iceland. The sites cover a total of 80 square kilometres in area. The areas are seabed coral fields and they are protected from all fishing that can damage the sensitive corals. The regulation entered into effect in 2006.

The research project Benthic Invertebrates of Icelandic Waters (BIOICE) began in 1992. The principal objective of BIOICE is to record the distribution of benthic fauna, their quantities and the potential impact of various environmental factors within the Icelandic territorial waters. The conclusions will be used to create a database that can be used for projects relating to the monitoring, protection and sustainable use of the marine biosphere. The programme is thus connected with the Rio Convention on Biological Diversity (1980), which emphasises the recording, assessment and monitoring of the biosphere as a necessary foundation for the protection and sustainable utilisation of the sea.

Sampling in connection with the BIOICE Programme has been concluded, and dozens of new species have been discovered, but final processing will take several years. A part of the BIOICE Programme involves research of sediments and the distribution of particle sizes, which provides important information on habitats. Mapping of seabed areas on the continental shelf has now begun, and this work will continue in the coming years, as in fact the undertaking is an extensive one. This mapping is a necessary foundation for further research of habitats in the sea around Iceland.[20]

Total regional planning of coastal zones, especially those close to urban areas

According to the current government regulation on regional planning, zoning plans and master plans must account for and classify protected areas with respect to groundwater and coastal pollution and pollution of streams and lakes. The plans should also account for and classify water supplies. Where any construction work is proposed on or near protected areas full account must be taken of provisions concerning protection. In fact, however, the comprehensive planning of coastal areas is limited, and the zoning plans for the metropolitan area of Reykjavík hardly mention the coastal areas. It is important for the National Planning Agency to address this matter and to work with the municipal governments on a master plan for coastal areas. The Regional Planning Act is currently under review.

Monitoring of the impact of sediment mobilisation and activities on habitats

Research on the impact of sediment mobilisation and civil engineering works on habitats in the ocean around Iceland has not been carried out to any extent. When fjords are bridged, care is taken to ensure that full water exchange is maintained so that salinity remains unchanged after conclusion of the civil engineering works. Attempts are also made to plan the works so that the impact on the tides is minimal. Salinity is monitored after the completion of the works, and it appears that such works have an insignificant impact on salinity and that the water exchange remains unchanged.

Considerable land reclamation is conducted, particularly in the metropolitan area of the capital and its vicinity, which destroys habitats and invertebrates in the seabed. Since knowledge of the ocean habitants and the seabed ecosystem is limited, not much is in fact known of the extent of the impact of such works.

Assessment - review

Studies of habitats and their condition in the sea around Iceland are in their early stages. The maritime areas around Iceland are large, and studies of this kind are very time-consuming. The BIOICE Programme established the foundation for the mapping of habitats in the sea around Iceland with its extensive sampling and investigation of invertebrates around the country. The sampling aspect of the Programme has been completed, and in the future a database may be expected to be created which will be useful for the study of the Icelandic marine environment, including habitats.

The Marine Research Institute is working on mapping the seabed using multibeam echosounding in co-operation with other domestic organisations, such as Reykjavík Energy and the Science Institute of the University of Iceland. These studies, which have been ongoing since the year 2000, are necessary for all research into marine habitats as well as for the mapping of important fishing grounds. Work will continue on mapping the seabed, and the plan is that in the coming years a comprehensive picture will be achieved of the entire continental shelf. The Marine Research Institute is also investigating the impact of fishing gear on the seabed and there is a growing focus on habitat studies in keeping with the increased emphasis of the ecosystem approach to marine research.

If predictions of vastly increased shipping in the Icelandic economic jurisdiction prove correct, research of the marine and coastal habitats around the country will have to be increased substantially. Basic research of mudflats needs to be increased as the mudflats are habitants of invertebrates on which a vast number of birds depend for their existence. Mudflats are sensitive to oil pollution as the oil attaches itself to the fine sediment in the flats and does not wash out easily. An assessment needs to be conducted of large civil engineering works, such as bridges across fjords and land reclamation projects.

The impact of fish farming on the environment and the potential pollution caused by fish farming needs to be carefully monitored as increased fish farming may be expected in the future.

2.11 Handling and Monitoring of Harmful Substances

Introduction

The term “harmful substances” is used here to cover all substances which can be harmful to the environment. This applies to toxic materials, hazardous materials, medicinal products, oils or other materials that, owing to their toxicity may have a harmful impact on the environment if released as a result of accidents or careless handling. This section discusses the regulation of imports, handling and disposal of substances which can cause contamination if precautions are not taken. It is not possible in brief to specify all the substances and substance categories that can be harmful to the environment.

Actions

Improved and co-ordinated legal framework with clear boundaries between monitoring bodies

Preparations for a reformed and co-ordinated legal framework have been in progress in recent years, and changes in the regulatory environment of these issues may be expected in the coming years.

Establishment of a co-ordinated registration system for harmful substances from importation to disposal

There are plans for a future inventory of all harmful substances. According to the provision, all toxic materials, hazardous materials and chemical products classified as such and pesticides, biocides and cosmetic products must be registered at the Environment and Food Agency prior to their importation, marketing or use. Materials covered by legislation on recycling fees are registered when they are delivered for disposal. The same applies to hazardous waste which is covered by an inventory of hazardous wastes and other waste material.[28]

Assessment of legislation and regulations in force

An assessment has been made of laws and regulations, and a legislative bill has been prepared concerning chemicals and chemical products which is scheduled for submission before the Althing in 2006.

Registration of the cycle of harmful substances

No work has been done on the registration of the cycle of harmful substances. The first step in the cycle registration would be to prepare an inventory of chemical products, which is planned for the coming years.[28]

Co-operation between inspection bodies improved and maintained

No systematic work has been conducted on this issue in recent years. The Environment and Food Agency and the Municipal Health Committees co-operate well in this area. Co-operation with other organisations such as the Icelandic Medicines Control Agency, the Administration of Occupational Safety and Health, the Icelandic Radiation Protection Institute and the Directorate of Customs needs to be increased.[28]

Active monitoring of importation, handling and disposal of harmful substances

Regulation of the importation of toxic substances and certain environmentally harmful substances which are subjected to import restrictions is the responsibility of the customs authorities. In other respects there is no active monitoring of the importation of substances. Regulation of the handling of harmful substances is in the hands of the Administration of Occupational Safety and Health when workplaces are involved. Regulation of disposal is conducted in compliance with applicable legislation and the environmental operating licences of undertakings involved in waste management or polluting commercial activities. Increased requirements have been established in recent years in legislation concerning waste management and waste collection.[28]

Assessment - review

When legislation on chemicals and chemical products enters into force it will be possible to introduce a co-ordinated registration of the cycle of harmful substances. Access to legislation and regulations has been improved with the information website www.rettarheimildir.is, where information relating to this issue can be obtained.

3 Order of priority

3.1 Introduction

In the Icelandic National Programme of Action published in 2001, an account was given of the criteria used for the prioritisation of issues and tasks. The issues to be assessed in accordance with the UNEP guidelines are: impact on food security, public health, marine and coastal resources, the quality of ecosystems and social and economic benefits, including cultural benefits. Also, account has to be taken of international agreements to which Iceland is a party as well as the special situation of Iceland, which includes the geographical location of the country, the small population and the importance of fisheries.

The order of priority of environmental issues was presented in the National Action Programme of Action, and this has not changed. Table 4 sets out an assessment of the importance of the individual issues. The impact of the various issues relating to the aspects of the environment to be evaluated according to UNEP Guidelines is illustrated in the table. There are three classes of impact: small impact (●), moderate impact (●●) and major impact (●●●). A further description of the assessment is provided in Annex 3 to the NPA.[1] This assessment and the order of priority presented here is based on Icelandic conditions and applies only to the Icelandic NPA. Other perspectives may apply elsewhere in the world in different conditions. Thus, nutrients are low in the order of priority in Iceland, in sharp contrast to the concerns relating to this issue elsewhere in the world.

Table 4. The impact of issues on different factors based on Icelandic conditions.

	Food Security	Public Health	Marine and Coastal Resources	Quality of Ecosystems	Social and Economic Benefits
Sewage	●●	●●	●●	●●	●●●
Persistent Organic Pollutants	●●●	●●●	●●●	●●●	●●●
Radioactive Substances	●●●	●●●	●●●	●●●	●●●
Heavy Metals	●●●	●●●	●●●	●●●	●●
Oils	●●	●	●●●	●●	●
Nutrients	●	●	●●	●●	●
Sediments	●	●	●●	●	●
Litter	●	●●	●●	●●	●
Physical alterations of habitats	●●	●	●●	●●	●●
Harmful Substances	●●	●●	●●	●●	●●

The order of priority of the issues is shown in Table 5, which is based on the risk assessment in Table 4. The principal points of emphasis are the same as in the Arctic Council. Regional Programme of Action for the Protection of the Arctic Marine Environment from Land-based Activities, to which Iceland is a party.

The order of priority of issues in the Icelandic context has changed in that sewage is now in Group II, as significant improvements have been made concerning sewage. In other respects, the order of priority is unchanged.
Group I represents the most urgent issues, Group II is less urgent and Group III is least urgent.

Table 5. Priorities listed according to importance in the Icelandic context.

Issue	Group
Persistent Organic Pollutants	I
Heavy Metals	I
Radioactive Substances	I
Handling and Monitoring of Harmful Substances.	I
Sewage	II
Physical alterations of habitats	II
Oils	II
Litter	III
Sediment Shift and Pollution	III
Nutrients	III

3.2 Group I

General

Solutions to problems connected with Group I are the most urgent. Many of the issues are difficult to deal with and they have a varied impact on public health, natural resources and industries. Most of these substances derive from land-based sources outside Iceland. For this reason, the campaign against their release has been conducted in co-operation with other nations. Many of the substances have the common feature of persisting for a long time, or forever, after their release into the environment. It is therefore important to prevent their release. It is also important to map the distribution of pollution if it exists.[1]

Persistent organic pollutants

These substances are extremely harmful to all life-forms, even in low concentrations. It is therefore a matter of priority for the Icelandic government to fight against pollution from these substances in the sea around the country. International co-operation is necessary, as most of them have their sources outside Iceland.[1] Studies of their sources in Iceland, mapping of pollution and measurements of the concentration of these substances in fish is necessary for Iceland to be able to prevent and react to pollution of this kind.

Heavy metals

Heavy metals do not degenerate, and for this reason their impact on the environment is usually long-lasting. The effects of heavy metal are harmful, even in low concentrations. Heavy metals in the environment derive partly from natural processes, such as volcanic activity, geothermal activity and erosion. If the concentration of the substances is measured at higher levels than the natural concentration in the environment, i.e. the background values, this constitutes pollution.[1]

Radioactive substances

The Icelandic government is concerned about the threat of releases of radioactive substances into the sea and have strongly advocated a ban on their release into the environment. All anthropogenic radioactivity in the sea is derived from sources outside Iceland and international co-operation is therefore a key aspect of the campaign against radioactive pollution of the sea.[1]

Handling, transportation and control of harmful substances

Changes have been made in the current legislation and regulations, and a legislative bill has been prepared for submission. If this legislation is passed it will be possible to begin registration of the cycle of harmful substances, which would improve practices in the handling, transportation and regulation of harmful substances.

3.3 Group II

General

The state of affairs is, to a large extent, connected with domestic activities and development. The management of measures is therefore easier than in Group I.[1]

Sewage

Sewage contains a great quantity of organic materials and nutrients. Sewage can also contain heavy metals, persistent organic compounds, medicinal residues, fire-retardant materials, substances with hormonal action, oils and various other kinds of waste. Sewage contains faecal pollution and bacteria can infect wild animals which in turn can infect humans.[1] There is limited commercial activity in Iceland which releases heavy metals and persistent organic pollutants. Nutrient pollution has not been observed in the sea around Iceland except in very localised conditions by certain sewage outlets. Faecal contamination is closely monitored around the coast and has been detected in several places.

Oils

Problems related to oils are quite well known, as are the effects of the pollution they cause. With the comprehensive

issue of environmental operating licences and responsible regulation this situation has been improving in Iceland.[1] However, if predictions of large-scale increases in the passage of oil tankers through the Icelandic pollution jurisdiction and related increases in port activities research and monitoring of oil pollution will need to be increased and reaction plans up-scaled.

Physical alterations of habitats

One of the biggest problems as regards the condition of habitats is that relatively little research has been conducted. Following the necessary basic research it will be possible to conduct more detailed studies of habitats around Iceland. The priority of this issue may therefore be expected to be revised following the research. Various civil engineering works can have a harmful impact on habitats, and it is important to be able to assess their impact on marine habitats in the future.[1]

3.4 Group III

General

The actions in this group have been given a lower priority than other issues as nutrient pollution has not been observed and contamination of sediments is minor. Nevertheless, it is necessary to monitor the situation carefully so that action can be taken if the situation changes.

Litter

Litter is not regarded as posing a major problem in the sea around Iceland.[1]

Sediment mobilisation and pollution

The concentration of pollutants in marine sediment around Iceland is quite low. Higher levels of concentration have been observed in the vicinity of urban areas which probably have their sources in sewers, harbour activities and pollution of the atmosphere.[1]

Nutrients

Nutrients are not considered to be a problem in the sea around Iceland, as the effluence of nutrients is limited and measurements of streams in the country indicate that the concentrations of nutrients in streams are lower than those measured in the ocean. Monitoring of nutrients in the sea around Iceland has been conducted for years, and is being increased.

4 Strategic planning and objectives

Iceland is an island, and matters of the sea are very important to Icelanders, as numerous sectors of the economy are connected with the sea in one way or another. The core objective of the country's policy on marine issues is to maintain a healthy ocean environment and to ensure sustainable utilisation, so that the ocean can continue to serve as a bountiful source of both healthy and valuable products and remain one of the mainstays of the country's economy.[23]

In the report "Welfare for the Future: Iceland's National Strategy for Sustainable Development 2002 – 2020, [27] which lays down the policy of the Icelandic Government, the following objectives are stated concerning a clean ocean environment:

- The concentration of man-made pollutants in marine products from Icelandic waters should always fall below the strictest standards of domestic and foreign health authorities
- The disposal of hazardous materials into the ocean by vessels and from land should cease – especially the disposal of persistent organic substances, radioactive materials and heavy metals
- Iceland should continue to show leadership in international co-operation on marine pollution prevention.

International co-operation in the struggle against pollution of the sea is extremely important, as pollution is carried over great distances by atmospheric and oceanic currents without regard to borders.

A clear policy on points of focus and implementation of measures against the pollution of the sea are prerequisites for success. Even though the pollution in the sea around Iceland is negligible and its sources are outside the country it is important for Icelandic legislation on the prevention of marine and coastal pollution to be clear and decisive. Icelandic legislation concerning the prevention of marine and coastal pollution is largely based on international conventions which Iceland has ratified. Legislation enacted in 2004 on measures to prevent the pollution of the sea and the coastline and activities which can endanger human health, harm the living resources of the sea and disrupt its ecosystem, pollute the environment or prevent the lawful

utilisation of the sea and the coasts represents a milestone in the campaign against pollution of the sea and the coastlines. The new act of law provides in clear terms for a ban on discharges, dumping, laying of cables, incineration of wastes, reception of waste and sewage and the obligation to report pollution accidents.

4.1 Current actions

Iceland is working in accordance with Iceland's National Programme of Action for the protection of the marine environment from land-based activities, which was presented in 2001 and is based on the UNEP Global Programme of Action.[1] Iceland is engaged in co-operation with other nations and the Programme of Action takes into account numerous obligations and declarations of intent which have been approved internationally. Iceland is a party to a number of conventions and has participated in formulating international policies and declarations of intent.

The EEA (European Economic Area) Agreement is legally binding for Iceland. In the agreement, Icelanders have agreed to harmonise their legislation and regulatory framework, *inter alia* in the field of environmental issues, with EU legislation

United Nations Convention on the Law of the Sea (UNCLOS). This convention lays down a foundation for a general legal environment for Iceland.

The ***OSPAR* Convention** is intended to promote the protection of the North East Atlantic marine environment from pollution. The Convention replaced the Oslo and Paris conventions.

LRTAP (Long-range Transboundary Air Pollution of Persistent Organic Pollutants) is a multilateral agreement to cease the use of certain persistent organic pollutants and to restrict the production and release of others. Iceland has not ratified the convention but is a party to its protocols on POPs and PAHs.

The International Agreement on Actions Against Persistent Organic Compounds **(POPs international** or the **Stockholm Convention)** is a convention designed to minimise the release of POPs into the environment.

MARPOL is an International Convention for the Prevention of Pollution from Ships and the discharge of pollutants into the sea.

The London Dumping Agreement is a Convention on the Prevention of Marine Pollution by the Dumping of Wastes and Other Matter.

The Copenhagen Convention deals with co-operation between the Nordic countries in the event of accidents caused by oils and other hazardous substances.

The Basel Convention is an international convention on the control of transboundary movement of hazardous wastes and their disposal.

Welfare for the Future: Iceland's National Strategy for Sustainable Development 2002–2020. This document lays down a strategy for sustainable development of the Icelandic community. It contains information on the principal objectives and priorities of the Icelandic government and provides guidance for future planning in important community areas.

The Rio Declaration. The Declaration lays down several general principles, including the precautionary principle, the polluter-pays principle and the user-pays principle. It also expresses the rights of individuals to information and education as well as decisions based on sustainable development.

Agenda 21. Iceland is a party to this action plan for environmental and developmental issues which was approved at the Rio Conference and discusses, among other things, the protection and management of the sea.

The Arctic Council. The Council's primary purpose is to promote the protection of the Arctic and to promote sustainable utilisation of resources. The Council has issued a Regional Programme of Action for the Protection of the Arctic Marine Environment from Land-based Activities. [1]

4.2 Pathways to stated objectives

The means that the Icelandic government intends to use in order to achieve its environmental objectives are:

- Legislation and regulations. An efficient and clear regulatory framework is a fundamental aspect of environmental protection.

- International Agreements. A large part of Iceland's work against the pollution of the sea is conducted in the international forum. International co-operation is important, as pollution has no respect for borders. [1]

- Economic Instruments. Economic measures can be a useful means of achieving environmental objectives and in many cases they can be more appropriate than bans and sanctions.
- Education and Dissemination of Information. This is an important factor in enabling the achievement of set environmental objectives. It is necessary for individuals and the public to have access to quality information on environmental matters.

To achieve the best possible results in maintaining the relatively low levels of pollution in the sea around Iceland it is necessary for government authorities, the public, the industries and other stakeholders to work together. The public and the industries have to be reconciled to laws and regulations if their objectives are to be achieved. This can only be achieved through extensive education and co-operation. The routes that Iceland has decided to take in order to achieve its objectives are contained in the report titled "The Ocean" [23], which was published in 2004; the routes include the following:

- To continue to work on the implementation of the National Action Programme for measures to prevent ocean pollution from land-based sources.

- Increase research on the possible impact of pollution and other environmental changes, together with monitoring of such changes in the ocean ecosystem and their economic and social consequences. Public institutions involved in research and monitoring of the oceans should co-ordinate their activities to the extent possible.

- To take an active part in the preparation of the Global Assessment of the Marine Environment, emphasising that its focus is on the pollution of the world's oceans. The assessment should not include areas already dealt with in other assessments.

- To promote international support for the enhanced implementation of the Global Programme of Action for the Protection of the Marine Environment from Land-based Activities (GPA). It should be ensured that the international campaign for improved sanitation in developing countries, adopted in Johannesburg, also include treatment of sewage before it enters the ocean.

- To continue financial support for actions by the Russian Federation to reduce pollutant releases into Arctic waters, in accordance with its National Programme of Action.

- To continue to promote vigorous international action within the United Nations against the release of heavy metals, POPs and other damaging anthropogenic substances into the oceans. This will require active participation in the work of the Stockholm Convention on Persistent Organic Pollutants, in UNEP's Mercury Programme, and negotiations on a Strategic Approach to International Chemicals Management (SAICM).

- To reduce still further the release of radioactive substances into the oceans and releases from nuclear reprocessing plants, to place added weight on actions aimed at reducing the danger of pollution from radioactive waste in the Arctic Ocean.

- To increase the co-operation between the countries of the Arctic Council on marine issues. An important means of achieving this is the drafting of the Arctic Marine Strategic Plan under the direction of the Council's working group on Protection of the Arctic Marine Environment (PAME).

5 Actions

The actions and projects listed below are based on an overview presented in the report on the Action Programme in 2001. The actions were divided into immediate projects that need to be initiated urgently and long-term projects which are either based on the results of one or more of the immediate projects or are projects that are not considered as critical as the former projects. The scope of the projects was assessed and graded using one to four points. The evaluation of scope is based equally on investment cost, operating cost, labour needs and working time.

Many of the projects have already been begun, and some are in their final stages. In some cases basic research was needed before actual work could be begun. This research has in some cases been completed and the actual projects themselves can now be begun. This refers primarily to the ocean habitat studies, which are preceded by the multibeam echosoundings of the Marine Research Institute. Other projects are still in the preparatory stages. [1]

Many of the projects described are integrated, so that their total scope is less than their aggregate scope in the tables. Many of the projects listed here are, or can become, a part of projects relating to work carried out under international obligations or as a part of other domestic projects. [1]

5.1 Group I

Persistent organic pollutants

Assessment: The overview of this issue is still inadequate. Information is lacking concerning quantities from domestic sources and knowledge of the distribution of certain substances in the Icelandic environment is still insufficient.
Measures against persistent organic pollutants in Iceland are directly linked to measurers relating to the handling of hazardous substances, sewage matters, waste incineration and industrial activities.

Corrective action	Scope	Project status
Immediate Projects		
Mapping of polluted areas and previous sources of pollution	●●●	In preparation
Evaluation of emissions of POPs	●	In progress
Measurements of dioxin and furan	●	In progress
Measurements of endosulfan	●	Completed
Measurements of concentrations of TBT in the Icelandic environment	●●	In progress
Administrative audit	●	In preparation
Issue and review of environmental operating licences	●●	In progress
Audit of location and scope of release	●	In progress
Long-term projects		
Increase scope of general monitoring	●●●	In progress
Cessation of low-temperature incineration of waste	●●	Completed
Administrative reforms based on the above evaluation, especially with regard to environmental operating licences	●	In preparation

Heavy metals

Evaluation: The concentration of heavy metals in the Icelandic environment is fairly well known but less is known about current land-based sources. Actions against heavy metals are connected to sewage system issues, fuel production and industry types.

Corrective action	Scope	Project status
Immediate projects		
Mapping of primary release points	●●	In preparation
Study of the geochemistry of Cadmium	●	Not begun
Survey of lead concentrations in the atmosphere	●●	Completed
Evaluation of emissions of heavy metals	●	In preparation
Issue and review of environmental operating licences for industries	●	In progress
Long-term projects		
Research on impact of anthropogenic activities as compared to natural sources	●	In preparation
Monitoring of the concentrations of heavy metals in the Icelandic environment	●●	In progress

Radioactivity

Evaluation: Good overall view of the issue and pollution from domestic sources is believed to be negligible. Pollution derived from radioactive substances is relatively independent of other issues.

Corrective action	Scope	Project status
Immediate projects		
Initiate measuring of Tc-99 in the sea around Iceland	●●	In progress
Long-term projects		
Continuous long-term monitoring to maintain overview of the issue	●●	Scheduled
Renewal and maintenance of reaction plans	●	Scheduled

Handling and monitoring of harmful substances

Evaluation: Supervision of the issue is in the hands of various parties that supervise a delimited field pursuant to statutory law. The regulatory environment is therefore complex and an overview is difficult to achieve.

Corrective action	Scope	Project status
Immediate projects		
Improved and co-ordinated legal framework with clear boundaries between monitoring bodies	●●	In progress
Establishment of a co-ordinated registration system for harmful substances from importation to disposal	●	In progress
Assessment of legislation and regulations in force	●	In progress
Long-term projects		
Registration of the cycle of harmful substances	●●	Scheduled
Co-operation between inspection bodies improved and maintained	●	Scheduled
Active monitoring of importation, handling and disposal of harmful substances	●●	In progress

5.2 Group II

Sewage

Evaluation: The administrative responsibility for drainage system issues is clear. Chemical contamination has been measured in sewage from Reykjavík, but chemical contamination in sewage elsewhere in the country is limited. POPs, heavy metals, oils, nutrients and litter are closely connected with drainage system issues

Corrective action	Scope	Project status
Immediate Projects		
Treatment of sewage in accordance with current legislation	●●●●	In progress
Mapping of the emission of pollutants from drains in various places in Iceland	●●●	In progress
Co-ordinated evaluation of the receiving waters around Iceland	●●●	In progress
Issue of environmental operating licences for drainage systems	●●	In progress
Issue of environmental operating licences for the larger industrial companies	●●	Completed
Long-term projects		
Continued treatment of sewage	●●●	In progress
Active monitoring of concentrations of pollutants in drains from industrial companies in accordance with environmental operating licences	●●	In progress
Monitoring of certain substances and substance groups in specific drainage systems in accordance with EEA Agreement requirements	●●●	In progress

Physical alterations of habitats

Assessment: A full overview of this issue is unavailable. The disturbance of habitats and species as a result of land-based anthropogenic activities does not seem to be a large problem based on current knowledge. Exceptions to this are mainly in confined areas close to urban areas. The protection of habitats and species is tied to general regional planning and nature conservation. Integrated coastal management has special significance in this context.

Corrective action	Scope	Project status
Immediate projects		
Mapping of habitats close to land	●●●●	In progress
Long-term projects		
Total regional planning of coastal zones, especially those close to urban areas	●●●	In preparation
Monitoring of the impact of sediment mobilisation and activities on habitats	●●	In preparation

Oils

Evaluation: The sources of oil contamination in Iceland are not well known. Pollution is considered negligible if accidents are excluded. Oils contain POPs and heavy metals. They can be transported into drainage systems and pollute habitats and sediments if they are carried to the sea.

Corrective action	Scope	Project status
Immediate projects		
Preparation of reaction plans for serious pollution accidents	●●	In progress
Complete the issue of environmental operating licences for petrol stations and other operations where oil is handled in significant quantities	●●	Completed
Establish notification requirements for accidents on land	●	Completed
Long-term projects		
The creation of risk maps with regard to potential oil pollution of coastlines	●●●	In progress
Maintenance of reaction plans for serious pollution accidents	●	In progress

5.3 Group III

Nutrients

Evaluation: Results of measurements of nutrients around Iceland do not indicate eutrophication. In light of current knowledge, nutrient eutrophication is not considered a problem in Iceland, in contrast with the norm in many other countries. Nutrients have close links to sewage issues.

Corrective action	Scope	Project status
Immediate projects		
Chemical analyses around major streams and rivers	●●●	In progress
Long-term projects		
Monitoring and recording of the frequency of algal blooms around Iceland	●●	In progress
Monitoring of the chemical content of streams	●●	In progress
Monitoring of nutrient conditions in surface water in accordance with EEA undertakings	●●	In progress

Litter

Evaluation: The volume of litter from land-based activities which is carried to the sea has been falling and is not considered to be a problem. Landfills are linked to heavy metals, persistent organic pollutants and sewage.

Corrective action	Scope	Project status
Immediate projects		
Complete the issue of environmental operating licences for disposal installations	●●	Completed
Closure of disposal installations that do not have an environmental operating licence	●●	Completed
Long-term projects		
Monitoring and cleanup of areas where litter accumulates.	●●●	In progress
Removal of shipwrecks from coasts.	●●●●	In preparation

Sediment shift and pollution

Evaluation: Regulation of the disposal of dredging materials is in good order. Knowledge of the impact of sediment mobilisation on the ecosystem and habitats is limited. According to current knowledge, the anthropogenic impact on sediment mobilisation or sediment pollution is not considered a problem.

Corrective action	Scope	Project status
Immediate projects		
Study the impact of activities (damming of streams, bridging of fjords, harbour construction, coastal installations) on natural sediment shifts and other environmental aspects	●●●	In progress
Study the natural flow of pollutants to the sea on suspended solids and in turbid water.	●	In progress
Acquire an overview of natural sediment transportation into the sea.	●	In progress
Long-term projects		
Follow up on the implementation of rules concerning the dumping of dredging materials	●	In progress
Legislation on environmental impact assessment should also cover dredging and seabed mining	●	Completed
Evaluate the long-term impact of activities on sediment mobilisation and pollution at the planning stage	●●	Completed

6 List of References

1. Iceland's National Programme of Action for the protection of the marine environment from land-based activities, 69, pages.
2. Website of Reykjavík Energy. www.or.is.
3. Website of the Ministry of the Environment. www.umhverfisraduneyti.is.
4. Stefán Einarson, Birna S. Hallsdóttir, Albert S. Sigurðsson. 2006. Assessment of contamination by persistent organic pollutants in Iceland. Environment and Food Agency. Unpublished report. [In Icelandic]
5. Ásta M. Ásmundsdóttir, Guðjón A. Auðunsson, Helga Gunnlaugsdóttir. 2005. Undesirable substances in seafood products – Results from the monitoring activities in 2004. IFL Project Report. 33-05. Icelandic Fisheries Laboratories, Reykjavík, 30 pages.
6. Guðjón Atli Auðunsson 2004. Monitoring of undesirable substances in seafood products. Project Report RF, IFL 06.04. Icelandic Fisheries Laboratories. Reykjavík, 34 pages. [In Icelandic]
7. Harbour at the industrial site at Hraun in Reydarfjord. Environmental impact assessment report. www.honnun.is/media/files/Hraunhofn.pdf. [In Icelandic]
8. Magnús Á. Sigurgeirsson, Kjartan Guðnason, Elísabet D. Ólafsdóttir, Sigurður E. Pálsson, Sigurdís Gunnarsdóttir 2005. 2004. Radioactivity in the environment and food in Iceland 2004. Reykjavík, Icelandic Radiation Protection Institute, 15 pages.
9. Sensitivity map and contingency plan of south and south-west coast of Iceland from Vík in Mýrdalur to Öndverðarnes. Reykjavík, 37 pages.
10. Report from a Foreign Ministry working group on opportunities relating to shipping routes in the Arctic. 2005. Ministry of Foreign Affairs, Reykjavík, 64 pages.
11. Website of the Kalka Waste Incineration Plant. www.kalka.is [Icelandic only]
12. Website of the Icelandic Recycling Fund. www.urvinnslusjodur.is.
13. Environment and Food Agency 2004. National waste handling plan 2004-2016. EFA Reports-2004:14. Reykjavík, Environment and Food Agency, 46 pages. [Icelandic]

14. Worldwide Friends website. www.veraldarvinir.is.
15. Working group report on the implementation of Act No. 33/2004, on the prevention of marine and coastal pollution
16. National waste handling plan 2004-2016. EFA Reports-2004:14. Reykjavík, Environment and Food Agency, 46 pages. [Icelandic]
17. Website of the Fisheries Ministry. www.sjavarutvegsraduneyti.is" www.sjavarutvegsraduneyti.is. Press Release 5 December 2005. [Icelandic]
18. Protection of sensitive marine areas off Iceland. Conclusions and proposals of a committee appointed by the Minister in October 2004. [Icelandic]
19. Coral fields in Icelandic waters: Situation assessment and proposal for their protection. Sigmar A. Steingrímsson og Sólmundur Tr. Einarsson. Marine Research Institute. Publication No. 110. Reykjavík, 39 pages. [Icelandic]
20. The BIOICE Project – Benthic invertebrates in Icelandic waters. 2005. Reykjavík, 63 pages. [Icelandic]
21. Review of the sewage situation in Iceland – Financial needs for development. Environment Ministry Sewer Committee. Reykjavík, 34 pages. [Icelandic]
22. Davíð Egilson, Elísabet D. Ólafsdóttir, Eva Yngvadóttir, Helga Halldórsdóttir, Flosi Hrafn Sigurðsson, Gunnar Steinn Jónsson, Helgi Jensson, Karl Gunnarsson, Sigurður A. Þráinsson, Andri Stefánsson, Hallgrímur Daði Indriðason, Hreinn Hjartarson, Jóhanna Thorlacius, Kristín Ólafsdóttir, Sigurður R. Gíslason og Jörundur Svavarsson, 1999. *Measurements of pollutants in Iceland and off the coasts of Iceland.* Working group on pollution measurements, March 1999, Reykjavík. 138 pages. [In Icelandic]
23. The Ocean. Iceland's policy. 2004. Ministry of the Environment, Ministry of Fisheries, Ministry of Foreign Affairs. Reykjavík. 44 pages.
24. Website of the United Nations Environment Programme. www.unep.org. UNEP:2nd Intergovermental review of the Global Programme of Action for the Protection of the Marine Environment from Land-based activities (GPA).
25. Sewage treatment situationin Iceland. Report of the Environment and Food Agency based on Article 28 of Government Regulation No. 798/1999, on sewers and sewage. EFA report for November, UST 03/20. Reykjavík. 14 pages. [In Icelandic]
26. Arctic Council. Regional Programme of Action for the Protection of the Arctic Marine Environment from Land-based Activities. 1998. Minister of Public Works and Government Services Canada, 17 pages.
27. Welfare for the Future: Iceland's National Strategy for Sustainable Development 2002 – 2020. Ministry of the Environment. 2002. Reykjavík, 82 pages.
28. Website of the Environment and Food Agency. www.ust.is.
29. Eva Yngvadóttir, Anna Mikaelsdóttir, Ingibjörg Jónsdóttir, Þuríður Ragnarsdóttir. Marine Research Institute. Monitoring of the Marine Biosphere around Iceland In 2004-2005. IFL Project Report 10-06. Reykjavík, 67 pages.
30. Website of the Icelandic Institute of Natural History. www.ni.is.
31. 2005 Assessment of data collected under the Co-ordinated Environmental Monitoring Programme (CEMP). Assessment and Monitoring Series. OSPAR Commission, 115 pages.
32. Website of the Marine Research Institute. www.hafro.is.
33. Website of Línuhönn Consulting Engineers. Electronic document URL: www.lh.is/umhverfismat/sundabraut/fylgiskjol/Endanl_matsk_vefur.pdf?PHPSESSID=dfbabdab7702566966f416346cabb50b
34. Sólveig R. Ólafsdóttir og Jón Ólafsson. 1999. Input of dissolved constituents from River Þjórsá to S-Iceland coastal waters. Publication of the Fisheries Department (1999) 79-88. Marine Research Institute. Reykjavík.
35. Dioxins and PCBs in four commercially important pelagic fish stocks in the North East Atlantic. NORA project report, 57 bls. Electronic document, www.sf.is/fif/finalreport.pdf.
36. Guðjón Atli Auðunsson. 2000. Behaviour and composition of sewage water from the treatment plant at Ánanaust in Reykjavík. Report RF 4-00, Icelandic Fisheries Laboratories, Reykjavík, 58 pages. [In Icelandic] waste incineration total dioxin.
37. Katla Jörundsdóttir, Jörundar Svavarsson og Kenneth M.Y. Leung. Imposex levels in the dogwhelk *Nucella lapillus* (L.) – continuing improvement at high latitudes. Marine Pollution Bulletin 51.

Ministry for the Environment
Skuggasundi 1
150 Reykjavík

October 2006