Memorandum

27 November 2006

Ministry of Sustainable Development

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Information on the Swedish national biodiversity strategies and action plans

(ref: SCBD /ITS/DC/MC/54802, letter from SCBD 24th of May 2006)

I have the pleasure to hereby provide the Secretariat with some information on the development, status and implementation of our Swedish strategies and action plans (NBSAP) regarding biodiversity.

General background

The Swedish government and Parliament have during the years since Sweden in 1994 ratified the Convention on Biological Diversity (CBD) taken decisions at several occasions regarding biodiversity. The earliest decisions after the ratification are the following:

- Bill to Parliament 1993/94:30: A Strategy for Biological Diversity (enclosed)
- Bills to Parliament in 1996 (1996/97:75) and 1997 (1997/98:2) on action plans for biodiversity. These two Bills were based on four sectoral action plans produced in 1995 by the National Board of Forestry, the Swedish Board of Agriculture, the National Board of Housing, Building and Planning, and the National Board of Fisheries (enclosed), plus an action plan also from 1995 produced by the Swedish Environmental Protection Agency (SEPA) (attached).

The biodiversity strategy and action plans from the 90:ies have been, in several but not all parts, superseded by the system of sixteen environmental quality objectives, adopted by Government and Parliament. These objectives express the environmental quality that should be reached within a generation (ca 25 years from 1999). The bills mentioned above have also been superseded by more specific strategies and action plans within and across sectors. One of the quality objectives - A Rich Biodiversity – is explicitly aimed at the conservation and sustainable use of biological diversity. Also many of the other environmental quality objectives - such as those on lakes and streams, the marine environment, wetlands, forests, the agriculture landscape, the mountain landscape - also encompass parts of

our biodiversity. The rather new (adopted by Parliament in 2005) objective A Rich Biodiversity takes a comprehensive and holistic approach to the biodiversity in Sweden.

Under each of the environmental quality objectives, Government and Parliament have also adopted so called interim targets, with specific time frames. Under A Rich Biodiversity there are three interim targets:
1. Halting the loss of biodiversity to 2010
2. Fewer species under threat (to 2015)
3. Sustainable use of biological diversity and biological resources so that biodiversity is maintained at the landscape level (to 2007 and 2010).

There are also several interim targets under other environmental quality objectives that are relevant for the conservation and sustainable use of biodiversity. This system with environmental objectives and targets is planned to be assessed every four years. Government will at these occasions report back to Parliament, on the basis of information received from the relevant governmental agencies, on how far the targets, and in the long term perspective also the environmental quality objectives, are reached. The latest report (2006) to Government from the Swedish Environmental Objectives Council is enclosed as an example of such a progress report.

The two most recent bills on environmental quality objectives are:

- The Swedish environmental quality objectives – Interim targets and action strategies (English summary enclosed), Bill 2000/01:130,
- Environmental Quality Objectives - A Shared Responsibility (English summary enclosed), Bill 2004/05:150. This bill contains the proposal of the objective A Rich Biodiversity. The Parliament adopted this new objective in accordance with the proposal in this bill.

This system with objectives and targets also includes three important strategies, where the "Strategy for the management of land, water and the built environment" is the one most important for biodiversity. After the adoption of A Rich Biodiversity the Government has commissioned several governmental agencies (SEPA, but also other sectoral agencies) to carry out work in order to achieve the targets that have been set.

Conclusion on Swedish NBSAP

Given the information above; it is obvious that there is not "a Swedish NBSAP" contained in one document. Instead, biodiversity is included in the broad system of environmental quality objectives and targets, adopted at highest political level in Sweden. This also means that biodiversity is treated and worked with in a integrated fashion; both in the broad environmental process, and also into relevant sectors, in accordance with article 6 of CBD.

More background information is also contained in the 3rd Swedish national report to CBD (submitted earlier). The policy on biodiversity – strategy and other political considerations – has been developed during the years since

our first strategy bill in 1994. Some elements in the bills from the 90:ies are still relevant as a part of the "Swedish NBSAP". The most recent policy and strategy documents are the bills on the environmental objectives; mentioned above.

Unfortunately, we do not have all these documents and decision available in English, nor in electronic format. Moreover, the English versions attached are only summary editions.

As regards the specific questions posed in the letter from the Secretariat we would like to refer to the Swedish 3rd national report; as well as other relevant CBD reports/submissions from Sweden (for example the one on protected areas sent recently). This also goes for most of the questions in the voluntary guidelines for parties. When it comes to "success stories and lessons learned"; this is generally integrated into the assessment process referred to above; regarding achievement of the environmental objectives and targets. "Sectoral responsibility" for the environment, as well as sectoral integration, has been a cornerstone in Swedish environmental policy since an environmental bill in 1988. Our experiences from this process contains both successes and problems. Sweden have shared some of our experiences from this in our three national reports to CBD.

Please also visit the Governments website (English version):
http://www.sweden.gov.se/

Yours sincerely

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Cc:

All CBD Thematic Focal Points in Sweden
MKM-ansvariga Na

SWEDISH ENVIRONMENTAL PROTECTION AGENCY

ACTION PLAN ON

BIOLOGICAL DIVERSITY

REPORT 4567

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Printed by Norstedts, Stockholm 1996

ISBN 91-620-4567-9
ISSN 0282-7298

Preface

This action plan has been prepared at the request of the Swedish Government as part of Sweden's implementation of the Convention on Biological Diversity. In parallel with it, sectoral action plans have been drawn up and submitted to the Government by the Swedish National Board of Housing, Building and Planning, the National Board of Fisheries, the Swedish Board of Agriculture and the National Board of Forestry. The five plans are complementary and each of them should therefore be read in conjunction with the others. The sectoral agencies' action plans are centred on the sectors of concern to those agencies, while the Swedish Environmental Protection Agency focuses in its plan on objectives for the conservation of biodiversity, action within its own sphere of responsibility, and an assessment of the sectoral authorities' plans.

The terms of reference laid down by the Government emphasized the need for coordination between the authorities concerned in the preparation of their action plans. A Coordinating Group was set up, drawing its members from the authorities in question, the Swedish Threatened Species Unit, the Nordic Gene Bank and the Museum of Natural History, Stockholm; further details will be found in Annex 2. At the end of April 1995, a seminar was held at the Swedish University of Agricultural Sciences in Uppsala, at which the authorities reported on progress on their action plans up to that point. At another seminar in late August, attended by representatives of higher education establishments, the sectors concerned and non-governmental organizations, among others, the Environmental Protection Agency presented a preliminary draft of its plan, with a view to eliciting suggestions for improvements from those present. In addition, comments were invited on a continuous basis from various quarters as the action plan took shape. A large number of bodies affected to a greater or lesser extent by its recommendations were given the opportunity to express their views, with the aim of securing the widest possible support for the plan. The document was not, however, made the subject of a formal consultation process.

A large amount of background material was prepared in the various departments of the Environmental Protection Agency. This material was subsequently edited by Jan Terstad, project manager and editor of the action plan. The various individuals who supplied draft texts are listed in Annex 2. In addition, a certain amount of background documentation was commissioned outside the Agency.

The opening chapter of this action plan describes the general background to the plan. It is followed by a chapter outlining the basic assumptions and principles behind both the plan and the ongoing endeavour to conserve biological diversity in Sweden. Chapter 3 deals with objectives, while chapter 4 sets out the Environmental Protection Agency's assessment of the sectoral authorities' action plans. The fifth and final chapter -- containing the main substance of the plan -- describes the action proposed in various areas, beginning with a table summarizing the proposals.

It is not entirely easy to consider goals and measures with a bearing on biodiversity in isolation from other action to protect the environment and conserve the natural heritage. It has by no means been self-evident what should and should not be included in an action plan with the present aims. What is quite clear, however, is that the Convention on Biological Diversity -- and hence this action plan -- covers a very broad range of issues: from pollution control to nature conservation and site safeguard, from environmental monitoring to regulatory instruments, to mention just a few of the many aspects involved. The conservation of biodiversity can be said to

be a fundamental element -- and also one of the overarching objectives -- of our endeavour to safeguard the environment. A crucial part of that endeavour has the ultimate aim -- alongside that of protecting human health -- of conserving biological diversity.

Biodiversity was also dealt with in the Environmental Protection Agency's earlier action plan *Strategy for Sustainable Development -- Proposals for a Swedish Programme*. Many of the goals and measures proposed in the present document have points in common with those set out in the earlier plan.

As far as possible, we have attempted to formulate this action plan in terms of *measurable objectives* and *proposals for tangible action* to be taken over the next three years. To a large extent, however, the task of conserving biological diversity and ensuring its sustainable use is a matter of establishing processes: maintaining the momentum for change within the sectors concerned, encouraging greater efforts on a local basis, pursuing various issues at the intergovernmental level, and so on. Both the Convention and this action plan should be viewed in that light -- as catalysts to set in motion and speed the pace of important processes.

It is important to emphasize the local perspective in the process of conserving biodiversity. Success will only be possible with the participation and commitment of local farmers and forest owners, trade associations and the general public. The involvement of voluntary organizations is equally vital.

The Environmental Protection Agency would like to thank all those who, by supplying background material or commenting on draft versions of the text, have made valuable contributions to this action plan.

Stockholm, November 1995

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CHAPTER 1

1. Introduction

1.1 The Convention on Biological Diversity

In June 1992, at the United Nations Conference on Environment and Development in Rio de Janeiro, a total of 153 states, together with the European Union, signed the Convention on Biological Diversity. Since then, a further 14 states have signed or acceded to the Convention, making it one of the most widely supported international agreements ever. The Convention came into force on 29 December 1993 and, with its broad approach, has the potential to play a coordinating and leading role in international nature conservation efforts.

The objectives of the Biodiversity Convention are `the conservation of biological diversity, the sustainable use of its components and the fair and equitable sharing of the benefits arising out of the utilization of genetic resources'. The last-mentioned of these aims concerns the relationship between countries providing genetic resources and those which use their technology and know-how to develop products from them.

The Convention sets out a number of guiding principles for the conservation and use of biological diversity, including provisions on the establishment of protected areas, the development of methods to ensure the sustainable use of biological resources, the environmental responsibility of different sectors of society, and education and research. It recognizes that states have sovereign rights over their own genetic resources, and makes recommendations concerning financial support for the efforts of developing countries to implement the Convention. The Convention calls on states to develop national action plans or programmes for the conservation and use of biodiversity. Its structure is nevertheless sufficiently flexible to allow each country to design its own policies in this area.

In view of this flexibility, however, a system of regular reporting on action taken or planned to conserve biodiversity needs to be established, and the reports submitted must be sufficiently comprehensive and detailed to permit the full range of issues dealt with in the Convention to be kept under review. Among other things, this requires the active involvement of all areas of society concerned, in particular the agriculture, forestry and fisheries sectors.

In November and December 1994, the Conference of the Parties to the Convention held its first meeting. At that point, the Convention had been ratified by 106 states and the European Union. Among other things, the Conference of the Parties adopted a work programme covering activities under the Convention over the period 1995-97.

The main provisions on implementation at the national level are set out in Articles 6-14 of the Convention. To a large extent, therefore, it was these articles which guided the process of elaborating proposals for inclusion in the Swedish action plans. Though not actually structured according to the articles in question, the present plan does include several references to relevant provisions of the Convention.

1.2 Terms of reference for the action plans

In July 1994 the Swedish Environmental Protection Agency was commissioned by the Government to draw up a plan of action to promote the conservation and

sustainable use of biological diversity. Around the same time, the Government asked four sectoral agencies -- the Swedish Board of Agriculture, the National Board of Forestry, the National Board of Fisheries and the National Board of Housing, Building and Planning -- to prepare corresponding action plans from the standpoint of their respective areas of responsibility. The agencies concerned were entrusted with this work as a result of Sweden's signature of the Convention on Biological Diversity. Their terms of reference stressed that the action plans were to be seen as an important contribution to implementing the Convention and that they would form the basis for the reports submitted by Sweden under it.

The Environmental Protection Agency, for its part, was asked *inter alia*

- to formulate objectives for Swedish activities to conserve biodiversity and to ensure the sustainable use of biological resources, partly with a view to guiding the work of the sectoral agencies,
- to propose tangible measures in areas not covered by the sectoral agencies' terms of reference, and
- to make an overall assessment of the sectoral action plans.

The Agency's action plan was also to include an integrated assessment of the measures required across the entire area of biodiversity. It was emphasized that the proposals for action set out in the plan should be accompanied by details of

- priorities among the measures proposed,
- who was to be responsible for implementing each of the measures,
- the timetable for implementing each measure, and
- the estimated cost of implementing each of the measures, together with proposals on funding.

The terms of reference made it clear that the Environmental Protection Agency's action plan was to be guided by the environmental objectives adopted by Parliament, the Government Bill *Strategy for Biological Diversity*, and the country study *Biological Diversity in Sweden*. The Agency was to work in continuous dialogue with the National Boards of Housing, Building and Planning, Fisheries, Agriculture and Forestry. Furthermore, it was to consult regional and local environmental authorities in the course of its work, and relevant research establishments and organizations were also to be given the opportunity to contribute.

Five authorities -- five action plans

The terms of reference laid down by the Government have resulted in five action plans -- one from each of the five agencies mentioned: the Environmental Protection Agency, the National Board of Housing, Building and Planning, the National Board of Fisheries, the Swedish Board of Agriculture and the National Board of Forestry. Each of these authorities was given independent responsibility for drawing up an action plan for its own sector.

To gain a clear picture of what action is deemed necessary to maintain Sweden's biodiversity, the five plans need to be considered side by side. With regard to forest areas, for example, the plans prepared by the Board of Forestry and the Environmental Protection Agency are complementary. While the Board of Forestry's action plan emphasizes measures relating to activities within the forestry sector, the plan presented by the Environmental Protection Agency sets out the objectives to be achieved by biodiversity conservation efforts in the forest landscape, proposes action to safeguard and manage forests of particular conservation value, and includes an assessment of the measures recommended by the Board of Forestry.

As indicated in the Government's *Strategy for Biological Diversity*, these two components must be regarded as being of equal importance: that is to say, modifying the ways in which biological resources are used in the different sectors, on the one hand; and `traditional' nature conservation instruments, such as the protection and management of sites of particular value, on the other.

Both the *Strategy* and the terms of reference for the action plans defined how responsibility was to be apportioned between the authorities involved and the action plans they were to prepare. According to the terms of reference, the *sectoral agencies' plans* were to focus on proposals for action within the sectors concerned, with the basic aim of ensuring that activities in those sectors are made ecologically more sustainable. The main concerns of the Environmental Protection Agency's action plan were to be those indicated above.

This division of responsibility has formed a good basis for dialogue and coordination between the different agencies. Over-rigid dividing lines between the agencies and their action plans would have been neither appropriate nor desirable, however. One of the points of `sectoral responsibility for the environment' (see below) is precisely that there should be an ongoing dialogue between environmental and sectoral authorities, with the former providing the necessary impetus and taking on the tasks of goal formulation, guidance and evaluation. The sectoral authorities, for their part, are to engage in a dialogue with their respective sectors of society, to work alongside them in planning and implementing necessary changes in their activities, and to disseminate knowledge and be the driving force in those sectors.

1.3 The Government's *Strategy for Biological Diversity*

In the autumn of 1993, the Swedish Government presented a bill entitled *Strategy for Biological Diversity* (Government Bill 1993/94:30). The bill was subsequently approved by Parliament and thus constitutes a political platform and strategy for the promotion of biodiversity in Sweden. This document sets out broad principles for the conservation of biological diversity and the sustainable use of biological resources.

The *Strategy* states that environmental objectives are to be accorded the same weight and importance as economic considerations, in order to ensure an ecologically sound basis for human activities. It also stresses that action to maintain ecological processes and to safeguard the long-term survival of species should be holistic in its approach. A principle underpinning the *Strategy* is an awareness that the conservation of biodiversity is in the long term essential to ecosystem productivity.

The opening chapter of the *Strategy* deals with the importance of biological diversity, both at the level of genetic variation and at the species and ecosystem levels. Other issues considered are the economic valuation of biodiversity and the present situation and trends regarding biological diversity in Sweden. An area of key concern is the relationship between biodiversity conservation and economic activities. The *Strategy* underlines the need to combine measures to improve the environmental performance of different sectors of society with continuing protection of valuable natural areas. It points out that substantial efforts will have to be made to ensure that greater attention is paid to nature conservation in agriculture, forestry, fisheries and reindeer herding, and to reduce the detrimental effects of pollution and development of land and water. At the same time, emphasis is laid on the need to

increase further the area of protected land.

[BOX:]

The three levels of action proposed in the *Strategy for Biological Diversity*:

1. The `ordinary' landscape: Due attention to the environment in connection with the use of land and water, and environmentally sounder methods of farming, forestry etc. (fundamental level, important in the long term).

2. Areas incorporating natural assets of greater value: Here, special action is needed to conserve species and to maintain ecosystem functions and processes.

3. Areas of particular value: Covers habitat types and species which, owing to their sensitivity, can withstand very little or no human disturbance or will only survive given a certain type of land management.

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Nature conservation builds on the combined effects of action at different levels. The various elements involved are complementary.

Sectoral responsibility and the question of who does what

One section of the *Strategy* attempts to define more precisely what the principle of *sectoral responsibility* for the environment means in practice. The main core of this responsibility is identified as *an obligation resting on any given sector of society to play its part in making its activities ecologically more sustainable, with a view to achieving the environmental objectives that have been set.* According to the *Strategy*, the role of the *sectoral authorities* in the nature conservation process can be summed up as being:

- to initiate projects and other measures,
- to draw up sectoral plans to implement the action required,
- to work alongside the sector itself in implementing action and monitoring the results,
- to publish regular environmental reports, and
- to disseminate information within the sector about necessary action and objectives, e.g. by means of education and training.

The principal functions of the *environmental authorities*, primarily the Environmental Protection Agency and the county administrative boards, are

- to define broader objectives,
- to evaluate activities in individual sectors,
- to protect and manage areas of particular value,
- to buy environmental services, such as continued active management of valuable farmland, and
- to serve as the driving force in environmental protection.

An ongoing dialogue between environmental and sectoral agencies and representatives of different sectors is underlined as being crucial to nature conservation.

The *Strategy* makes it clear that every sector of society is expected to foot the bill for any damage to the natural environment caused by its activities. This also applies to

the cost of conserving biodiversity. In the case of farming and forestry, regional adaptation and differentiation of the methods employed to take account of the type of land involved are important in ensuring more effective nature conservation. According to the *Strategy*, any costs associated with this process of adjustment can thus be built into the activities concerned.

Emphasis is laid on the importance of biodiversity conservation in sectors such as forestry, agriculture, reindeer herding and fishing. The great majority of Sweden's surface consists of areas of `ordinary' countryside managed for productive purposes, and will continue to do so in the years to come. Such areas are consequently of fundamental importance in the conservation of biodiversity. The *Strategy* underscores the need for a continued effort to define goals, preferably measurable goals, for nature conservation, and also to disseminate information. It describes plans for a special information campaign on biological diversity in agriculture. Other areas covered by the Government bill include the handling of genetically modified organisms and non-native species, environmental impact assessment, and international follow-up of the Convention on Biological Diversity. Protected areas, provisions on land drainage and habitat protection, and planning and safeguarding of urban biodiversity are dealt with in separate action-oriented sections of the bill. One chapter is devoted to agriculture and related issues, including the farmed landscape, environmental protection and conservation of genetic resources. One of the tangible measures proposed is the preparation of special conservation plans for all of Sweden's local crop varieties and local breeds of domesticated animals.

The adoption of the *Strategy for Biological Diversity* by Parliament also resulted in the establishment of a national centre for research in this field in Uppsala and of a national scientific advisory committee on biodiversity. In addition, the Government announced in the bill that it intended to commission a Swedish country study and national action plans. Finally, the *Strategy* described how the Convention on Biological Diversity would affect Swedish support for the efforts of developing countries to conserve and ensure the sustainable use of their biodiversity.

A Government paper on *Swedish environment policy within the European Union* (1994/95:167) identifies biodiversity conservation as one of four priority areas of Sweden's policy towards the EU in the environmental sphere.

1.4 Threats to biological diversity

At the request of the Government, the Environmental Protection Agency -- working in close consultation with a number of other bodies -- produced a report in 1994 on the current situation as regards biodiversity in this country: *Biological Diversity in Sweden -- A Country Study* (Swedish Environmental Protection Agency, *Monitor 14*). The other agencies involved were the National Board of Housing, Building and Planning, the National Board of Fisheries, the Swedish Board of Agriculture, the National Board of Forestry, the Swedish University of Agricultural Sciences, the Swedish Threatened Species Unit and the Nordic Gene Bank. According to the terms of reference for the country study, it was to form one of the cornerstones of an action plan.

The country study provides the general background to the goals and measures proposed in this action plan. It examines and describes in detail the present state of biological diversity, the problems which exist and the various factors that have affected and continue to affect biodiversity. These questions will therefore not be examined at any length in the present action plan. The following is merely a brief

summary of the most important conclusions of the country study.

Biological diversity is affected both by methods of land and water use and by pollution. The threats posed by these two types of factors are not directly comparable, nor can attention be focused on one to the exclusion of the other. In the terrestrial environment, the losses of biodiversity that have occurred up to now can primarily be attributed to land use, especially within agriculture and forestry. Pollution has hitherto had its greatest impact on aquatic environments, both freshwater and marine. Perhaps the two most important forms of pollution affecting biodiversity are acidification and eutrophication.

[BOX:]

Some of the findings of the country study (based on the data currently available):

- Sweden is naturally poor in species. It is, however, home to a large number of bryophyte and lichen species, even by international standards.
- In general, the average number of species per unit area has been reduced (the country's flora and fauna have become less diverse).
- Modern agriculture and forestry are the biggest single causes of depletion of biodiversity.
- In inland waters, measures to promote fisheries have often done more harm to other components of biodiversity than fishing itself.
- More needs to be known about how reindeer grazing affects the mountain environment.
- Hydroelectric schemes have affected a great many of Sweden's rivers, with highly detrimental consequences for biodiversity.
- Development for buildings and infrastructure has mostly had a local impact.
- Acidification has had major effects, particularly on oligotrophic (nutrient-poor) inland waters.
- Eutrophication has occurred in both the marine environment and inland waters.
- Persistent organic pollutants have had a particularly marked effect on top consumers in the food chains, e.g. seals and the white-tailed (sea) eagle (*Haliaeetus albicilla*).
- As regards biodiversity at the ecosystem level, Sweden has a number of ecosystem types which merit protection from an international as well as a national point of view:
    - the brackish-water environment of the Baltic Sea, including coastal archipelagos;
    - undisturbed wet forests and montane forests;
    - mires (with their hydrology largely intact);
    - major rivers not harnessed for hydroelectric power;
    - remaining areas of traditionally managed farmland with considerable habitat diversity.
- Generally speaking, we know most about Sweden's biodiversity at the species level, particularly with regard to red-listed (Red Data Book) species. Nevertheless, more needs to be known about the habitat requirements of red-listed species, for example.
- Some 3 500 species in Sweden are red-listed, corresponding to about 7 % of all the species in the country.

In general, more research needs to be conducted into:
- genetic variation within species and populations;
- invertebrates and other lower groups of organisms;

- marine biodiversity;
- the long-term effects of pollution on biodiversity; and
- the significance of biodiversity for the functioning of ecosystems.

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1.5 Time-scale of the action plan

The action plan relates primarily to the next three years, i.e. 1996-98.

The terms of reference laid down by the Government stated that the action plan was to cover a period of three years, but that this time-scale could be adjusted according to the nature of the individual measures concerned. The Environmental Protection Agency has taken this to mean that the three-year period immediately ahead, 1996-98, should form the overall framework for its action plan. However, this should not rule out objectives or actions geared to different -- primarily longer -- time-frames, when this is judged to be appropriate. A goal or measure may take longer than three years to implement and may therefore be defined in terms of, say, a ten-year period, but -- wherever possible and suitable -- interim goals and measures for the next three years will also be proposed. In the case of longer-term objectives and actions, an evaluation should be carried out after the first three years.

With a few exceptions, a timetable for implementing each of the measures proposed is indicated. In some cases, the dates by which stated objectives are to have been attained are also specified. This is primarily the case with `action objectives' (see 3.2 and Glossary).

CHAPTER 2

2. Basic assumptions and principles

What reasons are there for seeking to conserve biodiversity? What has Sweden, by signing the Convention on Biological Diversity, undertaken to do at the national level? How ambitious should Sweden's aims be when it comes to conserving biological diversity? Should we be endeavouring to preserve the biodiversity of every municipality, for example? And how should we view irreversible losses of habitats or plant and animal communities? This chapter explains some of the key assumptions and principles that have guided the Environmental Protection Agency in the elaboration of this action plan.

2.1 Why conserve biological diversity?

Biological diversity is of value from many different points of view. The preamble to the Convention highlights the ecological, genetic, social, economic, scientific, educational, cultural, recreational and aesthetic values of biological diversity and its components.

Biodiversity is of fundamental importance in that, to a large extent, it is a prior condition for *life-sustaining* processes and the functioning of ecosystems. All of the millions of species which exist today play a part in maintaining the environmental conditions on which both we and they themselves depend. While these conditions could well be sustained by fewer species, we do not know how far the earth's flora and fauna can be impoverished without a risk of unfavourable, perhaps life-threatening, environmental changes. In addition, we have an inadequate understanding of *which* species perform such important ecological functions that their loss would disrupt key ecological processes or affect the survival of many other species. Biodiversity is thus essential to properly functioning ecosystems, capable of producing the resources on which we human beings depend. Ultimately, the maintenance of biological diversity is essential to the *survival* of both humankind and other forms of life.

The *practical value* of biodiversity is evident in many different spheres: we use *biological resources* in a variety of ways, for instance as food. The plant and animal kingdoms also supply us with raw materials, in the form of genes and substances, for a range of industrial purposes, including the production of medicines. The turnover of the economic sectors in question is now enormous. We do not know at present which species or genes will prove useful in the future, but with every species lost we are losing for ever an opportunity to draw on nature's rich variety and, with it, a potential resource.

Aesthetic values are also important. Access to a varied natural environment is a basic human need. The aesthetic side of biodiversity is not just a matter of being able to enjoy the beauty of exotic places, but has to do with far deeper-seated needs and functions. In many cases, this aesthetic dimension also provides the basis for economic sectors such as tourism and recreation -- for example, the scenic beauty of mountain regions is the very *raison d'être* of much of the tourism which such areas attract.

Maintaining biological diversity is also an *ethical* question. Many of us would probably feel a sense of shame if species which are a natural feature of Sweden's

countryside were to disappear as a result of human activities. We would have failed to pass on to our descendants something entrusted to us by earlier generations.

2.2 What has Sweden undertaken to do?

The following have been our points of departure in the elaboration of this action plan:

[BOX:]

- Sweden has undertaken to maintain biological diversity in the long term.
- We have also undertaken to restore biodiversity in certain cases.
- Biodiversity is in itself a dynamic phenomenon.
- The concept of biodiversity includes ecological functions and processes.
- In practice, our concern must be to maintain the *basic conditions* for biodiversity.
- The situation from which we must proceed is one of ecosystems disturbed to a greater or lesser degree by human activities.
- Ecosystems and habitats will continue to be affected in various ways by human activities. However, the undertakings we have made mean that any losses must be compensated for over time. Active measures must be undertaken to compensate for irreversible losses of habitats and populations.
- The emphasis should be on the ecosystem and habitat level -- the parts combine to make a whole. At the species level, habitat-oriented action must predominate.
- Red-listed species are important both in their own right and as indicators of environmental conditions.
- *Ex situ* conservation is only a complement to *in situ* conservation.
- Sweden has a responsibility for `its own' biodiversity, even if the same components of diversity exist in other countries.

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Sweden's national undertaking -- to maintain biodiversity in the long term

The conservation of biological diversity and the sustainable use of its components are two parallel, fundamental objectives of the Convention. `Sustainable use' is defined in the Convention as `the use of components of biological diversity in a way and at a rate that does not lead to the long-term decline of biological diversity, thereby maintaining its potential to meet the needs and aspirations of present and future generations'. These two aims combined must be taken to mean that it is necessary to *maintain biodiversity in the long term*; in other words, over the long term there should be no loss of diversity. The maintenance of biological diversity can be said to be an indicator (though not the only one) of a sustainable state of the natural environment, in the sense that its components are not being used in ways which -- combined with other human influences -- have a decisive adverse effect on ecological systems and their productivity. The obligation we have entered into by signing the Convention defines a framework or limit as regards how far we can permit ourselves to impinge on the environment and on conditions for species other than our own.

The Convention also includes provisions on rehabilitating and restoring degraded ecosystems and on promoting the recovery of threatened species (Article 8(f)). This clause makes it clear that parties to the Convention undertake not only to maintain existing biodiversity on a long-term basis, but also to *restore biodiversity* where this is judged necessary in order to achieve the objectives of the Convention. This may be relevant at the species level, e.g. measures to restore populations of threatened species, but it may also be necessary in relation to genetic variation, e.g. action to support impoverished natural populations of salmon. In the `ordinary' countryside, it may be a matter of rehabilitating farming areas with a predominance of very large fields or the forest landscapes created by past decades of clear felling. Sweden has thus pledged both to preserve existing biological diversity in the long term and to restore certain aspects of its diversity.

What does this actually mean in more tangible terms for Sweden, for its counties and municipalities, and for its different sectors and industries? Biological diversity is, by its very nature, dynamic. It changes over time, and will always do so. The undertakings Sweden has made can hardly be taken to mean that every component of biodiversity -- every gene, species or habitat -- should be preserved and maintained *exactly where it is to be found today*. That would simply not be possible, bearing in mind changes in climate and the impact of human activities such as farming, forestry and other forms of land and water use on habitats, plant and animal communities etc. Nor would it be desirable or appropriate from a conservation point of view. Nature is and must be dynamic. A general attempt to `freeze' a particular state would be misguided.

Habitats and ecosystems will be affected in a variety of ways by human activities. The fundamental obligation we have assumed is to maintain biological diversity in Sweden, in the landscape as a whole, over time. A long-term, overall loss would be unacceptable, since it would mean that we had failed to meet this obligation. Any losses of habitats, substrates, plant and animal communities etc. which do occur therefore have to be compensated for in one way or another. The loss of one old natural forest, for example, must eventually be made good by allowing natural forests to develop in other places, so that the conditions for biodiversity which such forests represent are maintained in the forest landscape in the longer term. Should one site on which a particular plant species grows be destroyed, it must -- if necessary -- be compensated for in the long run, so that a viable population of the species concerned is able to survive. Long-term compensatory provision of this kind -- making good the losses which occur and which will continue to occur in various parts of the landscape -- is fundamental to achieving the aim of maintaining biodiversity. It is not altogether easy to describe or determine how this should be done in practice, but if it is to be possible we will need to formulate monitorable objectives for the most important variables on which biological diversity depends and gain acceptance for action to attain them (see 3.5 for further discussion).

Holistic approach to biodiversity

Biological diversity, as defined in the Convention, also includes the `ecological complexes of which [living organisms] are part'. The *functions and processes* which operate within ecosystems are fundamental in this context. They are often essential to maintaining biodiversity and should be regarded as a component part of it. Such processes include interactions between species, populations and ecosystems such as pollination, dispersal, migration, genetic exchange etc. Processes fundamental to ensuring the proper functioning of ecosystems include photosynthesis, nutrient cycling, soil formation, and the oxygen and carbon cycles in soil and water. Other

processes may be important in *creating habitats*, for example forest fires, natural flows of water, including flooding, and wood that is left to age, die and decompose *in situ* over a long period of time. Haymaking and livestock grazing are examples of man-made disturbances (or `disturbance regimes') that are decisive to the biodiversity associated with meadows and pastures.

Increasing importance is being attached to the role of biodiversity in maintaining functioning ecosystems. With the knowledge currently available, no one can say what consequences a general depletion of diversity will entail for the way ecosystems work. In view of this, our basic approach to biodiversity should be *holistic* -- an approach which also takes functions and processes into account.

Efforts to maintain biodiversity should focus on the ecosystem and habitat level

Species are associated with different ecosystems, and if their genetic variation is to be preserved, it is essential to maintain viable populations and properly working ecosystem processes and functions. `The parts belong within a whole.' A given ecosystem type (e.g. dry, sandy grassland), a specific plant and animal community (e.g. a grass heath) and the habitat of an individual species (e.g. a site where hairy milk-vetch (*Oxytropis pilosa*) grows) form part of a whole, in this case a cultivation system in a village with a history of farming.

The *emphasis* in our endeavour to maintain biodiversity should be on the ecosystem level, but measures at the species and genetic levels are also necessary. At the species level, the main focus should be on the habitats of the species concerned, which means that action will be concentrated on certain particularly interesting and valuable habitats and ecosystem types. *Certain species*, however, require species-oriented measures, alongside the protection and management of their habitats. Genetic variation also needs to be preserved. This must be achieved by maintaining viable populations of species within their natural ranges.

Usually a matter of maintaining basic conditions for biodiversity

The action that needs to be taken is rarely directly connected with the *components of biological diversity as such.* In practice, our concern must often be to maintain the *basic conditions* for biodiversity. It may be a question of ensuring that farmland habitats continue to be managed in appropriate ways, safeguarding old or coarse-stemmed trees or preserving a certain proportion of deciduous woodland in the forest landscape, or maintaining a chemical and physical environment in which species and ecosystems can survive. This is a pragmatic approach, based on our knowledge of factors that are important, and in some cases crucial, in maintaining biodiversity. For practical and financial reasons, it is not generally possible to measure or monitor *biodiversity itself* -- the amount of variation present in terms of genes, species or ecosystems.

Overall situation of red-listed species an important indicator

Generally speaking, our knowledge base is best developed at the species level, especially in relation to higher animal and plant species. Since Linnaeus's day, we have given species names, assigned them to groups, investigated which of them are related and so on. We know most of all, perhaps, about certain groups of species

which are included in Red Data Books or Red Lists, even if our understanding of such species is far from complete. Red-listed (Red Data Book) species (which in Sweden includes endangered, vulnerable, rare and `care-demanding' species) have attracted a particularly high level of attention. In public debate, there has sometimes even been a tendency to reduce the concept of biodiversity to the question of these species' survival.

Red-listed species are obviously of value in their own right, but they are important above all as *indicators of the overall situation in different ecosystems and within different groups of organisms.* The overall picture as regards the *threats to and habitat requirements of* these species provides a valuable basis for determining priorities, even if the Red Lists as such cannot be used for this purpose. Inclusion in such a list indicates that the species concerned is in a very serious situation, especially if it is assigned to the Endangered or Vulnerable category. However, while these Red Lists do provide useful background data for an analysis of the threats and problems involved, the species included in them are not necessarily the most important concern from the viewpoint of biodiversity (after all, the majority of species in Sweden are not red-listed).

Our starting-point is ecosystems disturbed to a greater or lesser degree by human activities

For better or for worse, the great majority of ecosystems in Sweden -- and hence the situation as regards biological diversity -- are influenced by human beings. In other words, our principal line of attack is not to seek to preserve undisturbed ecosystems (although relatively undisturbed ecosystems are often important for certain components of biodiversity). Often, what we need to do is to imitate disturbance regimes which, because of human interference with ecosystems, no longer occur naturally, or to safeguard and maintain habitats which are a product of human activities. The latter approach is particularly significant in the agricultural landscape, where biodiversity has to be seen in the context of historical changes in farming practices.

It is thus necessary to piece together a picture of the structure of each ecosystem and its degree of anthropogenic disturbance. Although any harvesting of biological resources must always be geared to the carrying capacity of the ecosystems involved and the natural disturbance regimes shaping them, within that framework there is a great deal of room for manoeuvre.

In situ conservation should be the primary approach to preserving biodiversity. *Ex situ* methods should be regarded as a complement, to be used only when *in situ* measures are impossible or insufficient (in line with Article 9 of the Convention). One consequence of this is that conserving existing biodiversity *in situ* must take priority over efforts to restore the same types of diversity. For example, within a given geographical region, the preservation of remaining wetlands should take precedence over the creation of new ones.

Sweden's undertaking in international perspective

The states that have ratified the Convention have pledged primarily to maintain biological diversity within their own borders. However, ecosystems, populations etc. do not fit neatly within national frontiers, but extend and interact across them. Species found in Sweden also occur in many neighbouring countries. Some species

migrate and spend part of the year in other areas of the world, while others use Sweden only as a stopping-off point on their migrations from one country to another.

The fact that a large proportion of `our' biodiversity, of `our' species, ecosystems and genetic variation, can also be found in other countries does not free us here in Sweden from the responsibility we have within our own territory. International cooperation to solve different problems is of course important (see 5.10). However, to argue that Sweden does not need to take action to protect a certain species or preserve a particular ecosystem, on the grounds that the same species or ecosystem also exists in other countries, would be at odds with the commitments entered into under the Convention. What is more, when it comes to *genetic variation*, we know relatively little about the situation in Sweden and about whether Swedish populations of particular species have a genetic make-up distinct from -- or similar to -- populations of the same species in neighbouring countries.

Every state has a fundamental responsibility for its own biodiversity. Faced with having to decide priorities, as will always be necessary in practice, there will sometimes be a case for making that decision in a perspective that goes beyond the borders of our own country. Such decisions on priorities must not, though, result in us here in Sweden abdicating our responsibility for habitats, species or genetic variation which undeniably form part of `our' biological diversity.

2.3 Principles for the conservation and sustainable use of biodiversity

Losses of biodiversity are often the result of the ways in which we use biological resources. A fundamental cause of the losses that have occurred in recent centuries is perhaps the fact that we have permitted these resources to be exploited with our own short-term benefits in mind, together with a lack of ability to make the changes and adjustments needed in the longer term.

Generally speaking, use of biological resources has repercussions for biodiversity, in the shape of modification or even destruction of habitats, overexploitation of certain species, or other changes to ecosystems which result in an impoverishment or loss of biological diversity. Another important factor in this connection is our use of land and water in a broad sense. We rarely analyse how a decision concerning the utilization of biological resources, land or water will affect diversity before the decision has been taken. And assessments of the long-term cost to society of possible losses of biodiversity are even less common.

Up to now, efforts to conserve biological diversity have largely been based on the traditional approach of trying to solve, or at least alleviate, problems relating to reductions or losses of diversity after they have arisen. One example of this is the setting up of reserves and similar, often last-minute measures to rescue sites considered irreplaceable. Another is new legislation aimed at halting already well-advanced processes that are detrimental to biodiversity, such as wetland drainage. A third example is action to conserve threatened species whose populations are already heavily depleted.

As a result, there has been a steadily increasing need for action by the authorities, while the problems have continued to pile up. To halt this trend, certain important principles need to be more widely applied than they have been up to now, particularly in connection with decisions on the use of natural resources, including land and water.

Our society will only be able to achieve and sustain the environmental policy aim of conserving biodiversity if the principles described below come to pervade its different sectors and decision-making processes -- and in particular, those sectors which make continuous use of biological resources and thus influence the basic conditions for biodiversity.

Some important general principles

This section describes an approach which should be applied on every occasion when a decision is to be taken which may be expected to have a significant impact on biological diversity. It is primarily applicable in contexts where there is a risk of biodiversity being adversely affected by a specific human project or activity. However, in the case of farmland habitats dependent on appropriate management, for example, the emphasis will be different: here, the primary need will be to maintain the farming practices required.

The principles set out below should be considered and applied in a hierarchical order, taking account first of (a), then of (b) and so on. The fundamental aim should be *careful decision making*. Decisions should be based on as good, broad and valid a body of data as possible, with a view to ensuring that decisions with a detrimental impact on biodiversity are averted at an early stage. As a general rule, the principle of prevention and the precautionary principle should be applied first and foremost, so as to avoid situations in which financial compensation or restorative measures become necessary. In the long run, consistent use of this approach should reduce the need for public-sector intervention to conserve biodiversity.

a) The *principle of prevention* involves seeking to avoid any action which entails the risk of a loss of biological diversity. The basic aim must always be to prevent any reduction or loss of diversity, i.e. to ensure that if possible such losses never occur or that they are at least kept to a minimum in each individual case. This should be achieved by encouraging ecologically sound activities and hence sustainable use of biological resources in the sector of society concerned. The idea of preventing loss of biodiversity by developing sustainable patterns of use is expressed in the preamble to the Convention and also in Articles 1 (objectives), 6(b) (on integration into sectoral plans etc.) and 10 (on sustainable use of components of biological diversity).

Anticipating and preventing problems is also of great importance in ensuring the cost-effective use of public resources. As a rule, it is considerably cheaper to maintain biodiversity while it still exists than to try to recreate it, e.g. by restoring habitats or even creating new ones.

b) The *precautionary principle* means that, if there is insufficient scientific evidence to assess how a given course of action will affect biodiversity, we should refrain from taking that action. This principle should be applied as a matter of course. One way of achieving this is to ensure that it becomes a far commoner practice than has been the case up to now to undertake environmental impact assessments (*EIAs*) which shed light on how particular projects will affect biodiversity. The Convention includes an article (Article 14) dealing specifically with EIA.

There have hitherto been considerable shortcomings in the way the precautionary principle has been applied. Decisions are often taken despite a lack of sufficient knowledge or basic data concerning the biological characteristics of the area in danger of being disturbed or developed. Little is known about how species and

populations are affected by different methods of farming or forestry, for example. What is more, there are large gaps in our understanding of how the functioning of ecosystems is affected by the increasingly monotonous character and depleted biodiversity of the `ordinary' forest and agricultural landscape.

c) The *principle of substitution* means that methods or substances which could result in a loss or impoverishment of biological diversity should be replaced with others that are less harmful or disruptive. This principle is well established in the area of pollution control, and should also apply in the conservation of biodiversity. A method of land use, for example, which is known to harm biodiversity should be replaced with another method that is less damaging and more in keeping with the aim of sustainable use.

d) The *principle of relocation* says that activities which could adversely affect biodiversity in one area should be resited in areas where they are expected to have less detrimental effects. Instead of developing a sensitive area, another, less valuable site should be chosen.

In addition, there are a number of principles that are used primarily to reduce pollutant emissions to air and water, such as *best available technology, best available policy instruments* and the *polluter-pays principle (PPP).*

The principles described here have been elaborated and laid down in various contexts, including in a number of Swedish environmental policy bills and also in several international documents. Principles concerning how biodiversity should be taken into account in different sectors of society are also set out in the Government's *Strategy for Biological Diversity*. The above account develops further on and defines more precisely the substance of the latter document. A general proposal concerning when, how and by whom these principles should be applied will be found in chapter 5.

Apart from these various principles, mention should be made of the existing regulations on *financial compensation* for encroachments on nature conservation interests. The Nature Conservation Act, for example, makes provision for the payment of compensation in conjunction with activities intruding on nature reserves (Section 12). There is also a rule concerning compensation for encroachments on the interests of nature conservation in conjunction with decisions to permit building development, quarrying or other operations (Section 42). So far, however, limited use has been made of these provisions.

The rules referred to should be applied more widely than has hitherto been the case. The basic approach should always be to attempt first and foremost to avoid damage or other adverse effects by applying the principle of prevention, the precautionary principle and the principle of relocation. Our efforts to maintain biological diversity must focus primarily on conserving and caring for existing components of diversity, on preserving and maintaining natural assets where they exist today (`maintenance is cheaper than rebuilding'). The question of compensation is also touched on in the action plan drawn up by the National Board of Housing, Building and Planning, which includes proposals on `compensatory habitats'.

2.4 How should the conservation of biodiversity be organized?

[BOX:]

- Draw up assessment criteria for biological diversity.
- Identify variables of particular importance for biodiversity.
- Define objectives relating to these variables, progress towards which can be assessed (i.e. quantified objectives).
- Design strategies and packages of measures to achieve the objectives set.
- Design a system, including appropriate methods of measurement, to monitor the state of the environment (in relation to the objectives).
- These variables and objectives can then guide others as they undertake the essential task of elaborating goals and measures (at different geographical levels).

[END OF BOX]

Biological diversity is often regarded as an imprecise entity which cannot be translated into tangible environmental protection and planning activities. It is very important to make the concept of biodiversity operational, i.e. capable of being handled in an objective--action--monitoring process. Below, we describe a model that can be used to this end. It involves a certain degree of *simplification*: biodiversity has to be broken down and handled ecosystem by ecosystem, important assumptions have to be made, and so on. It should be stressed that this model can be used both in nature conservation and in other areas of environmental protection.

One of the basic tasks to be performed is the elaboration of *assessment criteria* for different ecosystems and/or media, that is to say, criteria to guide our interpretation of data on the state of the environment, collected for example through monitoring programmes. Assessment criteria are also important as a basis for defining environmental quality objectives and for carrying out environmental impact assessments. The Environmental Protection Agency is currently drawing up assessment criteria for soils (in agricultural and forest areas), marine and coastal waters, groundwaters, and surface fresh waters. (In the case of the latter, however, criteria for assessing water quality already exist.) Since the elaboration of assessment criteria is a long-term venture, it has been necessary to formulate objectives and courses of action in parallel with this work.

In the present action plan, we have adopted the following approach. The first step is to attempt to *analyse what variables (or factors) are important as basic conditions for biological diversity*. By `variables', we mean phenomena in the natural environment which can be quantified in some way. (The National Board of Forestry's action plan uses the term `limiting factors'.) This analysis is undertaken on an ecosystem-by-ecosystem basis, looking at each of Sweden's major ecosystems in turn (forests, farmland, marine etc.). The resultant list of variables should not be regarded as complete or definitive; we know far too little about the factors crucial to maintaining biodiversity. As in environment protection and conservation work generally, we have proceeded on the basis of the knowledge currently available. Our lists of important variables will have to be reassessed and adjusted as new findings emerge. Nevertheless, we consider it necessary to identify the most important variables, in order to be able to go on to think about objectives and the action needed to achieve them.

The second step is to try to *define objectives* relating to these variables, *progress towards which can be monitored*. Such objectives are crucial if we wish to be able to ascertain in the long term whether the situation is improving or deteriorating as regards biological diversity. In certain cases, the resultant goals have assumed the

form of environmental quality objectives, in other cases `action objectives' or `load objectives' (see 3.5 for further discussion). These goals, especially those concerning environmental quality, are intended to guide other bodies and individuals in their efforts to promote biodiversity, i.e. specific sectors, local authorities and individual companies, farmers etc. The process of elaborating objectives must continue at other geographical levels and in individual sectors; for every county, municipality, forest holding, farm and so on. In that context, goals must be *modified to take account of local conditions* in the area concerned. Moving down to the level of the individual site, for example a pasture, any agreement on payments for environmentally sensitive management will need to include measurable quality objectives.

The third step is to *design strategies and proposals for individual measures and action programmes* to help achieve the objectives set and the defined levels of environmental quality. It will be very difficult to recommend courses of action if we do not know broadly what goals we are seeking to achieve. Measures and action programmes, like objectives, need to be elaborated not only by the Environmental Protection Agency and the other national authorities concerned, but also by a wide range of other bodies and individuals: farmers and forest owners (e.g. in conjunction with farmland management agreements or forestry planning), county authorities, municipalities and so on.

The fourth step involves *designing a monitoring system* to keep track of the state of the natural environment in relation to the variables identified and the objectives set on the basis of them. The main core of this system is made up of the sum-total of the country's *environmental monitoring programmes*, which, using established methods, keep a regular check on the state of the environment, whether it be a matter of the pH of an individual lake, the extent to which pasture-land is being used for grazing, or the number of old deciduous trees in the coniferous forest landscape. The resultant data obviously need to be interpreted and analysed, which is where the assessment criteria come in. Statistics of various kinds are another important source of data in this context. Measurable objectives are a vital element in monitoring progress.

Another aspect of monitoring concerns the *development of methods of measurement* which provide a true picture of the state of the environment and which are also practicable and affordable. Some of the basic questions here are

- What should we be measuring (what variables/indicators)?
- How should we measure them (by what methods)?
- How should we interpret and assess the data produced (assessment criteria/interpretative framework)?

Biological diversity

Weak link

Basic conditions
for biodiversity
= measurable variables

Objective

Action

Monitoring

Fig. 1. Simplified outline of the process. The key variables chosen as the focus of objectives and actions need to be verified, i.e. it must be ascertained that, taken together, they genuinely reflect the conditions that are of importance in maintaining biodiversity.

The process described will be a continuing one, in which our knowledge base is enlarged at the same time as the assumptions we have made are verified and, where necessary, objectives and measures are reappraised and adjusted. It cannot be undertaken one step at a time, as we would perhaps prefer; we will have to work on all the component elements at the same time. A good measure of humility is called for in the face of the complex issues and challenges involved in conserving biodiversity.

In parallel with our work on these various elements, there must be an ongoing effort to add to our stock of knowledge, by means of inventories, mapping, research etc. What components of biological diversity are present today, where are the most valuable sites, are there patterns in the distribution of biodiversity -- these are some of the questions which we shall need more knowledge to be able to answer.

What should be the geographical scale -- and boundaries -- of our efforts to conserve biodiversity?

[BOX:]

- Activities to promote biodiversity should primarily be linked to existing administrative structures (counties and municipalities), while also seeking to take account of nature's own boundaries, e.g. natural geographical regions.

- The parts (municipalities and counties) combine to make a whole (Sweden). Every municipality and county should reflect on its own share of the responsibility for maintaining biodiversity, its main focus of attention being the diversity existing within its own boundaries.

[END OF BOX]

Apart from the work that has to be done at the national level, which is the primary focus of this action plan, goals and measures also need to be formulated and implemented at lower geographical levels. *For practical reasons, it makes sense for this process to be linked largely to existing administrative units*, such as counties and municipalities. This makes it possible to use the administrative structures and regulatory frameworks that are already in place. *As far as possible*, however, the task of defining measurable objectives should be undertaken in relation to natural distribution ranges, geographical regions or populations. One problem, however, is that to a large extent we lack the knowledge and data needed to make consistent use of `nature's own boundaries' as the basis for formulating objectives. County and municipal authorities and others should coordinate their activities relating to particular habitat types, populations etc. across administrative boundaries.

In practice, then, a twofold approach will be called for, with the main emphasis on

existing administrative boundaries. The drawbacks involved are clear: it is not particularly scientific to define objectives and measures in relation to such boundaries. Nonetheless, the practical advantages outweigh the disadvantages: objectives can best be elaborated and action most effectively implemented at the county and municipal levels. At the same time, efforts to develop new knowledge and to further refine goals must take account of natural geographical regions, distribution ranges etc.

Our choice of the geographical scale on which to operate will depend very much on how ambitious we wish to be when it comes to conserving biological diversity. The undertaking to implement the Convention was admittedly made by *Sweden*, through its Government and Parliament, and not by individual municipalities or enterprises. Nevertheless, it is essential for a variety of bodies and individuals -- both in central and local government and in the private sector -- to become involved in the process of maintaining biodiversity. Sweden consists of the sum of its geographical parts -- and of all the different bodies and individuals to be found there. An additional factor with a bearing on the appropriate geographical scale of our efforts is the need to ensure that ordinary citizens have access to biological diversity in the vicinity of where they live, given the significance of biodiversity in terms of recreation, information and education.

If the Convention is to be successfully implemented and applied in Sweden, *it must to a large extent be put into effect at the local level* (this, incidentally, is a cornerstone of *Agenda 21*). Obviously, there needs to be cooperation and consultation across municipal and county boundaries, with a view to linking objectives and courses of action as closely as possible to natural geographical regions, catchment areas and distribution ranges, for example. It is also necessary to consider questions of cost-effectiveness when discussing what action is to be taken. The aim should be to *link action on biodiversity to the work already being done at the county and municipal levels.* The authorities concerned have a key part to play in promoting a good environment, whether it be a matter of the county administrative boards' regional environmental strategies (STRAM), the enlarged nature conservation role of the county forestry boards or, not least, the work on local Agenda 21s being undertaken by municipal authorities (see 5.9). The latter work alone is an important reason for coupling the process of elaborating goals and measures to the municipal as well as the county level.

The basic approach should be that every municipality and county should reflect on its own share of the responsibility for maintaining biodiversity. In this connection, *each municipality has a responsibility for the biological diversity that exists in its own area.*

Involvement essential

A great deal of work is now being done to safeguard and promote biodiversity, especially in the forest sector. A similar level of commitment can hopefully be expected before long within the agricultural community. An important aim here is to secure the *active involvement* of those sectors which have a key part to play in this context. It is in other words vital to involve farmers, forest owners, reindeer herders, fishermen and many other important groups in a process of change which has already begun in many quarters, but which needs to be broadened and intensified.

CHAPTER 3

3. Objectives for the conservation and sustainable use of biological diversity

3.1 The Environmental Protection Agency's role in the formulation of environmental objectives

For a number of years now, one of the functions of the Environmental Protection Agency has been to elaborate objectives in the area of environmental protection. This responsibility is laid down in several Government bills in the environmental sphere and also in the directions on the use of appropriations (*regleringsbrev*) issued to the Agency by the Government. In its work in relation to sectoral agencies and regional and local authorities, the Agency is to devote particular attention to goals, guidance, coordination and assessment relating to environmental protection. This also applies, of course, in relation to the conservation and sustainable use of biodiversity.

An entire chapter of the Government's *Strategy for Biological Diversity* is devoted to the need for a continuing effort to elaborate measurable objectives concerning nature conservation. The *Strategy* states that the overall environmental objectives established by Parliament should be developed and translated into measurable goals, to enable action to safeguard the environment to be evaluated. Broader objectives should be broken down into elements that can be implemented in practice in different sectors of society and at the regional and local levels. The development of measurable goals is described as fundamental to the proper discharge of the environmental authorities' responsibility for supervision and assessment in the environmental sphere in relation to the rest of society.

[BOX:]

Basic criteria defining measurable objectives (as set out in the Government Bill *Strategy for Biological Diversity*):

`Objectives should be relevant and must result in a genuine improvement in the situation. They must also be quantifiable and defined in time and space. They must allow scope for an ordering of priorities among different protective measures and methods of use.'

[END OF BOX]

3.2 Different types of objective concerning biological diversity

Environmental objectives can assume several different forms. In general, they can be said to express a desired state of or a desired result in the natural environment. This section presents and defines the types of objective that are used in the present action plan, which employs the same conceptual apparatus as the Environmental Protection Agency's earlier action programme *Strategy for Sustainable Development -- Proposals for a Swedish Programme*. Basically, four different kinds of objectives are involved.

[BOX:]

Different types of environmental objective

- *Overall environmental objectives* state in general terms what environmental situation is desirable in different ecosystems/areas and from the viewpoint of human health.

- *Environmental quality objectives* express the environmental quality (state of the environment) that is to be achieved by a given point in time. A quality objective is defined in terms of one or more measurable biological, chemical or physical properties of the environment, and indicates what their `value' or status should be.

- *Objectives concerning pollutant loads or physical disturbance (`load objectives')* express the maximum input of a pollutant or the maximum physical disturbance that can be accepted if overall environmental objectives and quality objectives are to be achieved.

- *Action objectives* express the result (e.g. a certain reduction in sulphur emissions, a particular state of management, a given protected area) which a set of measures are to achieve within a given period of time.

[END OF BOX]

Overall environmental objectives

state in general terms what environmental situation is desirable in different ecosystems/areas and from the viewpoint of human health. These goals are usually laid down by Parliament and the Government, and thus presuppose an assessment from the point of view of environmental policy. An overall environmental objective is generally long-term and does not incorporate a target date. The overall environmental objectives decided on at the political level which are of relevance to the maintenance of biodiversity are presented in the next section (3.3).

Environmental quality objectives

express what environmental quality or state of the environment is to be achieved or maintained. The expression `environmental quality' means a state of the environment described in terms of, for example, levels of pollutants (chemical and/or physical conditions), the existence of viable populations of species, or the area of habitats of a particular kind. The variables chosen should provide a basis for assessing the state of the environment with regard to biological diversity. Environmental quality objectives relevant to biodiversity can thus refer to variables relating either to *biological conditions* as such or to *basic conditions for the biological components of the environment* (chemical and/or physical variables, substrates etc.). What these goals have in common is that they express a state of the environment in terms of certain properties of ecosystems, e.g. the amount of dead wood present, the area of well-managed habitat types and plant communities in the agricultural landscape, or the size and range of populations. *They must be formulated in such a way that it is possible to assess progress towards achieving them.* It is therefore desirable to set a date by which they are to be attained.

An environmental quality objective is defined in terms of one or more measurable properties of the environment -- biological, chemical or physical -- and indicates what

the `values' of these properties should be. It may be expressed in numerical or descriptive terms. To be operational and easily translated into action objectives, an environmental quality objective should be quantitative. One possibility is to define such an objective with reference to a range of values. Objectives of this type are usually laid down by the Environmental Protection Agency and implemented at the regional level in county administrative boards' environment protection programmes or regional environmental strategies (STRAM). They constitute one of the prior conditions for achieving overall environmental goals, i.e. they are *laid down with reference to a desirable state of the environment*.

Long-term environmental quality objectives are defined in the light of existing knowledge about environmental impacts and thus have a *scientific basis*. Interim goals regarding environmental quality incorporate an assessment of the feasibility of achieving the ultimate objective by a certain date, and take account of other public policy aims; the time-scales of interim goals should be such that the possibility of achieving the long-term objective is not put in jeopardy. Environmental quality objectives are addressed to all the bodies and individuals expected to play a part in achieving and maintaining them, including municipalities, sectoral agencies, businesses etc. They need to be translated into load objectives and/or action objectives (within sectors, often sectoral and operational objectives), which will in turn guide environmental protection efforts within the sectors concerned.

Objectives concerning critical loads or physical disturbance

express the *maximum input of a pollutant or the maximum physical disturbance that can be accepted if overall environmental objectives and quality objectives are to be achieved*. Quantitative critical loads or levels of physical disturbance are calculated by researchers and related objectives are often proposed by the Environmental Protection Agency. It is important for there to be a link between these goals and environmental quality objectives. Values may for example be stated in terms of the total load or the load per unit of time. Load objectives relevant to biodiversity often relate to pollutants. For example: Atmospheric deposition of sulphur and nitrogen in southern Sweden should not exceed 300 kg S/km^2 yr and 500 kg N/km^2 yr.

Action objectives

express the *result* (e.g. a given protected area, a particular state of management of a pasture, a certain reduction in sulphur emissions) *which a set of measures are to achieve* within a given period of time. Action objectives relating to the Environmental Protection Agency's sphere of responsibility are proposed by the Agency and adopted either at the political level or by the Agency itself. As with other goals, it should be possible to assess progress towards meeting these objectives, which means that they need to be formulated in unambiguous and measurable terms, e.g. including a date by which they are to be achieved. Obviously, they should always contribute to the attainment of environmental quality and overall environmental objectives.

Where sufficient knowledge is available, action objectives should be set in the light of the relevant goals concerning environmental quality and maximum loads. In many cases, however, there are considerable gaps in our knowledge, making it impossible to quantify quality and load objectives. In such cases, action objectives have to be defined on the basis of the precautionary principle. Since many overall goals and environmental quality objectives will take a long time to attain, it is often necessary

to lay down action objectives to be achieved in several stages (gradually bringing us closer to the overall and/or quality objectives that have been set). Where it is difficult to specify environmental quality objectives, for example owing to insufficient knowledge, we must confine ourselves for the time being to formulating action objectives (leading in the direction of the overall environmental objectives).

Here are a few examples of action objectives: `By the year 2005, x hectares of mires included in the Mire Protection Plan should be safeguarded under the Nature Conservation Act.' Relating to pollution: `Sweden's sulphur emissions should be reduced by 80 % between 1980 and 2000' (an objective based on critical loads and deposition and emission data). `Pesticide use is to be halved by the year 1996' (an application of the precautionary principle). In a management agreement relating to an unimproved pasture, it may be necessary to define the action objective as follows: `By the autumn at the end of the period, the grazing pressure should have been sufficient to ensure that all grassland is well grazed. The quantity of vegetation remaining should be limited on all land. The average height of remaining stems on dry to normally moist soil should be a maximum of x cm' etc.

In addition to the above categories of objectives, sectoral, county and municipal authorities often use other terms, such as sectoral, planning, result and operational objectives. The last two of these often have a similar meaning to action objectives.

3.3 Overall objectives adopted by Parliament and the Government

In this section we present the environmental objectives, laid down at the political level, which can be considered relevant to maintaining biological diversity. Our overview makes no claim to be exhaustive: it is not easy to decide which goals are of relevance to biodiversity. Objectives concerning emission reductions, for example, have some impact on biodiversity, at least in the long term. No more than a handful of these are included below. The broader objectives presented here form the basis for the more specific goals set out in section 3.5.

It is not always possible to distinguish between goals and guiding principles. Except where otherwise indicated, the statements presented are interpreted as *objectives* for environmental protection activities. Our survey is based in principle on quotations from a number of Government bills.

Government Bill 1990/91:90: `A Living Environment'

[BOX:]

The four overall objectives of Sweden's environmental policy are
- to protect human health,
- to conserve biological diversity,
- to manage natural resources so as to ensure their sustainable use, and
- to protect natural and cultural landscapes.

[END OF BOX]

Other objectives set out in *A Living Environment* which are of relevance to biodiversity are as follows:

- Biological diversity and genetic variation should be safeguarded. Plant and animal communities should be maintained so as to enable viable populations of plant and animal species occurring naturally in Sweden to survive in natural surroundings. Viable, balanced populations of species occurring in sea areas and inland waters should be maintained.

- Land and water should be used in ways which enable a rich variety of landscape types, habitats and species to be maintained and viable populations of naturally occurring species to be preserved.

- Renewable resources should be used within the framework defined by ecosystem productivity. The use of non-renewable resources should, to an even greater degree than at present, be characterized by responsible management.

- The introduction of non-native species and genetically modified organisms should only be undertaken with considerable restraint and subject to adequate controls, so as not to jeopardize the conditions required by native flora and fauna.

- In the long term, persistent organic and environmentally harmful substances should not occur in the environment. Emissions of persistent organic and other toxic pollutants should by the turn of the century be reduced to levels which will not damage the environment. The use of environmentally harmful substances should be substantially reduced.

- Emissions of mercury, cadmium and lead should be reduced by 70 % between 1985 and 1995. Emissions of other important metals should be halved over the same period.

- Waterborne discharges of nitrogen from human activities should be halved between 1985 and 1995.

- Emissions of sulphur should be reduced by 80 % by the year 2000, compared with 1980 levels. Emissions of nitrogen dioxide should be reduced by 30 % by 1995, compared with 1980 levels.

Basic approaches and principles in `A Living Environment'

- Overall aims in the area of nature conservation are to be achieved by greater consideration of conservation needs, ecologically sounder activities in different sectors of society, and species and habitat conservation measures under the Nature Conservation Act.

- Broader nature conservation objectives should be translated into measurable quality objectives.

- Greater sectoral responsibility and greater decentralization should be encouraged, in order to secure broad support for environmental protection and conservation efforts.

- The polluter-pays principle applies to private individuals as well as to companies and authorities, and encompasses all spheres of activity.

Government Bill 1993/94:30: `Strategy for Biological Diversity'

This bill sets out approaches and guiding principles specifically relating to the maintenance of biodiversity in Sweden.

- The fundamental principle is that environmental objectives are to be accorded the same weight and importance as economic considerations in all areas of society, in order to ensure an ecologically sound basis for human activities. Action to maintain ecological processes and to safeguard the long-term survival of species should have an holistic approach.

Overall environmental objectives and guiding principles for different sectors

Agriculture

- The proportion of arable land with winter plant cover should increase in areas where leaching is a major problem. As from 1992, at least 40 % of the arable area of every farm enterprise in southern Sweden (Götaland) should have a green plant cover. By 1994, 60 % of the area is to have plant cover in the southernmost counties, and 50 % in the rest of southern Sweden (*Govt. Bill 1990/91:90: A Living Environment*).

- The environmental objective incorporated in the new food policy is to safeguard a rich and varied agricultural landscape and to minimize the environmental impact of agriculture attributable to plant nutrient leaching and use of pesticides. A rich and varied agricultural landscape is of key importance for flora and fauna and as a means of enhancing genetic diversity (*Govt. Bill 1989/90:146: Food Policy*).

- This environmental objective means that the agricultural sector must take account of the need for a good environment and for long-term, planned husbanding of natural resources. The detrimental effects of agriculture resulting from nutrient leaching and the use of chemical pesticides must be minimized (*Govt. Bill 1989/90:146: Food Policy*).

- The aim is to eliminate the health and environmental risks associated with the use of chemical pesticides. The use of chemical pesticides should be halved by just after the middle of the 1990s (*Govt. Bill 1989/90:146: Food Policy*).

- Agriculture should, to a reasonable extent, be undertaken in such a way as to promote the conservation of genetic variation and of valuable components of the flora and fauna of the agricultural landscape (*Govt. Bill 1989/90:146: Food Policy*).

- Leaching of nutrients from agriculture should be halved between 1985 and 1995. Ammonia emissions should, as a first step, be reduced by 25 % by 1995 (*Govt. Bill 1990/91:90: A Living Environment*).

Forestry

- The natural productivity of forest soils should be preserved. Biological

diversity and genetic variation should be safeguarded. Forests should be managed in such a way as to enable viable populations of plant and animal species occurring naturally there to survive in natural surroundings. Threatened species and habitat types should be protected (*Govt. Bill 1992/93:226: A New Forest Policy*).

Basic approaches and principles

- Forestry methods need to be adjusted to take account of new knowledge about the state of the natural environment and the natural regeneration processes of forest ecosystems (*Govt. Bill 1992/93:226: A New Forest Policy*).

Fisheries

- Viable, balanced populations of species occurring naturally in sea areas and inland waters should be maintained (*Govt. Bill 1990/91:90: A Living Environment*).

- The objective of nature conservation and environmental protection efforts in the area of fisheries is to maintain viable, naturally reproducing populations of fish and shellfish and their food organisms. This includes action to safeguard all fish species in the country. It is essential to preserve within-species variation, since this variation is in many cases considerable (*Govt. Bill 1993/94:30: Strategy for Biological Diversity*).

- It is important to maintain viable, naturally reproducing populations of fish and shellfish. Special attention must be paid to within-species variation. This is important for Atlantic salmon (*Salmo salar*), for example, which together with noble crayfish (*Astacus astacus*) and wels (*Silurus glanis*) should be made the subject of measures under the action programme to conserve populations of threatened aquatic species (*Govt. Bill 1993/94:158: Fisheries Policy Bill*).

The urban landscape

Basic approaches and principles

- The need for green spaces in urban and adjacent areas should be catered for in municipal planning (*Govt. Bill 1990/91:90: A Living Environment*).

- Extensive areas in the vicinity of urban centres which offer tranquillity and are of significant natural interest should as far as possible be given long-term protection in municipal and regional planning (*Govt. Bill 1990/91:90: A Living Environment*).

- *Govt. Bill 1993/94:30: Strategy for Biological Diversity* underlines the importance of green spaces in the immediate vicinity of urban areas and the need to devise arrangements to ensure the long-term conservation and development of green spaces in or adjacent to towns and other built-up areas.

Pollutant emissions

Action objectives laid down by the Government for emissions to water (W) and air (A) which are of appreciable significance for biological diversity in Sweden:

Substance (general chemical formula)	Action objective (reduction)	Time-frame for achieving objective	Problem and damage caused to biodiversity
Ammonia (NH_x)	-25 % A	1980-1995	Implicated in eutrophication. Harmful to biodiversity in southern Sweden especially
Dioxins (CHCl)	-70 % A, W	1985-1995	Toxic pollutants. Cause damage in particular to fauna of Baltic Sea, Kattegat and Skagerrak
Phosphorus (P)*	-50 % W	1985-1995	Decisive role in eutrophication of lakes, rivers and northern Baltic Sea. Detrimental to aquatic biodiversity
Chlorofluorocarbons, CFCs (CClF)	-100 % A	-1995	Decisive factor behind increase in UV radiation and contribute to global warming; harmful to flora and fauna
Carbon dioxide (CO_2)	0 % A	1990-2000	Decisive role in global warming; can damage mountain flora in particular
Mercury (Hg)	-70 % A, W	1985-1995	Toxic pollutant. Especially harmful to higher aquatic fauna
Nitrogen oxides (NO_x)	-30 % A	1980-1995	Decisive factor in eutrophication and formation of ground-level ozone; contributory factor behind almost all air pollution problems
Nitrogen compounds	-50 % W	1985-1995	
Volatile organic compounds, VOCs (HC)	-50 % A	1988-2000	Decisive factor in formation of ground-level ozone. Especially harmful to plants in pea family (legumes)
Sulphur oxides (SO_x)	-80 % A	1980-2000	Decisive factor in acidification. Especially harmful to flora and fauna of surface waters

* At the 1987 North Sea Conference, Sweden entered into an agreement to reduce phosphorus inputs to the sea by 50 % between 1985 and 1995 in areas where phosphorus has caused or could cause environmental problems (Govt. Bill 1987/88:85, JoU 23, rskr 373).

3.4 Measurable objectives -- difficult, but necessary

Biological diversity is *dynamic*, not static. It changes -- and should change -- over time and space. The key problem today is the rapid and dramatic changes resulting directly or indirectly from human activities, and significantly impairing the basic

conditions for biodiversity.

Another fundamental difficulty is our *lack of knowledge*; in many areas, we simply do not know enough to be able to set goals meeting the criteria of measurable objectives described earlier, particularly in the case of environmental quality objectives. We do know that adverse, often radical changes have occurred -- for example, that less dead wood is now available as a substrate, that small-scale habitats such as wetlands in the agricultural landscape have become less numerous, that sulphur and nitrogen deposition have increased, and so on. What we often do not know, however, is what level, what state of the environment, is required for us to be able to say that there are reasonable prospects of maintaining biodiversity. In many cases, there is a need for further research and other action to enhance our knowledge base. Even when such work has been carried out, however, an element of assessment of what level is reasonable -- based on the knowledge available -- and an application of the precautionary principle will always be involved.

Yet another basic difficulty is the fact that, for natural reasons, different objectives for biological diversity have to be set for different parts of the country. *Natural conditions differ*, particularly in terms of climate and geology. In addition, human activities have influenced the basis for diversity to differing degrees in different areas.

A fourth aspect to be borne in mind when formulating biodiversity goals in a national action plan is that *biological diversity is no respecter of national frontiers*. Populations often have ranges extending far beyond our own country's borders. Some species are migratory and dependent on conditions in other countries. `Swedish' ecosystems are not self-contained, being subject to the influence of conditions and activities outside our national territory.

The dynamic nature of biodiversity creates certain difficulties when it comes to assessing individual species. Differing outlooks can result in conflicts between different conservation interests. Objectives therefore have to be set squarely in the context of land use past and present, and not simply be designed to maximize biological diversity at a very general level. We also need to be clear about the periods of time which expressions like `original levels of biodiversity' refer to. In the case of farming areas, for instance, `original' cannot be equated with the state existing prior to any human influence on the landscape.

What is `measurable' also depends on the resources available -- on whether they are sufficient to establish and operate the necessary monitoring systems.

Conservation of biodiversity and *sustainable use* of its components are both fundamental objectives of the Convention on Biological Diversity. The balance between conservation and sustainable use established in the Convention must be reflected in the objectives that are laid down at the national level. Goals relating to sustainable use should serve to guide individual sectors as they seek to adjust their activities in a direction which avoids long-term losses of biodiversity.

The first criterion of a measurable objective (as defined in the *Strategy for Biological Diversity*) -- that it should be relevant and, when attained, result in a genuine improvement -- should be easy to fulfil for the majority of objectives. It is primarily a matter of choosing the right kinds of goals. To assess whether the attainment of an objective will result in an improvement, we need to draw on the knowledge available and an analysis of what the principal problems are and what causes them. Such an analysis was undertaken -- on the basis of existing knowledge -- in the framework of

the Swedish country study.

The second criterion -- that goals should be *quantifiable and defined in time and space* -- is the most difficult to meet. Quantification is necessary if it is to be at all possible to measure and monitor progress towards objectives, but at the same time it entails stringent requirements as regards how we formulate those objectives. They must be framed in such a way that the relevant variable is expressed in terms of a specific unit of measurement (ha, kg, number per unit area etc.). However, it would be an illusion to believe that every aspect of biodiversity can be expressed in quantifiable terms.

The requirement that an objective be defined in time means that it must include a date by which it is to be achieved. As for defining it in terms of space, differing degrees of precision may be required in different contexts. Sometimes Sweden as a whole is a sufficiently precise geographical definition. In conjunction with a farmland management agreement (as a basis for Agri-Environment Programme payments), on the other hand, the relevant area will be the piece of farmland the agreement is intended to cover. The need for geographically differentiated goals means that only a limited number of measurable objectives should, or indeed can, be set at the national level. A great deal of effort will need to be devoted in various contexts to elaborating goals at the regional (county) and local (municipal) levels. The basic approach here should be to adapt national objectives to regional/local conditions. Such objectives cannot simply be transferred to the regional or local level; an *analysis* will need to be carried out to determine what level of aspiration is appropriate or reasonable for the geographical area concerned. Examples of the results of such work will be found in the following section.

The third criterion is that objectives must allow scope for an ordering of priorities among different protective measures and different methods of farming, forestry etc. The necessary scope should be created if a reasonable balance is struck between goals and action with a focus on conservation and goals concerned with ensuring sustainable use. Scope to decide priorities should primarily be achieved by formulating objectives geared towards both protective measures (e.g. reserves) and measures which emphasize adjustment within the sectors concerned (e.g. goals requiring changes in farming methods etc.). A tangible example of this is the need for a balance between objectives relating to the protection of productive forest land and those which relate to sustainable forestry and which are intended to ensure that forestry does not result in any long-term loss of biodiversity.

Relatively few of the objectives presented in this action plan have to do with biodiversity -- the variety of living organisms and their habitats -- as such. However, it is very important to formulate and adopt such goals, too, not least in order to verify the assumptions on which objectives concerning the underlying conditions for biodiversity are based. Species live in a given context, in an ecosystem in which species interact and in which, especially in the agricultural landscape, there is also a long history of very significant human influence. Forest areas have also been subject to a relatively intensive anthropogenic influence, particularly in the south of Sweden.

3.5 Proposals for more specific objectives

This section presents a set of more detailed objectives relating to the conservation and sustainable use of biological diversity in Sweden.

[BOX:]

Objectives have been formulated in the light of:

- the undertakings arising from ratification of the Convention on Biological Diversity,
- the objectives laid down by the Government and by Parliament,
- the criteria of measurable objectives set out in the *Strategy for Biological Diversity*, and
- the analysis of existing biodiversity presented in the Swedish country study.

[END OF BOX]

The aim here has been to translate -- *as far as possible and appropriate* -- the objectives decided on at the political level into measurable goals, or at least goals expressed in terms that enable us to assess progress towards achieving them. The first steps in this process were taken in the Agency's *Strategy for Sustainable Development*. In general, the environmental objectives set out in that document also form a basis for the present action plan. Some of the objectives laid down in the *Strategy for Sustainable Development* have been further elaborated and defined in greater detail in the course of preparing this plan.

The difficulties outlined in the previous section have forced us to be pragmatic in our attempt to elaborate objectives which can be monitored. The criteria of measurability have been fully met in certain cases, but only partly fulfilled in others.

The objectives presented here should not be regarded as the last word as regards the levels of aspiration which should guide our efforts. As time passes, new knowledge will no doubt make it necessary to consider adjusting the objectives set, and particularly the environmental quality objectives. For the same reason, it is not possible *at present* to formulate *environmental quality objectives* relating to certain variables and states of the environment; instead, *action objectives* are presented, indicating the direction and to some extent the pace of the work that needs to be done. Furthermore, by providing examples of goals and models for defining them, this action plan points to a *strategy* for breaking down overall objectives into different types of goals at other geographical levels in the country, e.g. within counties and municipalities.

Environmental quality objectives should reflect the basic conditions that need to be achieved in order to maintain biological diversity. In many cases, the knowledge needed to define such objectives is not yet available. This is illustrated by the goals proposed for the forest landscape, for example. To be able to monitor the status of biodiversity in this ecosystem, we need to define objectives which specify what state of the environment or environmental quality is desirable (in the long term). However, we do not know enough to be able to determine, say, how much dead wood -- in cubic metres per hectare -- is required to sustain those components of biodiversity which depend upon dead wood in one form or another. Until sufficient knowledge is available, monitorable *action objectives* should be laid down, indicating the direction and pace of action needed to improve the situation.

[FIGURTEXT:]

Quantifiable variable (e.g. ha, m^3/ha or kg/ha yr)

Original level/extent

Environmental quality objective (state desirable in long term)

Action objective to be achieved by 2010 (interim objective)

Time axis

?

Q_1
Q_2
Q_3

Figure 2. Schematic diagram showing the possible relationship between present situation, earlier level/extent, action objective and environmental quality objective. The shape of the curve up to the present time corresponds roughly to the decrease in the area of meadowland (expressed in hectares over Sweden as a whole) or the trend regarding the quantity of standing dead trees -- the variable `dead wood' (expressed in m^3/ha). Our current lack of knowledge means that it is not possible at present to say at what level objectives should be set in order to maintain biodiversity in the long term. Action objectives whose achievement can be monitored should be defined, however.

The fact that it is difficult to set environmental quality objectives must not result in our making no attempt whatsoever to do so, however. *Some of the objectives proposed here state only the relevant variable*, e.g. amount of dead wood per hectare, and give no indication of the figure or level to be achieved. The Environmental Protection Agency feels that it is important to at least state *what variables are considered most significant* as prior conditions for biodiversity. On the basis of future discussions, this set of variables can then be adjusted or added to, and the figures supplied where necessary. The elaboration of goals has to be seen as a long-term process. In some cases, the environmental quality objectives presented do not meet the criteria of measurable goals described earlier.

This section of the action plan is arranged as follows:

- Objectives relating to major ecosystems, and at the same time addressed to important sectors:
  - The agricultural landscape
  - The forest landscape
  - Wetlands
  - The mountain landscape
  - Lakes, rivers and streams
  - The coastal and marine environment

- Objectives relating specifically to the other levels of biological diversity:
  - Species
  - Genetic variation within species

- Other objectives relating to pollutants and biological diversity (not presented under the ecosystem headings)

In many cases there is obviously considerable overlap between the categories of objectives outlined above. Goals concerning forests and forestry may of course relate to the species level, those dealing with wetlands in farming areas are relevant under both the agricultural landscape and wetlands headings, and so on. The mode of presentation chosen should be seen simply as a practical way of handling and grouping the different objectives. We have sought here to lay the emphasis on the ecosystem level and to take account of the Environmental Protection Agency's role of guiding the elaboration of goals within the different sectors concerned.

Objectives concerning the biodiversity of the built environment, including towns, are also important. This area is dealt with in the action plan presented by the National Board of Housing, Building and Planning, and here, too, a great deal of work still needs to be done.

By and large, objectives are grouped according to type (environmental quality, load and action objectives). Some sections also include examples of goals adopted at a regional or municipal level, which are intended to guide and inspire other county administrative boards and municipal councils in their efforts to translate national objectives into goals geared to regional and local needs.

Objectives at the ecosystem level

3.5.1 The agricultural landscape

In the case of the agricultural landscape, whose biodiversity has been shaped by historical patterns of land management, it is important to take an holistic approach when formulating objectives -- to consider the ecosystem and its *agricultural history*.

[BOX:]

General variables of importance for the biodiversity of the agricultural landscape:

- Variety at the landscape level, associated with a mosaic of types of land, landscape features, moisture gradients etc. created by historical patterns of land use.
- The use of traditional methods of farming (management regimes).
- The extent and distribution of older, unimproved types of meadows and pastures.
- The extent and distribution of small-scale landscape features and habitats, especially small bodies of water (open ditches, ponds, temporary pools and other wetlands, marl-pits etc.). Such features are important as refuges and corridors for the dispersal of species.
- The abundance of old trees with trunks exposed to the sun, which can be found in a traditionally managed agricultural landscape and which provide habitats for lichens, insects etc.
- Transition zones between forests and open ground.
- The abundance and species richness of the arable weed flora.
- The species composition and activity of the arable soil fauna.

Important variables in connection with *individual farmland sites*:

- The species richness and species density of plant communities.
- The ability of populations of plants and animals to reproduce within viable

populations.

[END OF BOX]

`Traditional methods of farming' means, broadly speaking, the agricultural methods that were practised before the widespread introduction of chemical fertilizers and pesticides.

Sectoral objectives directly linked to agricultural production are expected to be proposed in the Board of Agriculture's action plan. The Environmental Protection Agency intends to work alongside the Board, and hopefully also the farming community, to further develop and define environmental quality objectives. These objectives should cover factors such as the availability of animal manure uncontaminated with toxic substances (crucial to the fauna associated with manure) and the biological status of arable soils (crucial to important decomposition processes). The species richness and abundance of the fauna of arable land significantly affects both the long-term productivity of such land and biodiversity. As work in this area continues, objectives need to be defined concerning species composition, activity (decomposition) etc.

Objectives concerning the reduction of nitrogen inputs to sea areas and to inland waters are described in other sections.

Efforts to conserve farmland biodiversity must proceed on the basis of the agricultural landscape as a whole -- the ecosystem with its history of land use and farming practices. In this connection, it should for example be borne in mind that the majority of unimproved infield pastures used to be meadows, which were mown to provide winter fodder for livestock. Meadows -- and also the once extensive practice of mowing mires for hay -- ceased to be significant factors in hay production in the late 19th century and the early decades of the 20th century, as farmers began to use arable land (leys) to grow fodder crops. The abandoned meadows were either ploughed up or else used for grazing, which previously had mainly been confined to outlying land and forests. Such changes in land use and management regimes are reflected in the vegetation of the areas affected. Without analyses of this type, it is impossible to understand what quality objectives are achievable as regards conserving farmland biodiversity, or to assess what action is needed to attain them.

Since the 1920s, most agricultural regions have seen an increasingly rapid increase in the area of habitats arising by natural succession from land types created by or dependent on farming. This is the result of farmland being taken out of production or managed less intensively. These successional habitats (`seral stages'), which are a reflection of changes in land use and/or abandoned or neglected management, have proved unfavourable for species which depend on management being maintained, but favourable for certain other species. Generally speaking, though, they are not under threat as habitat types, but will probably always exist as a result of changes in land use.

Farmland management agreements and decisions on environmental support are important means of guiding the conservation of farmland biodiversity in line with the objectives set. They regulate the manner in which the public sector purchases specific nature conservation services and involve *payments for commissioned production of `public goods'*, in this case the biodiversity associated with management-dependent habitat types. A model for the use of objectives to promote the conservation of meadows and pastures will be developed in the forthcoming

book *Äldre fodermarker* (`Old meadows and pastures'; U. Ekstam, in preparation).

Environmental quality objectives

[BOX:]

· The 3 000 ha of meadows and 200 000 ha of unimproved pastures assigned to nature conservation classes I-III in the nationwide Meadows and Pastures Inventory should, by the year 2000, be conserved and managed in such a way that plant and animal communities shaped by past management systems, together with their species, are able to survive in viable populations.

The total area of meadowland and unimproved pasture-land in the various regions of Sweden should consequently be as follows:

Northern Sweden (Norrland) 4 150 ha
Central Sweden (Svealand) 24 250 ha
Southern Sweden (Götaland) (apart from Öland and Gotland) 93 100 ha
Gotland 39 000 ha
Öland 42 500 ha

· An estimated 100 000-150 000 ha of older types of pasture-land, which for various reasons were excluded from the Meadows and Pastures Inventory, should, by the year 2000, be managed in ways which favour plant and animal communities shaped by past management systems, together with their species.

· x % of remaining older types of grazed forest (on outlying land) should be conserved and managed in such a way that their specific qualities are preserved.

[END OF BOX]

COMMENT: We do not know what areas of meadow- and pasture-land need to be preserved in different parts of the country and how these areas need to be distributed in order to maintain viable populations of all species dependent on traditional farmland management within their natural ranges. The *minimum* level of action needed to prevent further impoverishment of biological diversity is to conserve the areas referred to above. The area of unimproved pasture includes areas of enclosed pasture in forests (on outlying land) which were identified in the Meadows and Pastures Inventory. In addition, in a number of counties in northern Sweden, there are areas of unspecified extent incorporating older types of grazed forest, in which livestock are allowed to roam freely.

It has not been possible in this action plan to quantify the objective relating to the management of grazed forests.

Meadows and unimproved pastures include a wide variety of habitat types. Below is an overview of the commonest types in Sweden.

Meadows	Other treeless meadows
	Meadows supporting trees and shrubs
Small meadows on rocky/sloping ground	Freshwater shore meadows, mown for

hay
Seashore meadows, mown for hay
Wet/damp meadows
Fen meadows
Water meadows

Pastures

Freshwater shore meadows, grazed
Seashore meadows, grazed
Treeless pastures
Oak pastures
Birch pastures
Mixed-deciduous pastures
Other pastures with trees and/or shrubs
Alvars (limestone pavements)
Calluna heaths
Other treeless outlying land
Outlying scrubland
Grazed forest (outlying), fenced or unfenced

[BOX:]

Improved pastures of documented biological interest, e.g. associated with old trees, or with unimproved fragments harbouring components of biodiversity dependent on traditional management of meadows or pastures, should be preserved. The area concerned should amount to at least x ha.

[END OF BOX]

COMMENT: No data are available concerning the area of improved pasture-land which is of value in terms of biodiversity.

[BOX:]

Arable land and its landscape features: The management-dependent biodiversity associated with arable land, with its landscape features/habitats, should be conserved and developed by appropriate management.

[END OF BOX]

COMMENT: An action objective concerning the management of small-scale landscape features is presented below. Measurable quality objectives should in future also be elaborated relating to the biodiversity of arable soils (including decomposer organisms).

Action objectives

[BOX:]

The area of meadowland should be increased from 3 000 ha to at least 6 000 ha by the year 2005 by ensuring that unimproved pastures which used to be meadows and which still support a flora favoured by haymaking are once again managed as meadows. By 2005, the state of management of this land should be such that optimum conditions have developed for flora and fauna favoured by or dependent on haymaking.

[END OF BOX]

COMMENT: The late 19th century saw an extremely marked decline in the area of meadowland, a decline that has continued throughout the 20th century. According to the Meadows and Pastures Inventory, only a few tenths of a per cent of the meadow area that existed prior to this decline now remains. The area of meadowland therefore needs to be extended, in order to promote the plant and animal life specifically associated with this type of land.

[BOX:]

Within at least 250 000 ha of arable land, and within the area of meadow- and pasture-land to be maintained under the objectives above, small-scale landscape features (road verges, headlands, ditches and other edge-zone environments, mid-field patches of rough ground, ponds, avenues, willow shelter belts, solitary and/or old trees etc.) should, by the year 2000, be managed in traditional ways in order to promote a flora and fauna of the type created by past patterns of management.

[END OF BOX]

COMMENT: A measurable environmental quality objective has yet to be established for landscape features/habitats of the kinds described. Such an objective could be expressed in terms of the average number (or length) of features of types x, y and z in a stated area of farmland. However, given the appreciable differences between agricultural regions and the lack of inventory data, this is hardly feasible at present. Objectives should instead be formulated at a regional and local level on the basis of existing knowledge, taking account of conditions in the region or area concerned. Apart from such objectives, sites in the agricultural landscape which have been safeguarded under habitat protection rules should be fully preserved. Traditional forms of management are also of vital importance as regards landscape features/habitats.

[BOX:]

Species-rich haymaking leys on former arable land, generally older types maintained for many years, should by the year 2000 be managed in such a way as to enhance their flora.

[END OF BOX]

COMMENT: Even former arable land can be of considerable biodiversity interest, in that it can include elements of a meadow flora. This is particularly true of older-established leys which are cut for hay. Since there are so few meadows left in Sweden, it is important to make good use of these habitats, too, by managing them in appropriate ways. This goal needs to be more precisely defined, in terms that enable progress towards it to be monitored.

Quality and action objectives for individual sites

The need to elaborate and adopt goals at the regional and local, as well as the national, level exists in relation to all types of ecosystem. In the agricultural landscape, with its management-dependent habitats, such goals are of fundamental importance now that a *new and extensive Agri-Environment Programme* is to be introduced. It is necessary to have a *system of management by objectives* which ensures that funds are used to optimum advantage and that the results can be monitored and evaluated. The Environmental Protection Agency has developed such a system, based on some ten years' experience of nature reserve management and of the NOLA (Nature Conservation Measures in the Agricultural Landscape) and Landscape Conservation schemes.

Examples from the municipal level

Municipality of Karlstad, draft nature conservation programme:

* All meadow- and pasture-land assigned to classes 1-3 in the Meadows and Pastures Inventory (some 420 ha) should be conserved and managed in such a way that its natural habitat value is safeguarded by agreements or other means no later than the year 2005 (52 % of the area is currently covered by signed agreements). Restoration work and a resumption of traditional management should result in an increase in the area of meadow- and pasture-land to 600 ha by the year 2005.

3.5.2 The forest landscape

In the view of both the Environmental Protection Agency and the National Board of Forestry, monitorable objectives for the forest landscape should be elaborated according to the following general model:

1) Analyse important `limiting factors', i.e. habitats, structures and ecological processes which are not present on a sufficient scale.
2) Elaborate action objectives (expressing the desired direction), progress towards which can be monitored, and translate these into operational programmes.
3) When sufficient knowledge is available, define the conditions that are desirable in the long term (environmental quality objectives).

Day-to-day operations and the elaboration of goals must involve interaction between different geographical and administrative levels. The Environmental Protection Agency and the Board of Forestry have the role of guiding the work carried out at other levels, by producing examples, coordinating, compiling data etc. At the same time, these central agencies are dependent on suitable measurable objectives being developed for different regions/counties/municipalities. In parallel with this, further knowledge needs to be developed to provide a basis for formulating goals. The Agency and the Board intend to embark on a joint project to continue the work of elaborating measurable biodiversity objectives for the forest landscape.

An important guiding principle is that the objectives set should be perceived to be workable, and it is therefore very important that they take account of local and regional conditions.

[BOX:]

General variables of importance for the biodiversity of the forest landscape:
Processes:

· Disturbance (e.g. fires, natural formation of gaps, grazing)

Patterns:

· Proportion of old, natural forest
· Deciduous and mixed forest (area and distribution)
· Deciduous element in coniferous forests
· Existence of key habitats, e.g. wet forests
· Edge zones by lakes, rivers and wetlands

Structures:

· Dead wood and fallen tree trunks
· Large-diameter and/or old trees

· Deciduous trees

[END OF BOX]

The temporal dimension -- how these variables have changed over time -- needs to be highlighted. Basically all the variables above can in general be regarded as limiting factors in the forest landscape of today.

The environmental quality objectives below should be regarded as *examples* of objectives relating to important determinants of forest biodiversity. We do not consider it possible at present to define measurable, nationwide objectives for the majority of these variables. Goals defined at a national level often involve the use of rough averages, entailing a risk of insufficient clarity and misinterpretation. It should be clearly stressed that the objectives described (where percentages, for example, are given) cannot be *directly transferred to the local or regional level*. Most of the examples should be seen as *models* which can guide the formulation of measurable goals for different geographical regions.

Objectives relating to pollutant loads are dealt with in section 3.5.8.

Environmental quality objectives

[BOX:]

Model for formulating objectives concerning old natural forests:
In the regions below, old natural forests should make up at least:
Region x1: x % of the productive forest area
Region x2: y % of the productive forest area.
These percentages should be attained no later than the year y and subsequently maintained. `Natural forest' means a forest created by natural regeneration and not substantially changed by silvicultural intervention. `Old' means older than the minimum ages for final felling laid down by the Board of Forestry for different tree species and sites in regulations under Section 10 of the Forestry Act, plus 20-40 years.

[END OF BOX]

COMMENT: The purpose of objectives formulated as above is to ensure that natural forest of a certain minimum age continues to make up a certain proportion of productive forest land. Both the structure of natural forests and their considerable age are fundamental factors benefiting biological diversity. Another is continuity of forest cover. If this objective is met in the long term, conditions for biodiversity will generally be improved. The objective does not mean that particular areas of land or specific sites have to be permanently set aside in order to achieve the percentage stated; the important thing is to maintain that percentage in the long term. There has been a steady decline in the proportion of old natural forest in the last few decades, and the remaining areas of old forest are under heavy pressure.

To a certain extent, this objective incorporates variables such as large-diameter trees, dead wood etc. However, goals concerning these variables should be set for forests in general.

From the viewpoint of biodiversity, it makes good sense to ensure that the relevant percentage consists primarily of certain types of forest, e.g. wet forests and deciduous forests consisting of warmth-demanding species such as oak, beech etc. (see below).

The proportion of the forest area made up of wet forest varies extremely widely from one part of Sweden to another. Different goals concerning the extent of wet forests meeting certain basic criteria therefore have to be set for different regions. They should be expressed in terms of the area of wet forest exhibiting an undisturbed hydrology, continuity of the tree layer and shading, and continuous production of dead wood.

[BOX:]

The following areas or proportions of different types of forest should be maintained:

- The area of warmth-demanding deciduous forest in Sweden should be at least 200 000 ha.
- Other types of deciduous forest should account for at least 5 % of the productive forest area of the country, which *inter alia* makes it necessary to double the deciduous area in northern Sweden.
- Mixed forests should make up at least y % of the productive forest area.

Definitions: Deciduous forest = > 70 % deciduous trees; mixed forest = 40-60 % deciduous trees; warmth-demanding deciduous forest = *ädellövskog*, as defined in the Forestry Act, i.e. forest or other tree-covered land dominated by ash, beech, elm, hornbeam, lime, maple, oak or wild cherry.

[END OF BOX]

COMMENT: This objective means that the percentage of deciduous forest needs to be increased somewhat, compared with the present situation. Warmth-demanding and other deciduous forest types are generally beneficial in terms of biodiversity. It is therefore important to maintain -- or preferably increase -- the proportion of forest land which they make up, and to ensure that deciduous forests neither develop nor are converted into mixed or coniferous forests. The goal is formulated so as to leave room for further *increases* in the areas of warmth-demanding and other deciduous forest (`at least'). It has been proposed against the background of a decline in the deciduous area.

It has not been possible to set a quantified objective for mixed forests. Such goals should be elaborated on a local and regional basis. They underline the importance of maintaining a certain deciduous component in the forest landscape (over and above the deciduous element that should be maintained in predominantly coniferous forests, see objective below). It is important to stress the *dynamics* affecting the extent and development of deciduous and mixed forests (fire dynamics, succession, anthropogenic influences etc.) The endeavour to maintain a certain percentage should not be taken to mean that the areas involved must be located at the same sites over time. The Agency has not considered it possible to state a target date for the objective above.

[BOX:]

The following minimum proportions of deciduous trees should be maintained in

coniferous forest stands where natural conditions for such trees exist:

Northern Sweden (Norrland): > 15 % of the volume of timber
Central Sweden (Svealand): > 15 % of the volume of timber
Southern Sweden (Götaland): > 20 % of the volume of timber.

This objective should be achieved around the year 2020. An interim evaluation should be carried out no later than 2010 (to analyse trends and the prospects of achieving the objective by 2020).

[END OF BOX]

COMMENT: Most forest regions in Sweden have a heavy predominance of coniferous forest. There are now far fewer large-diameter deciduous trees in the country's forests than there used to be, and we know that many species are dependent on or favoured by such trees. The naturally high proportion of deciduous trees began to decline a long time ago in most of the coniferous forest zone. The rapid increase in the elk (moose, *Alces alces*) and roe-deer (*Capreolus capreolus*) populations in recent decades partly explains the low proportion of deciduous trees. To conserve the many species which depend on such trees in different regions of the country, it is important to increase the deciduous element in coniferous forests during the entire forest rotation. Deciduous trees also have a beneficial impact on the state of the soil and can counteract soil acidification. Their spatial distribution is also important. The objectives given for the different regions express *averages* and cannot be used as guide values. In certain areas higher figures must be set, in others lower ones. In this case, however, the Environmental Protection Agency does consider it possible to define a measurable objective, as set out above. The prospects of achieving this objective vary from one region to another, and the target year for attaining it should therefore be adjusted according to the region concerned.

[BOX:]

Model for formulating objectives concerning dead wood:
Dead wood should make up at least the following percentages of the total volume of timber:
Standing dead trees, at least x % of the total volume; fallen dead trees, at least y %.

[END OF BOX]

COMMENT: A continuous supply of coarse dead wood is essential to ensure that substrates in various stages of decomposition are available in forest stands; such substrates are necessary for many species of insects, lichens, fungi etc. In all, over 550 species included in the Swedish Red Lists are judged to have been detrimentally affected by a shortage of dead wood. Research shows that the availability of dead wood has been very substantially reduced (by about 90 %) compared with the natural state (although the figure varies across the country).

Clearly it is very important to break this objective down in various ways, e.g. geographically, for different types of dead wood, exposed/not exposed to the sun etc. With the knowledge currently available, it is not considered possible to define an environmental quality objective for the variable dead wood. For the time being, this factor will have to be addressed by *various measurable action objectives* (within the forestry sector), aimed at improving the situation as rapidly as possible.

Action objectives

[BOX:]

Long-term protection of valuable forests:
Both the 1993 forest policy decision (Govt. Bill 1992/93:226) and the *Strategy for Biological Diversity* state that `a goal of 5 % protected land within forest ecosystems outside the montane zone cannot be ruled out'. These documents also observe that it may be appropriate in the long term to formulate a guide value for the creation of reserves, once practical experience has been gained of the new forest policy.

Pending this, an interim operational objective should be set for reserve designation work over the next few years:
By the year 2005, a further 100 000 ha of productive forest land should be safeguarded by some form of site protection.

[END OF BOX]

COMMENT: Municipalities, too, should help to safeguard valuable forest sites by creating reserves of their own. Within the forestry sector, there are currently discussions about voluntary undertakings by forest owners to set aside areas as `company reserves', `diocesan reserves' and so on.

Such measures are very important and could help to safeguard areas of particular interest in terms of biodiversity. In this context, it will be of great value if the following criteria are met:

- The areas selected should have properties of fundamental significance for biodiversity.
- Some kind of declaration should be made to the effect that the sites are being set aside on a long-term basis.
- Boundaries and other data about the sites (e.g. area of productive forest land, features of natural habitat interest) should be published.

To what extent voluntary undertakings to set aside forest sites will help to safeguard substantial areas of valuable forest will depend on the forestry sector, especially the larger companies. Such `voluntary reserves' would be a very important contribution in this context, however.

3.5.3 Wetlands

Action objectives

[BOX:]

All mires included in the Swedish Mire Protection Plan should be safeguarded by means of site protection by the year 2010. In each three-year period between 1996 and 2010, at least a fifth of the unprotected area covered by the plan should be protected.

[END OF BOX]

COMMENT: The sites included in the Mire Protection Plan make up just over 6 % of the total mire area in Sweden, of which almost 3 % is already protected. Natural forests within mire reserves should also be protected.

[BOX:]

Between 1996 and 2000, at least 4 200 ha of wetlands and small bodies of water in the agricultural landscape should be recreated/restored. The focus of this work should be on central Sweden and the plains of southern Sweden, with a particular concentration on calcareous areas.

[END OF BOX]

COMMENT: As a basic policy, the conservation of valuable areas which remain intact should take precedence over restoration. In certain regions, however, losses of wetland habitats over the last 150 years have been so significant that restorative measures are required. The action needed to meet this objective is primarily the responsibility of the agricultural sector (both the relevant authorities and farmers themselves), since the losses observed are chiefly a result of its activities. When new wetlands are established, they should whenever possible be located on former wetland sites. Wetland restoration projects fall within the scope of the Agri-Environment Programme. This objective is in line with the Board of Agriculture's action plan.

Examples from the regional and municipal levels

Älvsborg county, `Environment Strategy 2000':

* All remaining wetlands (nature conservation classes 1 and 2) should be protected from disturbance.

Municipality of Karlstad, draft nature conservation programme:

* The municipality's most valuable wetland sites (seven in number) should be protected, primarily by designation as nature reserves, by the year 2020. Mires and other wetlands in conservation classes 1 and 2 covered by the Wetlands Inventory should be protected from disturbance by development, pipe-laying, forestry, peat extraction and other operations. Drainage schemes to convert previously undrained areas into productive land are not to be carried out in the municipality.
* Edge zones at least 5 metres wide are to be left unfarmed along the fringes of lakes, rivers, ponds, mires and other wetlands. No clear felling is to be carried out within 15 metres of these waters and wetlands.

3.5.4 The mountain landscape

Environmental quality objectives

[BOX:]

Vegetation: The cover of ground-layer vegetation, and especially lichens, should remain at least as high as at present; i.e. it must not be further reduced by anthropogenic impacts, such as reindeer grazing, tourism or atmospheric pollution. It should be maintained at least at such a level that there is no risk of exposure of mineral soil horizons or of erosion. Wind-exposed sites with bare soil or rock must not increase in size or number.

[END OF BOX]

COMMENT: Because of their thin humus cover, mountain areas above the tree line have low rates of biological growth and are highly sensitive to disturbance. There are now clear indications that the vegetation of such areas has been disturbed in such a way as to increase the extent of bare soil and rock. Damage appears to occur in two stages: (1) the ground-layer lichen cover decreases or is even reduced to zero, and (2) mineral soil horizons are exposed, with a concomitant risk of erosion. This is an extremely serious problem and can have major consequences for sensitive mountain ecosystems. The causes may be wear and tear from tourism, grazing and trampling by reindeer, or other disturbances. A current study of vegetation trends over the last few decades, based on aerial photographs, is expected to improve our understanding in this area. Preliminary results of the study (relating to certain mountains in Dalarna) show that the lichen cover has decreased in all areas where the ground layer includes lichens. In certain areas, the reduction has been substantial (up to 30-40 %). It is not possible to draw conclusions applicable to the whole of the Swedish mountain range on the basis of these findings, however.

Some local wear and tear, for example in limited areas or on routes used more heavily by reindeer herders or tourists (e.g. calf-marking enclosures and marked trails), is inevitable and should not be regarded as conflicting with the above objective, provided that no damage is done to sites with key functions.

[BOX:]

As a measure of satisfactory water quality with respect to acidification, the following indicator species should be present:

- In mountain streams (1-5 m wide): the mayfly *Acentrella lapponicum.*
- In running waters, large lakes, smaller lakes and pools: the crustacean *Gammarus lacustris*.
- In temporary waters (standing waters entirely dependent on precipitation): the crustaceans *Polyarctinicta forsipata* and *Boranchinecta polydosa*.

[END OF BOX]

* * *

No overall environmental objective for the *reindeer-herding sector* has been set at the political level, apart from generally worded statements to the effect that reindeer herders, like those engaged in other primary activities, should show due consideration for what the natural environment is able to sustain. The Board of Agriculture's action plan therefore proposes such an objective.

3.5.5 Lakes, rivers and streams

The principal threats to the biodiversity of lakes and running waters are *regulation of water levels and/or flow*, *pollution*, including acidification, and the *introduction of non-local species*. As with environmental quality objectives for other ecosystems, the goals below need to be further elaborated and adapted to regional and local conditions (by county administrative boards, municipalities and others).

The European Union is currently negotiating on a directive concerning the ecological quality of surface waters. Where applicable, references to the proposed directive are indicated by the parenthesis (EU). The purpose of the directive is to maintain good water quality where it already exists and to achieve good water quality in other waters. Good water quality is considered to exist when waters have a capacity for self-purification and support reproducing populations of naturally occurring species, and when the quality and structure of their sediments allow natural communities to occur in the ecosystems concerned. The directive focuses on the impact of land use on water quality, and on the effects of diffuse sources of pollution.

The draft directive also sets out the procedure needed to achieve these objectives. Member states are to do the following:

- define operational targets for good ecological water quality (to be adapted to regional and local conditions in line with the general principles set out in the directive);
- adopt integrated programmes to achieve these targets, incorporating binding requirements;
- regularly monitor environmental quality and submit a report every three years;
- regularly identify and assess point sources of pollution and diffuse pollution;
- standardize and calibrate sampling programmes;
- draw up action programmes and make them the subject of public consultation.

The directive sets the framework for action by each country. The member states will each decide on quality objectives and monitoring and action programmes, in the light of the principles set out in the directive and existing environmental conditions and the action needed. At the time of writing, the text of the directive has still to be finalized. The objectives below should be developed and brought into line with the directive once it has been finally adopted.

[BOX:]

General variables of importance for the biodiversity of aquatic environments are:

- species richness and species composition
- dissolved oxygen levels
- alkalinity
- concentrations of toxic substances
- nutrient status
- water regime
- characteristics of the lake/river bed
- characteristics of the catchment area and littoral/riparian zone.

[END OF BOX]

Environmental quality objectives

[BOX:]

Species richness: The diversity of invertebrates (planktonic and bottom-dwelling), aquatic plant communities and higher animal life (fish, amphibians, birds and mammals) should resemble that of similar water bodies with insignificant anthropogenic disturbance. Key species/taxa normally associated with the undisturbed condition of the ecosystem should be present (EU).

[END OF BOX]

COMMENT: The above objective is incorporated in the draft EU directive on ecological water quality.

[BOX:]

Alkalinity: To avoid serious acidification damage, the alkalinity of the water must be no more than 25 % below its original level. It should in any case not be below 0.05 meq/l, unless a lower value is natural.

[END OF BOX]

COMMENT: This assessment criterion is a way of defining what level of environmental quality is desirable with respect to the risk of acidification damage to lakes and watercourses. In scientific terms, it means that, at the level defined, unacceptable damage to biodiversity will not occur and threatened species are not expected to be eliminated as a result of acidification.

Some 20 % of Sweden's lakes, rivers and streams have suffered such serious acidification damage that at least 10-20 % of the number of species once present have disappeared. Where acidification has lowered the pH of the water by one unit, as many as half of all species may have been eliminated. The species/taxa worst affected are roach (*Rutilus rutilus*), salmon (*Salmo salar*), crayfish, bivalves, leeches and mayflies. An acidified lake typically suffers a substantial reduction in the number of planktonic algal species: in many lakes near the west coast of Sweden, for example, the number has been halved.

[BOX:]

Toxic substances: Concentrations of toxic and other harmful substances in water, sediment and biota should not exceed levels which have been demonstrated to pose no threat to aquatic species and should not prevent the normal uses of the water body (EU). In the longer term, mercury levels in pike (*Esox lucius*) should not exceed 0.5 mg/kg wet weight. Background concentrations of metals in water, living organisms and sediments in non-acidified waters must not increase above existing regional levels.

[END OF BOX]

COMMENT: Metals occur naturally in low concentrations in fresh waters, with higher levels in sediments and organisms as a result of natural enrichment. The precise figures vary, depending on the bedrock and superficial deposits of the lake or stream catchment. Metal concentrations are also influenced by the acidity of the water and

its levels of organic matter etc., with the result that considerable variation occurs even under natural conditions. In small quantities, many metals serve important biological functions.

As a result of direct discharges and other anthropogenic factors, concentrations of metals in many standing and running waters are now well above their natural levels. It has been shown that metals primarily have biological effects in lakes and streams in conjunction with acidification. Mercury levels are chiefly of concern from the viewpoint of human health, but are also relevant to biodiversity, since top consumers, such as birds of prey and otters (*Lutra lutra*), feed on fish and may be harmed as a result.

At present, insufficient data are available to make a reasonably accurate assessment of temporal trends and the risk of metals having large-scale biological effects in Swedish lakes. It cannot be ruled out that they are having such effects, however. One reason for the uncertainty is the fact that metals are involved in the `acidification syndrome' and that it is often impossible to distinguish clearly between their effects and those of acidification (i.e. the higher hydrogen ion concentration) itself. Levels of metals such as manganese, aluminium, zinc, cadmium, lead and mercury are clearly elevated in acidified areas, owing to increased leaching from the surrounding land, and the bioavailability of lead, copper, aluminium and mercury is also higher in an acidic environment. An assessment of individual metals shows that concentrations in acidified waters are not infrequently close to or above the lowest levels at which the metals concerned are known to have effects in fresh waters (their `critical' concentrations). Measures to tackle metal pollution of inland waters should preferably be coordinated with action on acidification.

[BOX:]

Nutrient status: Phosphorus and nitrogen concentrations should be reduced to no more than twice their `original' levels (`original' = prior to any significant anthropogenic disturbance). More stringent objectives may need to be set for waters of particular value, however. There should be no evidence of excessive macrophytic or algal growth due to elevated nutrient levels of anthropogenic origin (EU).

[END OF BOX]

COMMENT: Individual objectives should be set for each lake. In most lakes, rivers and streams, the principal limiting factor for plant production is phosphorus. Lakes with high phosphorus inputs suffer heavy growth of planktonic algae, which increases the turbidity of the water, and in the long run also increased growth of rooted aquatic plants; in running waters, the main plant groups to increase in abundance are attached algae and rooted vegetation. For these reasons, the nutrient/trophic status of lakes and watercourses is usually defined on the basis of their phosphorus concentrations. In certain hypereutrophic waters, phosphorus levels may be so high that at times plant production is regulated by the availability of nitrogen.

It is important to avoid further inputs of phosphorus to polluted lakes. Even where this is achieved, however, the problems may persist. Lakes which -- owing to an excessive load of phosphorus compounds in particular -- are eutrophic, becoming choked with vegetation or suffering heavy algal blooms, accompanied by considerable accumulation of biomass and depletion of oxygen, may therefore need

to be restored. This can be done by removing reeds, roots and sediments or by treating the bottom water of deeper lakes. One aim of restoration projects in lakes that have undergone eutrophication may be to recreate open areas of water, thereby enriching the landscape and benefiting bird life.

In some aquatic environments, stores of nutrients have been depleted. This is true of reservoirs associated with hydroelectric power stations, and of severely acidified lakes and streams. In such cases, a carefully calculated addition of nutrients may help to recreate functioning food chains, without changing the basic oligotrophic character of the system.

[BOX:]

Dissolved oxygen: The concentration of dissolved oxygen should allow the survival and reproduction of naturally occurring animal species. Unnatural oxygen deficiencies in bottom water should not occur (EU).

[END OF BOX]

COMMENT: The oxygen status of the water is of vital significance for an aquatic ecosystem. Dissolved oxygen concentrations can vary very widely during the year, chiefly depending on productivity and the loading of organic matter, including natural humus from the catchment. In lakes where oxygen levels vary widely, they are lowest at the end of the summer and winter stratification periods, when conditions critical to many organisms may arise.

[BOX:]

Water regime: In rivers which have not been harnessed for power production, the natural water regime should be preserved as an environment for fauna and flora which depend on flowing water.

[END OF BOX]

COMMENT: The flow of most of Sweden's large rivers is now artificially regulated as a result of hydroelectric projects. Hydroelectric dams also act as barriers to migrating fish and other animals. This has resulted in the loss of several genetically unique populations of salmon and brown trout (*Salmo trutta*). A regulated watercourse has a rhythm entirely different from the natural rhythm of lakes and rivers, and this eliminates a large proportion of its riparian flora and its benthic flora and fauna. In both storage reservoirs and stretches of rivers whose flow is now controlled, hydroelectric projects have reduced biodiversity more than any other anthropogenic factor. Rivers which remain unregulated should be preserved and given greater protection against other forms of disturbance. See also the action objective below.

Load objectives

[BOX:]

Acidification: Deposition of sulphur and nitrogen should be below critical loads with respect to acidification damage.

[END OF BOX]

COMMENT: Critical loads with respect to acidification indicate what levels of deposition of acid air pollutants (sulphur and nitrogen oxides) the Swedish natural environment can withstand without suffering damage (see 3.5.8 for further discussion). The critical loads set for different parts of Sweden are presented in table 1:

[BOX:]

Table 1: Acidification of lakes, rivers and streams

Deposition of sulphur and nitrogen should be below critical loads, i.e. the levels of deposition which, as far as is known at present, will not cause long-term damage to the ecosystems concerned (from *Strategy for Sustainable Development*)

	kg S/km^2 yr	kg N/km^2 yr
Southern Sweden (Götaland)	300	500
Central Sweden (Svealand)	250	400
Northern Sweden (Norrland)	250	300

[END OF BOX]

Critical loads for inland waters have been determined with reference to the chemical parameters pH and alkalinity and the biological parameter roach. The critical load with regard to acidification corresponds to a pH of over 6.0 and an alkalinity of more than 0.05 meq/l throughout the year. In such conditions, the indicator species roach will not be eliminated by acidification and biodiversity will not suffer unacceptable damage -- among other things, no threatened species would be expected to be eliminated owing to acidification. In practice, acidification damage may be expected to occur in lakes and watercourses in areas where the pH of precipitation is below 4.8.

[BOX:]

The aim of liming is to ensure that the pH never falls below 6 and that the alkalinity is no less than 0.05 meq/l. However, it must not result in higher than natural pH and alkalinity values.

[END OF BOX]

COMMENT: Liming projects undertaken in Sweden are intended to achieve an alkalinity of 0.1 and a pH of 6.0 during *stable periods* of the year. The chemical objective of liming is that the pH should never fall below 6 and the alkalinity should never be less than 0.05 meq/l.

Action objective

[BOX:]

New hydroelectric schemes -- including small-scale (100-1 500 kW) power stations -- should not be built beyond the level of 66 TWh/year decided on by Parliament (the aim being to maintain a natural water regime in those major rivers which still retain a largely natural regime).

[END OF BOX]

COMMENT: The significance of undeveloped rivers in terms of biodiversity (and other aspects of nature conservation) is such that conservation interests must from now on take priority over the development of these rivers. Waterfalls and rapids which remain undisturbed should not be developed. Existing schemes which regulate level and flow regimes should be modified to take greater account of nature conservation and fishery interests (see proposal for a review of water rights judgments). Diversions of water which leave stretches of rivers dry (zero-flow regimes) should not occur.

3.5.6 The marine environment

The diversity of marine ecosystems around Sweden's coastline means that there are considerable variations in species composition and species diversity, resulting in many entirely unique plant and animal communities. In the Skagerrak, the salinity of the water is around 30 parts per thousand, and several marine species are confined to this area. Further south, in the Kattegat, salinity decreases, and with it the number of species. The Skagerrak is home to some 1 500 species of marine invertebrates over 1 mm in length (macrofauna), the Kattegat to just over 800. In the southern Baltic, salinity is as low as around 10 parts per thousand. This is too low for the majority of brown algae and for entire groups of marine animals, e.g. echinoderms (starfish, sea urchins), which are consequently not found in this sea area. In the southern Baltic Sea there are around 150 macrofaunal invertebrate species, while in central parts of the Baltic there are just under 80. In the Bothnian Sea, the number of such species is even lower, around 50. The Baltic Sea comprises the Baltic Sea proper (from the Sound (Öresund) to the Åland Islands) and the Gulf of Bothnia (Åland Sea, Bothnian Sea and Bothnian Bay). In the far north of the Bothnian Bay, salinity is only a few parts per thousand. Here, only a few marine species and a number of tolerant freshwater species are able to survive.

There are many gaps in our understanding of marine biodiversity. At present, we do not know how many species certain habitat types support, or whether there are species (e.g. in the Baltic) with a genetic make-up unique to Swedish sea areas.

The principal threats to the biological diversity of Sweden's marine environments at the present time are *eutrophication, toxic pollutants* and various forms of utilization of sea areas, e.g. *fishing, aquaculture, construction, and extraction of mineral resources*. The spread of *non-native organisms* and *climate change* could have serious consequences in the future.

[BOX:]

Environments and processes of general importance for the biodiversity of the marine environment:

Environments:

- The Baltic, as a brackish-water sea, which has an extremely low species richness compared with other sea areas, and a unique mix of marine, brackish-water and freshwater species. Organisms existing at the limits of their salinity tolerance may have unique genetic characteristics.
- Shallow (0-4 m deep) bays and inlets, which provide nursery grounds for invertebrates and fish.
- Seaweed belts and eel-grass meadows -- which are productive and species-rich environments -- are important for ecosystem processes (e.g. cycling of nutrients) and provide nursery areas for invertebrates and fish.
- River mouths, which provide spawning grounds for fish (e.g. salmon (*Salmo salar*) and brown trout (*S. trutta*)).
- Deeper areas of the seabed, which may harbour unique animal communities (e.g. deep rocky bottoms of Kosterfjorden) or be important for ecosystem processes (nutrient cycling in deep benthic sediments).
- Offshore waters, which are recruitment areas for invertebrates and fish (e.g. Norway lobster (*Nephrops norvegicus*) in the Kattegat, cod (*Gadus morhua*) in the southern Baltic), and wintering areas for seabirds (northern Kattegat).

Processes:

- Marine currents, which carry nutrients and oxygen into the fiords of the west coast and through the Sound into the Baltic, and influence the recruitment of organisms to coastal and offshore waters. River-borne inputs of fresh water, nutrients, and organic and inorganic matter from the land.
- Inputs of nutrients and toxic pollutants via land, water and the atmosphere.
- Introduction of non-native organisms to Swedish sea areas as a result of shipping and aquaculture.
- Use of the coastal zone for the extraction of mineral resources, engineering projects, recreation etc.

[END OF BOX]

Environmental quality objectives

Below are a number of examples of environmental quality objectives concerning key determinants of marine biodiversity. Objectives relating specifically to marine species and genetic variation in the marine environment are dealt with in 3.5.7.

[BOX:]

Species diversity of algal belts: The species richness of plants and animals living in algal (seaweed) belts should not be adversely affected by human activities. The depths to which seaweed belts extend in the coastal archipelagos of the Baltic, Kattegat and Skagerrak should be unchanged or have increased by the year 2000. To achieve this objective, water transparency in the vicinity of algal belts must be enhanced.

[END OF BOX]

COMMENT: Seaweed belts are among the most species-rich environments in both the

Baltic and the Kattegat/Skagerrak. The depth to which bladderwrack (*Fucus vesiculosus*) grows in the Baltic has decreased owing to higher water turbidity, which is in turn attributable to heavier nutrient loads. In the Åland Sea, the lower depth limit of bladderwrack decreased from about 12 m in 1943/44 to some 9 m in 1984. In several cases, a correlation has been found between the lower limit of the algal belt and transparency (the greater the transparency, the greater the depth to which the algal belt extends).

Higher nutrient loads result in greater abundance of short-lived, e.g. filamentous, algae and reduced abundance of brown algae (*Fucus* species) in the Baltic, Kattegat and Skagerrak. Changes in the species composition of algal belts have been particularly marked in the Kattegat (e.g. Laholm Bay and Skälderviken) since the 1970s.

It may be difficult to monitor progress towards this objective. However, seaweed belts represent a habitat of great importance to marine diversity, and it is therefore very important to define an objective relating to them. The same is true of the objective regarding eel-grass meadows, set out below.

[BOX:]

The distribution of eel-grass meadows and the rhizome activity of eel-grass should be unchanged or have increased in the Baltic Sea proper and in the Kattegat and Skagerrak by the year 2000, compared with 1992.

[END OF BOX]

COMMENT: `Meadows' of eel-grass (*Zostera marina*) are one of the five priority types of marine ecosystem of high conservation value and high biodiversity (serving as nursery grounds for fish and other animals, among other things) which according to a Government paper on *Agenda 21* are to be surveyed and protected. Eel-grass meadows are threatened by eutrophication and physical disturbance. The distribution of eel-grass and the fauna associated with it are adversely affected by the spread and epiphytic growth of short-lived algae, resulting from higher nutrient inputs. A gauge of the state of eel-grass meadows is their rhizome activity, which can be measured in terms of the number of new rhizomes per unit area.

Another measure of the state of eel-grass meadows is the depth to which they grow. A Danish study has shown there to be a correlation with water transparency (the greater the transparency, the greater the depth to which eel-grass extends).

[BOX:]

Hard-bottom communities: The zonation of shallow and deep hard-bottom flora and fauna in Swedish sea areas, in terms of both distribution and number of species, should not be adversely affected by human activities. The long-term objective is for the zonation of these communities to correspond to that found at the beginning of the 1960s.

[END OF BOX]

COMMENT: A characteristic feature of the flora and fauna of hard marine substrates is the clear zonation of both plants and animals. In many cases, changes in the pattern of zoning suggest that environmental changes are occurring, e.g. as a result of eutrophication. Deep, rocky areas of the seabed along the west coast of Sweden are unique habitats, supporting large numbers of invertebrates, including corals. The aim should be to maintain the natural ranges of the attached plants and animals of hard-bottom communities in the Baltic, Kattegat and Skagerrak, and also communities of both annual and perennial species. Short-lived algae and common mussels (*Mytilus edulis*) are favoured by higher nutrient loads and have a tendency to displace other species.

In Gullmarsfjorden on the west coast, the lower limit of macroalgae decreased from a depth of about 25 m in the 1960s to 10-15 m at the end of the 1980s. The relative abundance of different macrofaunal species on hard substrates down to a depth of about 30 m has changed since the end of the 1920s.

[BOX:]

Soft-bottom communities: The abundance of short-lived (e.g. filamentous) algae should have decreased on shallow soft-bottom sites along the west coast of Sweden and in the Baltic Sea proper by the year 2000, compared with 1990. On deep soft-bottom sites, the species composition, species diversity index, size distribution and biomass of the macrofauna (invertebrates longer than 1 mm) should show that these communities are not adversely affected by anthropogenic nutrient inputs and the resultant oxygen depletion. Populations of fish and crustaceans should not be adversely affected by a deficiency of oxygen.

[END OF BOX]

COMMENT: Shallow benthic sediments are very productive environments, of great importance as spawning and nursery grounds for many fish species. Mass growth of short-lived algae, caused by increased nutrient loads, has been observed in many shallow soft-bottom areas along the west coast of Sweden, including Laholm Bay and the south-eastern Kattegat, where it is associated with large-scale mortalities of bivalves and fish.

Soft substrates in deep water play an important ecological role in the recycling of organic matter produced in the pelagic zone above. In the low-salinity northern areas of the Baltic proper and in the Gulf of Bothnia, the number of macrobenthic animal species is extremely low compared with other marine areas. This means that any reduction in the number of species (e.g. resulting from oxygen depletion) could be detrimental to ecosystem processes. In addition, benthic animal communities are a very important source of food for several fish species.

Anoxic conditions have eliminated benthic animal communities from almost half the area of the Baltic proper (around 10 million ha in 1990). In certain cases, entire food chains have been detrimentally affected. Baltic coastal waters from which soft-bottom communities have disappeared or where they have become less species-rich include the inner Stockholm archipelago, Bråviken and the Karlskrona archipelago. Off the west coast, mass deaths of Norway lobster were observed in the early 1980s in the south-east Kattegat, a result of oxygen depletion affecting benthic invertebrates and fish on deep soft substrates. Anoxia is now an annually recurring phenomenon in the fiords of Bohuslän.

[BOX:]

Mass blooms of phytoplankton: Substantial shifts in the species composition of pelagic phytoplankton communities in the Baltic Sea, Kattegat and Skagerrak, in the form of mass blooms of harmful algae (e.g. blue-green algae, toxic flagellates), should in the long term not become more widespread or more frequent as a result of human activities.

[END OF BOX]

COMMENT: Intense blooms of harmful algae are not a new phenomenon, having occurred in Swedish sea areas in previous centuries too, but in recent times they have probably become more extensive and frequent. Two problems associated with harmful algal blooms are the development of such a large biomass that oxygen deficiencies arise, and the risk of algal toxins accumulating in the food web and giving rise to large-scale mortalities of marine organisms. It is suspected that eutrophication of Swedish sea areas and changes in the balance between nutrients such as nitrogen and phosphorus, together with higher inputs of humus and trace metals from the land as a result of acidification, cause changes in the species composition of phytoplankton and promote mass occurrences of algae.

[BOX:]

Fish and other organisms should not contain such high concentrations of toxic pollutants that they are harmful as food for top consumers, including human beings, marine mammals, seabirds and other fish.

[END OF BOX]

COMMENT: Concentrations of identifiable toxic pollutants, such as PCBs and DDT, in the biota of the Baltic Sea have fallen appreciably since the 1970s. Despite bans on the use of these substances in its drainage basin, the Baltic still receives a significant input, as shown for instance by atmospheric deposition and sediments. Certain effects appear to have become less marked as levels have fallen. However, some species are still having problems, e.g. eggshell thinning in the case of the guillemot (*Uria aalge*).

Many of the chlorinated compounds whose presence in fish can be shown by chemical `sum parameters' such as EOCl (extractable organically bound chlorine) have still to be identified. In recent years, results have emerged which suggest that a significant proportion of them are chlorinated fatty acids, but the majority are still of unknown composition. It is important to establish whether these unknown substances are a greater threat than the known ones. Concentrations of unknown halogenated compounds should be at levels which may be assumed not to pose any risk to top predators in the ecosystem. Concentrations of metals (copper and cadmium) in Baltic herring (*Clupea harengus*) have risen in recent years, but the cause is not known. Toxic pollutants are a suspected cause of the high mortality rates observed among the fry of Baltic salmon (the `M74 syndrome').

[BOX:]

The general status of fish inhabiting coastal waters of the Bothnian Sea and other coastal receiving waters in the Baltic, Kattegat and Skagerrak, measured in terms of population status and physiological indicators of toxic organic pollutant loads, should have improved by the year 2000, compared with 1990.

[END OF BOX]

COMMENT: The findings of the Environment/Cellulose research project, on the environmental effects of the pulp industry, indicated widespread disturbance of the general health of perch (*Perca fluviatilis*) in coastal waters of the Bothnian Sea. The EROD enzyme system was found to be more markedly induced in fish in these waters than in the Baltic proper. This has been attributed to discharges from pulp bleaching plants. If this phenomenon is the result of chlorinated compounds, the situation should improve appreciably as chlorine discharges fall. If it does not, another serious perturbation will be indicated.

[BOX:]

Marine plants and animals should not be harmed by *oil or oil-contaminated water*, discharged from land or at sea.

[END OF BOX]

COMMENT: Discharges of oil at sea, e.g. from offshore production and transport, and inputs of oil-contaminated water from land are a serious threat to several marine organisms. The damage may be immediately visible, in the form of bird deaths, or less apparent, in the form of elevated petroleum hydrocarbon levels in the water column and in marine invertebrates and other organisms. Compliance with legislation and regulations on the handling of oil and oil products is poor.

[BOX:]

Introduction and spread of *non-native species and genes*: Uncontrolled introduction or spread of alien species or genes should not occur in Swedish sea areas. Unintentional introductions should be prevented, and intentional introductions should as far as possible be controlled. No later than the year 2000, national action should have been taken to prevent unintentional introductions via shipping, and no later than 2005 international agreements should be in place to limit undesirable introductions to sea areas around Sweden.

[END OF BOX]

COMMENT: At least sixty new species have been introduced to the Baltic Sea, Kattegat and Skagerrak as a result of human activities, either deliberately or accidentally. Shipping and aquaculture in a broad sense are two of the main routes by which species are introduced. The new species may have a major impact on native ecosystems and their species diversity, and entail a possible risk of large-scale ecosystem changes. Detrimental effects observed in Swedish waters to date include

the introduction of parasites and competition with native species. Several toxic and bloom-forming phytoplankton species may have been (unintentionally) introduced by human activities.

Aquaculture is an important source of introductions. Adverse environmental impacts may occur at the ecosystem level (e.g. due to escapes of introduced species), the species level (e.g. spread of diseases) and the genetic level (genetic changes in natural populations due to the stocking of farmed populations of the same or related species).

International shipping is one of the principal routes by which alien species are introduced. At a global level, and in Swedish waters too, the number of introductions appears to be increasing, and international solutions are needed to deal effectively with the problem.

Load objectives

[BOX:]

Dissolved oxygen in deep waters: Anoxia (oxygen deficiency) due to eutrophication in the deeper basins of the Baltic Sea and in the bottom waters of the Kattegat and Skagerrak should not have increased in scale by the year 2000, and in the longer term it should not occur at all. Influxes of oxygenated salt water to the Baltic should not be impeded by human use of coastal areas or by climate change associated with the greenhouse effect.

[END OF BOX]

COMMENT: Because of the morphology of the Baltic Sea and the irregular input of oxygenated salt water from the Skagerrak and Kattegat, the bottom water of deeper basins of the Baltic is naturally anoxic at times. Eutrophication of the Baltic, Kattegat and Skagerrak has increased the amount of organic matter settling to the seabed and hence the amount of oxygen consumed in breaking it down. This has resulted in more rapid depletion of oxygen and longer periods with anoxia (defined as less than 2 ml oxygen per litre of water).

In the more saline deep water of southern areas of the Baltic proper, high oxygen and salinity levels are necessary to enable cod eggs to develop. The dramatic decline suffered by Baltic cod since the mid-1980s is due to a combination of oxygen depletion in spawning areas and overfishing.

The goal of improving the oxygen status of bottom waters is linked to that of reducing nutrient inputs to Swedish sea areas.

[BOX:]

Toxic pollutants in marine mammals: Concentrations of toxic organic pollutants in common porpoise (*Phocoena phocoena*) and seals (ringed (*Phoca hispida*), grey (*Halichoerus grypus*) and common seal (*Phoca vitulina*)) in Swedish sea areas should be reduced to levels at which they do not cause diseases or reproductive disorders.

[END OF BOX]

COMMENT: Since the 1960s, persistent, toxic organic pollutants, especially breakdown products of DDT and PCBs, have caused a pattern of pathological conditions in seals (skin lesions, skeletal deformities, diseased internal organs and impaired reproduction). This has further exacerbated the decline in their populations, to such an extent that the survival of the species concerned cannot be regarded as assured (although there has been a slight recovery in recent years).

Action objectives

[BOX:]

The physical protection of coastal marine habitats in the Baltic, Kattegat and Skagerrak should be improved by the year 2000, compared with 1995.

[END OF BOX]

COMMENT: The use of coastal areas for activities such as fishing, aquaculture, engineering projects (marinas, roads, bridges, shipping lanes, dredging), recreation (tourist centres, summer cottages) and the extraction of mineral resources (oil and gas, sand) poses threats to both species and habitats. The trend today is one of increasing pressure on Swedish coastal and sea areas, and hence a growing threat to biological diversity. The combined effect of many minor encroachments can be considerable.

Shallow coastal waters (0-3 m) are very productive and of great significance as nursery grounds for invertebrates and fish, including species later to be found in deeper waters. It is therefore important to conserve shallow-water sites (e.g. sandy or muddy areas of seabed, eel-grass meadows, mussel beds) as production and nursery areas; they represent a vital natural resource. The Swedish coastal zone is also an area of conflict, however, with different interests competing over its use. The significance of small, shallow bays for marine biodiversity must therefore be borne in mind when different forms of coastal development are being considered.

[BOX:]

The objective of a 50 % reduction in *inputs of nitrogen* to the sea by 1995, compared with 1985, should be attained as soon as possible. The long-term objective as regards reducing nutrient inputs should be a further reduction no later than the early years of the next century.

[END OF BOX]

COMMENT: Eutrophication resulting from increased inputs of nutrients to Swedish sea areas in the course of this century has caused far-reaching changes in marine biodiversity, at both the species and the ecosystem level. The politically determined objective for phosphorus inputs was achieved in 1995, but the halving of nitrogen

inputs that has also been set as a goal has not yet been attained. Support must be given to action under the conventions relevant to the marine environment (HELCOM, OSPARCOM, LRTAP) to reduce inputs of nitrogen.

Intergovernmental negotiations should be held in the relevant forums on a new target year acceptable to all the countries concerned. In its directions for the use of appropriations for the present financial year, the Swedish Environmental Protection Agency has been asked to draw up proposals specifically to achieve the goal of a 50 % reduction. The Agency therefore intends to return to this objective when presenting those proposals.

[BOX:]

Inputs of *toxic pollutants* to Swedish sea areas should have decreased appreciably by the year 2000, compared with 1990. National legislation and international agreements should be made more stringent.

[END OF BOX]

COMMENT: The expression `toxic pollutants' is used here to refer primarily to toxic organic compounds and heavy metals. Despite the bans on PCBs and DDT introduced in the 1970s, the marine environment is still subject to a significant input of these substances. New compounds have been introduced, such as PBDEs as a substitute for PCBs. A significant proportion of inputs are attributable to long-range atmospheric transport, and can only be tackled through international conventions. To achieve the objective set out above, it will for example be necessary

- to appreciably reduce the use of pesticides in agriculture and forestry,
- to review the use of halogenated solvents, with a view to ensuring that only environment-friendly, rapidly degradable products are permitted,
- to cut emissions from combustion plants dramatically,
- to reduce significantly the use of chemical additives in industrial processes,
- to reduce the use of anti-fouling paints, and
- to work at the international level to reduce emissions.

In the case of many organic pollutants -- particularly those that are persistent, toxic and bioaccumulating -- the aim should be to eliminate discharges altogether. Single- and multi-species tests and model ecosystem studies have shown pollutants with such properties to be present in pulp mill effluents.

Support should be given to the work being undertaken under the relevant conventions (HELCOM, OSPARCOM, North Sea Conference and LRTAP).

[BOX:]

Concentrations of known *toxic pollutants* and unidentified halogenated compounds *in sediments* should have started to fall by the year 2000, compared with 1990.

[END OF BOX]

COMMENT: Levels of toxic pollutants and unidentified halogenated compounds are high in shallow- and deep-water benthic sediments in the Baltic, Kattegat and

Skagerrak. A large proportion of the deeper seabed of the Baltic proper has been devoid of macroscopic benthic fauna for a couple of decades. It is important to ensure that toxic pollutant concentrations are so low that they pose no risk to benthic organisms or to fish foraging on the seabed when oxygen supplies are replenished and these deeper areas can be recolonized.

[BOX:]

Discharges of toxic pollutants should continue to decrease so that bladderwrack (*Fucus vesiculosus*) communities have expanded by the year 2000, compared with their range in 1990.

[END OF BOX]

COMMENT: Chlorate discharges from the pulp industry have greatly reduced species richness by eliminating entire bladderwrack communities in the Gulf of Bothnia and the Baltic Sea proper. The pollution situation must be improved so as to allow bladderwrack to begin to recolonize sites from which it has disappeared. An increase in the range of bladderwrack has already been observed, following the elimination of chlorine gas from bleaching processes.

Discharges of organochlorines from pulp mills have also damaged benthic faunal communities and fish. The objective set regarding a reduction of the discharge of AOX by the forest products industry was achieved in 1994 (AOX = adsorbable organically bound halogens).

Single- and multi-species tests and model ecosystem experiments show that the effluents now resulting from the manufacture of bleached kraft pulp have appreciably less marked biological effects than those discharged from conventional chlorine-based bleaching processes in the 1980s. However, the effects on fish health have been alleviated far less clearly than the effects on various ecosystem parameters. In other words, clear damage to or effects on fish (rainbow trout, *Oncorhynchus mykiss*) can still be observed. Better surveys of the persistent and toxic substances involved are necessary in order to be able to predict the possible long-term effects of these discharges.

Greater use of closed cycles at bleaching plants and/or external treatment of effluents would further reduce the risk of effects in receiving waters. However, it is important to implement a well-designed and regular programme to monitor any environmental impacts for a number of years after the planned process changes have been introduced. Responsibility for reducing discharges of organic pollutants should rest with the forest products plants concerned, in collaboration with county administrative boards and municipalities.

[BOX:]

Effects of fisheries on fish populations and ecosystems: Fishing in Swedish sea areas should be carried out in such a way as not to threaten the future development of individual fish stocks. Equally, catches must not bring about changes in natural interactions between different fish species or the natural dynamics of other species which feed on fish. Bycatches of seabirds and mammals (porpoises and seals, chiefly seal pups) in fishing nets should be reduced by 80 % by the year 2000, compared

with the period 1982-88.

[END OF BOX]

COMMENT: Overfishing is one of the main reasons for the sharp fall in Baltic Sea populations of wild salmon and cod since the mid-1980s. It is suspected that the decline in cod stocks has altered the balance between different fish populations in the Baltic, and that it is a contributory factor behind the present marked dominance of herring and sprat (*Sprattus sprattus*) in the pelagic ecosystem. Demersal trawling affects large areas of the seabed, constituting a threat to both individual species and ecosystems. It is mostly carried out on soft substrates: off the west coast of Sweden, for shrimps, Norway lobster and cod; and in the Baltic Sea for cod. The effects of trawling on Swedish marine benthic ecosystems are poorly understood. However, several species of benthic invertebrates, including sea-pens and corals, are threatened by demersal trawling off the west coast. Certain types of trawling gear can cause harm to animals and plants in benthic habitats which used to be inaccessible. Mid-water trawling for herring and sprat may have an indirect impact on plankton communities by altering the size of the fish populations.

Fisheries pose a threat to species which are caught unintentionally, particularly marine mammals and birds. Mammals and birds are also drowned in lost fishing gear (`ghost fishing'). To protect marine species threatened by fishing in Swedish waters, therefore, changes in fishing methods and equipment will be necessary. To establish the exact number of deaths caused by bycatches, schemes involving independent observers on fishing boats need to be set up.

Entanglement in cod nets is the biggest threat to the porpoise in Swedish sea areas today (the species is classed as endangered in the Baltic Sea and the Sound, and as vulnerable in the Kattegat and Skagerrak). It is estimated that at least 150 porpoises drowned in fishing gear in Swedish waters every year between 1988 and 1991. The number of porpoises killed by the entire Danish North Sea fishing fleet in 1993 was an estimated 7 000. Swedish studies conducted off the west coast in 1995 suggest that 2-3 % of the porpoise population become entangled and drown in cod nets. In the Baltic, a large proportion of grey and common seal pups drown in fishing gear, but the exact figures are not known. Between 1982 and 1988, some 25 000 birds drowned in fishing nets in the south-east Kattegat, off the coast of Skåne, chiefly in conjunction with the cod fishery. It is suspected that many guillemots from the Karlsöarna islands are killed in fishing nets in the Baltic, but at present there are no figures on the numbers of seabirds suffering the same fate in other Swedish sea areas.

The fisheries sector has a particular responsibility for monitoring progress towards and achieving the objective above.

[BOX:]

Bladderwrack belts in the vicinity of pulp mills: Bladderwrack belts on shallow, rocky substrates in polluted coastal waters in the vicinity of pulp mills should have increased in density and extent by the year 2000, compared with 1992.

[END OF BOX]

COMMENT: Chlorate discharges from pulp mills have greatly reduced numbers of species by eliminating entire bladderwrack communities along the coast of Sweden, particularly in the Bothnian Sea. These species-rich ecosystems are of great importance, providing spawning, nursery and foraging grounds for many fish species in coastal waters and the open sea. Discharges of organochlorines have harmed fish populations and altered patterns of genetic variation in mussel populations.

It takes a very long time for bladderwrack to spread and re-establish itself in affected areas (around 5 years from germling to reproducing individuals), and at present it is not possible to state at precisely what rate natural recolonization can occur.

3.5.7 Objectives relating specifically to species and genetic variation

[BOX:]

Overall objective regarding the conservation of species and populations (Govt. Bill 1990/91:90: *A Living Environment*):
`Biological diversity and genetic variation should be safeguarded. Plant and animal communities should be maintained so as to enable viable populations of plant and animal species occurring naturally in Sweden to survive in natural surroundings. Viable, balanced populations of species occurring in sea areas and inland waters should be maintained.'

[END OF BOX]

This objective, or variants of it, has been adopted by the Government and Parliament in other contexts as well, for example in the most recent decision on forest policy.

Species assigned to the categories Endangered and Vulnerable in the Swedish Red Lists are judged to have such a status that their long-term survival in Sweden is not assured. They are in other words `threatened' in that sense. The overarching objective set out above must be taken to mean that, in the long term at least, we must seek to ensure that no species occurring naturally in Sweden are to be found in the Endangered or Vulnerable category as a result of anthropogenic factors. Species may, however, fall within these categories of threat as a result of natural causes and processes, such as natural climate change. At present, some 1 300 species are listed under these two headings. To achieve the overall goal stated, therefore, populations of these species must be strengthened so that they can attain such a status that they are no longer deemed to be endangered or vulnerable. This means that the species concerned must become more abundant and spread to more localities, and that the sites where they occur must be conserved. Every loss of a site constituting the habitat of an endangered or vulnerable species represents a departure from the objective.

Conservation of species' habitats

A general guiding principle is as follows: to be able to conserve both species and genetic variation, viable populations of the species concerned have to be maintained within their natural ranges. Every species and population belongs to a plant or animal community, which in turn forms part of an ecosystem. As has been pointed out before, the *habitats* of the species in question therefore have to be conserved on the

necessary scale and with an appropriate distribution. These habitats have primarily been dealt with in the ecosystem sections above. In the following, attention is focused on the *species themselves*. To begin with, we need to define two key concepts:

Naturally occurring species: Species which have established themselves in the natural environment (including the older agricultural landscape) by their own efforts; that is to say, they have not

- been deliberately introduced, directly or indirectly, by human beings,
- become established with the help of increasingly efficient man-made transport and communication systems.

The term `naturally occurring species' also includes species which *used to* have naturally established populations in the country and which have subsequently been reintroduced.

Natural range (of a species or population): Because of human impacts on the natural environment, the ranges of many species have contracted, while those of others have expanded. The present range of a species therefore cannot always be regarded as its natural range. Generally speaking, the natural range of a species should be regarded as the whole of the geographical area in which the species has occurred regularly and naturally (without active human assistance) during some period of time -- with a climate similar to that of today -- since the last glaciation. Where a species is expanding, its range is changeable, and may increase from one year to the next. When determining the natural range of a species, we should take account of the historical evidence available. Where reliable evidence of this kind does not exist, the range has to be estimated, for example on the basis of the likely distribution of the species' habitats.

Environmental quality objective

[BOX:]

Habitat diversity should be preserved at *at least* the same level, in terms of both quality and quantity, as at the beginning of the 1990s. For the most vulnerable habitats, additional active measures will be necessary.

[END OF BOX]

COMMENT: Objectives concerning the conservation of habitats are very difficult to quantify. This objective needs to be broken down for the different types of habitat (e.g. different kinds of forests, wetlands etc.) and to take account of regional conditions. Further impoverishment of habitats cannot be accepted. In many cases -- where habitat diversity has declined over a long period and considerable losses have occurred -- the situation must be improved. For further discussion, see the objectives in the ecosystem sections.

Species conservation

Environmental quality objective

[BOX:]

- Viable populations of all *non-red-listed species* occurring naturally in Sweden should be maintained in all regions falling within their natural range.

- Viable populations of *rare and care-demanding species* should be maintained at at least as many sites or in at least as many areas as at the beginning of the 1990s.

- Viable populations of *species* listed in the EC *Habitats and Birds Directives* and other *endangered and vulnerable species* should be maintained at at least as many sites or in at least as many areas as at the beginning of the 1990s, and the species concerned should in addition be enabled to spread to new sites within their natural ranges. This should be achieved on the one hand by appropriate care or management of suitable sites and by preserving or creating important habitats, and on the other hand by protecting the species from collection and persecution.

[END OF BOX]

COMMENT: Measurable goals linked to this objective, e.g. desirable population sizes and/or ranges, should be elaborated in species and habitat action programmes. Here, too, it is important to draw up objectives at the regional and local levels. It is particularly serious when commonly occurring species become uncommon. Populations, ranges etc. of common species, too, should therefore be monitored.

Action objective

[BOX:]

Red Lists should be compiled for groups of species for which such lists do not exist or are incomplete.

[END OF BOX]

COMMENT: Particularly by international standards, Sweden has devoted a great deal of effort to the preparation of Red Lists of plants and animals. However, there are still major groups, including various taxa of invertebrates and also marine animals and plants, for which lists have not yet been compiled. It is very important that the Swedish Threatened Species Unit should be able to continue its Red List work in relation to the species groups for which such lists do not yet exist.

Species of international importance

Sweden has a *special responsibility* for species which occur in Sweden and whose Swedish populations are *of international importance*. This is the case as regards species

i) where Sweden holds a significant proportion of the total global or European population,
ii) which occur in Sweden and are threatened at a global or European level, or

iii) which are endemic, i.e. only occur within a defined, limited area.

A study should be made of the need to identify and list `species of international importance'. At the same time, it should be ascertained whether the identification of such species could form part of a general system to determine priorities as regards species conservation measures.

Action objective

[BOX:]

A study should be made of the concept of `species of international importance', and of whether this concept could form a component part of a system to determine priorities. If there proves to be a need to draw up a list of Swedish species of international importance, such a list should be prepared for vascular plants, birds, mammals, reptiles and amphibians in the course of 1996.

[END OF BOX]

Genetic variation

The general guiding principle and aim as regards conserving genetic variation is that viable populations of the species concerned should be maintained throughout their natural ranges. In the case of domesticated or cultivated species, the aim should be to safeguard existing and future genetic variation in the most appropriate way possible, for example in gene banks or by entrusting relevant conservation projects to organizations. Below, we confine ourselves to an action objective of a general nature and an objective regarding fish populations (one area in which the conservation of genetic diversity is known to be a problem).

Action objective

[BOX:]

Non-native (alien) species and/or genetic material should only be permitted to be introduced in such a way that the genetic make-up of native species is not put in jeopardy and other damage to biological diversity is avoided.

[END OF BOX]

COMMENT: The introduction of alien species and genetic material is a problem area in its own right. To achieve the objective above, data on which to base risk assessments etc. need to be available (in order to apply the precautionary principle). A separate objective concerning the introduction and spread of marine species and genes is set out in the section on the marine environment.

[BOX:]

Genetic variation in natural populations of fish: When fish are bred for stocking of Swedish sea areas (e.g. compensatory rearing of Baltic salmon), the genetic composition of the wild population should be safeguarded. Scientific criteria should be applied in this connection, including the genetic background of the hatchery and wild populations, and the absolute and effective sizes of these populations.

When fish are bred for conservation purposes, scientifically accepted criteria should be applied; among other things, account should be taken of the selectivity of the breeding programme, and of the effective population size.

[END OF BOX]

COMMENT: In Sweden, salmon, brown trout and cod are reared to stock sea areas, chiefly in the Baltic. The salmon of the Baltic are genetically distinct from other populations of the same species in Europe, and within the Baltic there are also genetic differences between populations from different rivers and even different parts of the same river. Hydroelectric schemes built during the 20th century on rivers flowing into the Baltic have reduced the number of rivers in which salmon spawn from around 60 to 20. A large proportion of the genetic variability of salmon has consequently been lost. Compensatory rearing of Baltic salmon, which has been undertaken on a large scale since the 1950s, has further reduced the species' genetic diversity within the farmed populations.

Where fish are reared to strengthen natural populations (supportive breeding), it is especially important that this is not carried out in such a way as to endanger the genetic integrity of the natural population. Baltic salmon are a case in point; wild fish make up just 5-10 % of the species' marine populations. In the present serious situation, the fisheries sector has a special responsibility to monitor and ensure progress towards this objective.

Hunting

Environmental quality objective

[BOX:]

Hunting is permissible in Sweden if it is justified either from the viewpoint of utility or from the viewpoint of preventing damage, and if it is undertaken in such a way that biological diversity is maintained and promoted.

[END OF BOX]

COMMENT: `Justified from the viewpoint of utility' means that the flesh or skin of the animal hunted is used. `Justified from the viewpoint of preventing damage' means that hunting prevents either (a) damage to biodiversity resulting from excessively large populations or caused by introduced non-native species or genetic material, or (b) unacceptable damage to a human activity, such as transport or forestry.

Examples from the regional and municipal levels

Draft nature conservation programme, municipality of Karlstad:

* Plant and animal species should be conserved so as to ensure that viable, balanced populations of all plant and animal species occurring naturally in the municipality, both on land and in water, are able to survive in natural surroundings.

* A rich and varied flora and fauna should be maintained in the municipality. The municipality's plant and animal life should not be impoverished as a result of local extinctions of species. Species threatened at the national and local levels should be protected and enabled to maintain or increase their numbers (more individuals on more sites), compared with the situation in 1994. In the long term, no species occurring naturally in the municipality should be threatened by human activities. No alien species should be introduced or released into the natural environment.

* The long-term survival of threatened species occurring in the municipality should be assured no later than the year 2010. The municipality of Karlstad has a special responsibility for the following 37 species: ... (see the municipality's nature conservation programme).

3.5.8 Other objectives relating to pollution and biological diversity

This section sets out objectives relating to pollutant loads and reductions not dealt with in earlier sections. In principle, most pollutants can in the long term have a detrimental impact on biodiversity. The objectives below concern *those pollutants that are judged to have the biggest adverse effects* on biological diversity in Sweden.

Load objectives

Existing load objectives regarding atmospheric deposition of sulphur and nitrogen do not need to be changed at present.

[BOX:]

Load objectives for nitrogen:
Atmospheric deposition of nitrogen should not exceed the following critical loads:

Northern Sweden (Norrland) 300 kg/km^2 yr
Central Sweden (Svealand) 400 kg/km^2 yr
Southern Sweden (Götaland) 500 kg/km^2 yr

[END OF BOX]

COMMENT: These load objectives are geared in particular to preventing eutrophication, but are also relevant to acidification and ground-level ozone. They have been set primarily with a view to maintaining long-term sustainable forestry, but they are also sufficiently stringent to conserve the biodiversity of most Swedish ecosystems. Possible exceptions are certain forest sites not managed for timber production and certain mountain heaths with thin soils. No date has been set for achieving these objectives, chiefly because (in most areas of Sweden) 60-90 % of atmospheric deposition of nitrogen originates in other countries.

The assessment criteria currently being drawn up regarding the eutrophication of Swedish coastal waters may result in new load objectives for nitrogen and phosphorus with respect to coastal waters. Those objectives may cover emissions to water as well as air. They are being elaborated as part of a Government-commissioned study, and will be presented in the course of 1996.

[BOX:]

Load objectives for sulphur oxides:
Atmospheric deposition of sulphur should not exceed the following critical loads:

Northern Sweden (Norrland) 250 kg/km^2 yr
Central Sweden (Svealand) 250 kg/km^2 yr
Southern Sweden (Götaland) 300 kg/km^2 yr

[END OF BOX]

COMMENT: These load objectives are geared to preventing acidification and are well in line with the overall goal of conserving biodiversity in Sweden. However, they have been set primarily from the viewpoint of maintaining long-term sustainable forestry and conserving the natural flora and fauna of surface waters. No date has been set for achieving the objectives, primarily because (in most areas of Sweden) 70-95 % of atmospheric sulphur deposition originates in other countries.

Action objectives

The majority of action objectives concerning atmospheric emissions which were presented in *Strategy for Sustainable Development* are by and large still relevant. To conserve biodiversity, however, it is important to set more stringent objectives for nitrogen oxides and ammonia. There is also a good basis for introducing a more stringent objective regarding atmospheric emissions of sulphur oxides. Politically determined objectives for nitrogen oxides, ammonia and sulphur oxides were set out in Government Bill 1990/91:90:

[BOX:]

Substance	Existing goal	Outcome
· Nitrogen oxides	-30 %, 1980-95	-14 %, 1980-94
· Ammonia	-25 %, 1980-95	+6 %, 1980-94
· Sulphur oxides	-80 %, 1980-2000	-81 %, 1980-94

[END OF BOX]

Proposals for more stringent action objectives relating to nitrogen oxides, ammonia and sulphur oxides are discussed below.

Nitrogen oxides, sulphur oxides and ammonia

The Environmental Protection Agency intends to propose action objectives

concerning reductions of atmospheric emissions of nitrogen oxides and ammonia over the period 1990-2000. These proposals are expected to be submitted to the Government in January 1996 as part of a package of further measures, requested by the Government, to reduce emissions of nitrogen oxides and volatile organic compounds in all sectors.

Under the UN ECE Convention on Long-Range Transboundary Air Pollution (LRTAP), work has recently started on an international protocol to reduce atmospheric emissions, particularly of nitrogen oxides, in Europe and North America, the aim being to elaborate the protocol within the next few years. An abatement of atmospheric emissions of ammonia is also on the agenda, at least at the present time. A protocol on sulphur oxides already exists. The existing Swedish action objective for nitrogen oxides covers the period 1980-95. This goal, i.e. a 30 % reduction of emissions by 1995, will not be attained. Between 1980 and 1994, emissions were reduced by only 14 %, and the reduction achieved by the end of 1995 is likely to be no more than 15-20 %.

Sweden has undertaken to reduce sulphur emissions by 80 % between 1980 and 2000, in line with earlier policy decisions. By 1994, Swedish emissions of sulphur had already been cut by 81 % from the 1980 baseline. Since this is not enough to solve the problem of acidification, there is cause to propose a further reduction of Swedish emissions up to the years 2000 and 2005 (it should be noted that several other European countries have presented proposals with a target date of 2005).

The present Swedish action objective for ammonia covers the period 1980-95. This objective, i.e. a 25 % reduction of emissions by 1995, will not be achieved. Between 1980 and 1994, emissions increased by about 6 %.

CHAPTER 4

4. Assessment of the sectoral agencies' action plans

In the process of drawing up its own plan of action, the Environmental Protection Agency was asked by the Government to undertake `an overall assessment of the sectoral action plans'. This assessment was to take into account the relationship between existing objectives and the state of the natural environment from the viewpoint of biological diversity. The Agency's plan was also to include an integrated assessment of the action required across the area of biodiversity as a whole. This aspect of the Environmental Protection Agency's assignment may be seen in the light of its responsibility, as the national environmental authority, for monitoring and evaluating activities in the different sectors of society.

Basis for the assessment

The general principles that were to guide the assessment were set out in the terms of reference for the Agency's action plan (which refer to the *Strategy for Biological Diversity*, see section 1.3) and for the plans to be prepared by the sectoral authorities. The broader framework consisted of the environmental objectives laid down at the political level and the overall assessment of the problems involved set out in the country study. On this basis, the Environmental Protection Agency has attempted to make an overall analysis and assessment of the action needed to achieve and maintain the objectives set. Will the proposed measures be sufficient? Which are the most pressing problems? In this context, valuable basic data have been provided by the Swedish Threatened Species Unit's analysis of the action needed to safeguard red-listed species.

4.1 General comments on the sectoral plans

The long-term maintenance of biodiversity is dependent on both conservation measures and action to ensure that biological resources are used in such a way as not to deplete biodiversity in the long term (sustainable use). The principal role of the sectoral authorities -- and the sectors which they cover -- is to develop and gain acceptance for sustainable methods of use.

The Convention gives a clear definition of `sustainable use', and hence of the requirements flowing from it (see Annex 1). An important task to be addressed in many sectors -- particularly those involving economic activities -- is the *development of criteria to define sustainable use* (primarily from the point of view of biodiversity). In addition, the sectoral authorities, alongside the sectors themselves, have a special responsibility to try to outline the *future shape of sustainable agriculture, fisheries etc.* Much more work needs to be done in this area. The National Board of Forestry, in its action plan, has made most progress in this direction.

An area of common concern is the elaboration and *adoption of measurable objectives*. Sectoral agencies must ensure that goals relating to change and implementation within their sectors are formulated in terms which allow progress towards them to be monitored.

4.2 The Board of Agriculture's action plan

The terms of reference for the action plan to be drawn up by the Swedish Board of Agriculture stated that it was to concentrate on the measures needed in the agricultural, horticultural and reindeer-herding sectors to achieve the environmental objectives that have been laid down. The basic aim was to be to `seek to ensure that activities in these sectors are made ecologically more sustainable'.

The Board of Agriculture's action plan places the main emphasis on unimproved grasslands and small-scale habitats, which make up a few per cent of the total area of farmland in Sweden. Reindeer herding is also dealt with.

The plan offers a good description of the biodiversity of the farmed landscape, and a good overview of how agricultural use of the countryside has affected biological diversity. It clearly elucidates the *dynamic* nature of the landscape, and how the *prior conditions for biodiversity have changed* -- in many cases dramatically -- over the last hundred years or so. The plan notes that `many of the basic factors on which the biological diversity of the agricultural landscape depends have disappeared or declined'. It also points out that these changes will continue and, what is more, that the changes that have already taken place have not yet made themselves fully felt. The threats described include phenomena such as *inadequate numbers of grazing livestock or agricultural enterprises* in certain areas, *structural changes* in milk production, and *atmospheric pollution*.

It would be useful if *this analysis could be pursued further* and *conclusions could be drawn as to what action needs to be taken in the agricultural sector* -- in certain cases, at the policy level -- to halt a trend that could crucially undermine the basis for maintaining biodiversity in the agricultural landscape. In addition to the phenomena mentioned above, factors of importance include the general feasibility of farming in forested and mixed forest/farmland regions, milk quota allocations (and the principles underlying them), the age structure of the farming community and (neglected) investment needs.

Another fundamental question to be addressed by the agricultural sector is: *What does sustainable agriculture entail* (`sustainable' with particular regard to the long-term maintenance of biodiversity)? What shape will sustainable agriculture assume in the future? What conditions must be met to develop agriculture along such lines? A great deal of work still needs to be done in the agricultural sector on these questions, not least in terms of research and data collection.

The introductory section of the Board of Agriculture's action plan makes it clear that the plan does not look in any detail at areas that are already or are expected to be the subject of separate inquiries or studies. Consequently, a number of major agricultural factors with an impact on biodiversity are not dealt with, in particular pesticide use, plant nutrient leaching and ammonia emissions. The country study stresses that these are factors with significant adverse consequences for diversity. What is more, their effects are not confined to the agricultural landscape, since they also have an impact on adjoining ecosystems (lakes, rivers and the sea).

As was mentioned above, the Board has chosen to focus in its action plan on unimproved grasslands and small-scale habitats. By omitting any discussion of pesticide use, nitrate leaching and ammonia emissions, *the plan fails to provide a complete picture of what needs to be done in this sector* over the next few years. It would have been useful if the plan had at least included a summary of the present situation and the action that needs to be taken over the next few years in these problem areas.

Valuable aspects of the plan

The action plan includes many proposals which the Environmental Protection Agency supports. Several of the objectives and measures suggested are in line with the Agency's own plan. Points which the Agency welcomes include the following:

-- The plan draws attention to the need to investigate the value of *improved pasture-land* in terms of biodiversity.

-- It refers to a number of important projects, such as those on *animal growth and economics* and *avermectin preparations.* The projects `Animal growth and economics' and `Economic feasibility of quality-oriented landscape conservation' will be completed early on in the period primarily covered by the plan (1996-98). In view of this, a preliminary outline of the additional steps likely to be taken on the basis of these projects would be useful. As regards avermectins, the Environmental Protection Agency agrees with the proposals for mandatory documentation of the environmental effects of medical products and concerning the application of the substitution principle.

-- The plan underlines the importance of using the results of the Key Habitats Survey concerning *forest pastures*. Remaining forest pastures may be mentioned as one area for which the Environmental Protection Agency, the Board of Agriculture and the Board of Forestry should continue to share responsibility.

Areas requiring further attention

There are a number of areas in which further discussion and additional proposals would be of value. These include:

-- Views of and potential problems associated with *greater use of genetically modified organisms (GMOs)* in agriculture. Both the Board of Agriculture and the Environmental Protection Agency and other bodies are currently developing policies on this issue. One area of concern is the danger that increased use of genetically modified crops with herbicide resistance could result in an increase in herbicide use.

-- *Monitoring of the sector's own activities:* Every sector and every enterprise etc. within it has a responsibility to monitor its own actions. In the case of the agricultural landscape, monitoring of individual sites covered by the Agri-Environment Programme is very important.

-- The plan deals with the question of *recreating/restoring habitats*. It is important to underline, as the Board of Agriculture does, that the *primary* approach must be to continue to manage and preserve remaining sites of habitat interest. As far as restoring and reinstating habitats is concerned, it is important now to draw up and carry out operational programmes and projects.

-- One of the proposals in the plan is that principles should be elaborated concerning *active reintroduction of species* and measures to strengthen weak populations. The plan rightly stresses that, where reintroduction is being considered, it is essential that there is evidence of the species having occurred on the site previously and that seed/plant material is available in the

same village or district. Nevertheless, the Environmental Protection Agency is somewhat hesitant about species reintroductions, on the grounds that it is questionable whether they are a cost-effective measure, other than in very special circumstances. In some cases, active reintroduction can be regarded as an attempt to manipulate habitats so as to maximize the number of species. The Agency wishes to emphasize that the vital thing is to *conserve habitats* of significance for biodiversity. In the agricultural landscape -- as the Board of Agriculture indeed observes -- the main concern must therefore generally be to maintain appropriate patterns of management.

-- The Convention on Biological Diversity takes an integrated approach to all aspects of biodiversity. Domesticated and cultivated components of diversity, above all *plant genetic and other agricultural genetic resources*, are of great importance in terms of both conservation and use. The plan includes a number of brief proposals relating to *domesticated and cultivated biodiversity*. In parallel with its work on the action plan, the Board of Agriculture was also commissioned to draw up conservation plans for landraces (local breeds and varieties). These plans will be presented separately. A summarized account of the measures proposed concerning landraces, and other proposals relating to this aspect of diversity, would be useful.

In that context, an account of the Board of Agriculture's views on the potential problems arising from EU regulations on the marketing of seed varieties (EU common catalogue of varieties), and of any action it considers necessary, would be of interest. There have been fears that these regulations could lead to fewer varieties being grown, as a result of a dwindling range of varieties on sale. Here, the Environmental Protection Agency would draw attention to the inquiries recently conducted in Sweden in the area of agrobiodiversity.

The Agency endorses the overall environmental objective proposed for the *reindeer-herding sector.* As regards the goal which states that reindeer pasture areas should be grazed by domesticated reindeer, it wishes to point out that there is also a need for *reference areas* for research and environmental monitoring, and that care should be taken to ensure that this objective does not conflict with meeting that need. Under the threats heading, the plan notes that the international border between Norway and Sweden makes it more difficult to ensure that reindeer grazing is ecologically sustainable. However, no measures to tackle this problem are suggested.

4.3 The Board of Forestry's action plan

The Environmental Protection Agency agrees with the analysis and descriptions set out in the background and strategy sections of the action plan presented by the National Board of Forestry. The two authorities are largely in agreement on the nature of the problems involved, but may have differing views on what measurable objectives should be set and what instruments are needed to solve the problems. The Agency supports the Board of Forestry's strategy to promote the development of forestry towards future sustainability. This strategy attaches equal weight to forestry methods which take greater account of nature conservation, on the one hand, and the establishment of reserves, on the other. Certain additional elements and more in-depth analysis of a number of topics would make this a more complete document.

The Agency commends the following aspects of the plan:

-- It emphasizes that a fundamental factor in the conservation of biological diversity is the methods by which its components are used (and the principles underlying them).

-- It recognizes the importance of environmental objectives expressed in such a way that progress towards achieving them can be monitored (i.e. objectives which are defined in time and space). The Environmental Protection Agency endorses the approach presented by the Board of Forestry. Efforts to develop monitorable objectives and strategies must be stepped up, and they must be made at the local and regional as well as the central level. At the county level, close collaboration between county administrative boards and county forestry boards is very important.

-- The plan proposes a study of the effects of lower final-felling ages and changes in the rules limiting the areas that can be felled. This study should begin as soon as possible.

-- It highlights the need for further collection of data concerning the effects of different forestry methods on biodiversity. However, greater knowledge alone is not enough; it is also important to make sure that modified (new) methods are *widely introduced at a practical level* in the forestry sector.

-- Attention is drawn to the significance for biodiversity of forest land classed as `unproductive' (i.e. yielding less than 1 m^3 of timber per hectare per year). In this connection, it may be necessary to distinguish between different types of unproductive forest land and possibly to use different forms or degrees of protection in different parts of the country.

A key question to be addressed is *how* forestry methods should be changed, particularly as regards certain types of forest. *What instruments need to be used to ensure that the necessary measures are implemented?* Two important components of Sweden's new forest policy are deregulation and voluntary nature conservation measures, and the emphasis is therefore naturally on policy instruments such as advice, information and training. The crucial question is whether such devices will be sufficient to achieve the aims and implement the proposals set out in the action plan. The plan points out that, to a large extent, protection of habitats requiring special attention is dependent on forest owners voluntarily refraining from or adapting silvicultural measures. It is not entirely clear at present to what extent forest owners (corporate or individual) can be expected to take the necessary care, employ new/alternative methods etc.

It has to be asked whether, alongside information, training and advice, there may not in some cases be a need for legal and/or economic instruments. Such instruments may be needed to promote, for example,

-- the adjustment and development of silvicultural systems (including adjustment to take account of natural forest dynamics),
-- the adjustment of felling methods (to avoid felling of entire stands) in spruce forests that are little disturbed by fires,
-- priority for deciduous trees in the afforestation of arable land,
-- the maintenance of tree cover in habitats where the tree layer exhibits long continuity, and
-- the retention of deciduous stands created by past forest fires, until other, similar sites in the vicinity are able to take over their ecological functions.

Further economic incentives could be considered, to help ensure that the practices

outlined above are introduced on a large scale.

An important general question is how financial responsibility should be apportioned between the forestry sector and the state. It is necessary to draw up *estimates of the costs* involved and to decide *who pays for what*. Under existing environmental policy, the basic principle is that the sector concerned must itself bear the cost of the adjustments needed to maintain biodiversity.

The Environmental Protection Agency supports the Board of Forestry's proposal for a study of appropriate arrangements for documenting the *provenance of plants and seeds.* It would be of value if this inquiry were to result in the near future in tangible documentation requirements (to be met by the forestry sector), accompanied by a duty to report on this documentation. Such a system is essential if the genetic variability of forest trees is to be preserved.

In many forest areas, *restoration measures* are needed. What should be the responsibility of the industry itself, and what should be done by the forestry authorities etc.? Restoration is touched on in various sections of the action plan. An overall analysis of responsibilities, levels of aspiration etc. may also be necessary here.

Sections and lines of reasoning which need to be developed

-- *What does sustainable use, primarily from the viewpoint of biodiversity, entail* for the Swedish forestry sector? The action plan does examine the question of sustainable forestry, but does so with an emphasis on production (growth, removals, standing volume etc.). Given the basic principles intended to guide the preparation of the action plan (primarily the Convention on Biological Diversity), further consideration should be given to the concept of sustainable forestry (in the sense of forestry which will not lead to a long-term decline of biodiversity). It is also of interest here to analyse in greater depth whether the production and environmental objectives of forestry can be met in full with the resources and instruments available, or whether there is an in-built *conflict of objectives* and/or a need to change the basic framework of regulations/instruments/resource allocation. The estimates relating to habitat protection measures which the Board of Forestry presents are interesting and a step in the right direction.

-- *Objectives should be expressed in terms which as far as possible enable progress towards achieving them to be monitored.* In this respect, as the action plan points out, there are a number of basic difficulties, particularly as regards action objectives. The following are a few *examples* of action objectives which could be formulated in monitorable terms (more specifically, quantified and given a defined time-scale):
* an increase in the quantity of old, coarse-stemmed trees,
* an increase in the quantity of dead wood, and
* an increase in the deciduous element in coniferous stands.
One option here is to define interim objectives (e.g. what level should be achieved by the year 2005, as an average for the whole of Sweden). Further efforts to elaborate measurable objectives for the forest landscape will be made on a collaborative basis by the Environmental Protection Agency and the Board of Forestry, with the involvement of the forestry sector and researchers, among others.

-- One fundamental question is whether the existing rules on attention to nature conservation and habitat protection are sufficient to maintain the habitats of red-listed species. It needs to be stressed that we know very little about the habitat requirements of red-listed species and about the reasons why they are threatened. Despite our limited knowledge in this area, an analysis of the *habitat requirements of different species (red-listed and others)*, i.e. the conditions that mu st exist if viable populations are to survive within their natural ranges, should form the basis for the action to be taken. Such an analysis could proceed from existing forestry methods and regulations and the conditions and constraints which they create. The plan enumerates the red-listed species to be found in forests. It would have been interesting if this account of the present situation had been linked to the thinking behind the measures proposed.

-- The aim of *`avoiding or reducing damage to sites supporting red-listed species'* is crucial and needs to be more precisely defined. It should be made clear that `damage' has to be defined on the basis of species' habitat needs, in other words, a given intervention must not be undertaken if it could impair the prospects of the species or population(s) concerned surviving in at least the same numbers on the site in question (an application of the precautionary principle). Buffer zones are important in this context. Further data needs to be gathered on the habitat requirements of individual species and how they respond to different types of impact/intervention. One important source of basic data will be the Key Habitats Survey (reflecting a habitat-oriented approach). Meanwhile, the precautionary principle should be applied.

-- Under the new forest policy, forest owners are required, when notifying the authorities of their felling plans, to *give details of the nature conservation measures they intend to undertake.* Proposals for specific measures to develop this instrument so as to avoid damage to sites supporting threatened species would be of interest. As part of this procedure, owners could be required to inventory and document the species and habitats present on the site, before they are given the go-ahead to begin felling operations. Despite a major commitment to survey work in recent years, there is a clear risk of habitats and sites of value to red-listed species disappearing, simply because we are unaware of their existence. It would also be of interest to examine what impact the new reporting requirement has had and could have on overall nature conservation efforts in forest areas. Do owners supply sufficient information? Does the system work in practice? Reporting of nature conservation measures should be one of the subjects covered in the first stage of the evaluation of the new forest policy, which is intended to be completed in 1997 (see proposals in Board of Forestry's action plan).

Conclusions concerning the forest landscape

The new forest policy incorporates ambitious aims regarding the environment, and especially concerning biological diversity. Forests cover a very large proportion of Sweden's land surface. At the same time, we know that many forest-dwelling species are red-listed and that the basic conditions for biodiversity have deteriorated dramatically in the last roughly one hundred years.

The main concern as regards forest biodiversity is to retain natural forests and to prevent impoverishment of the structure and functions of natural fore sts in the managed forest landscape. Virtually all the general and more detailed evidence

available to us concerning forest ecosystems, valuable forest habitats and the requirements of forest-inhabiting species indicates that this is the case. And the great majority of the measures implemented to stem the impoverishment of the forest landscape are indeed geared to promoting the structure and functions of natural forests. This is the case not only in Sweden, but also in the rest of the Nordic region and most other countries with temperate forests.

As forests continue to be managed for timber production, further areas of natural forest will be converted into forests created or at least shaped by man. New approaches will probably result in numerous smaller areas of natural forest being saved as `special care' sites and in certain structural elements of natural forests being preserved by detailed attention to conservation needs in conjunction with felling. In the long term, 50-100 years, it is also possible that the human-managed forests of today will assume greater biological interest, as a result of new approaches in forestry, including greater attention to individual site conditions, alternative methods, and conscious attempts to incorporate features otherwise found in natural forests. However, such measures will not eliminate the need to establish reserves, where nature conservation is the paramount interest and preservation of the site is guaranteed in perpetuity.

There is a risk that the remaining areas of natural forest could become even more fragmented. The forest landscape of tomorrow may consist of productively managed forests which are biologically richer than the monocultures of today, together with thousands of small areas of habitat interest, conserved by landowners themselves or under the habitat protection provisions of the Nature Conservation Act. More extensive natural forest ecosystems will mainly survive in reserves.

An important question is whether the equation between objectives set, existing instruments to implement them and available resources will balance. The ecological requirements of species and populations are one basic factor. Another is the rules on compensation and their application, and the resources available to make payments where landowners wish to receive the compensation they are entitled to. Few individual or corporate forest owners are likely to forgo payments to which they are entitled under existing regulations. An assessment based on the objectives set suggests that the funds available are far from sufficient to meet the needs that have been identified.

The Board of Forestry has estimated what it will cost to implement the habitat protection scheme on forest land. To this, we must add the compensation that will need to be paid to establish reserves on forest land whose conservation interest is incompatible with commercially viable forestry. Existing knowledge about the habitat needs of red-listed species suggests that the survival of quite a number of species, at least, will depend on restrictions on forestry going beyond what can be demanded on the basis of normal rules on nature conservation measures or habitat protection. For example, within the project to save the white-backed woodpecker (*Dendrocopos leucotos*), it has been estimated that it would cost at least SEK 100 million to maintain a viable population of this species in Sweden. This estimate was based on the area of forest from which forestry would have to be banished in order to ensure that the remaining individuals had a chance of surviving and reproducing.

To meet the objectives that have been set, the following action is called for:

- Further changes in forestry methods in Sweden, giving equal weight to environmental and production considerations. New methods, better geared to nature conservation, need to become more widespread and rapid

improvements need to be achieved regarding `limiting factors', such as fire disturbance, dead wood, old and large-diameter trees, and different types of natural forest. This process of change is already in progress, having begun a few years ago.

· Greater financial resources need to be allocated to safeguarding valuable forest sites (sites where basically no form of forestry can be allowed if they are to retain their biological interest). This is an urgent need, given the number of sites in danger of being lost over the next few years.

4.4 The Board of Fisheries' action plan

The environmental quality objectives set by the National Board of Fisheries for lakes, rivers and streams and for coastal and offshore waters tally closely with the Environmental Protection Agency's objectives. The two authorities take a largely similar view of the environmental quality objectives laid down for the aquatic environment and fish populations. According to its standing orders, the Board of Fisheries has the role of promoting the responsible management of fish resources, with a view to contributing in the long term to the country's food supply and overall prosperity. Under its sectoral responsibility for the environment, and in consultation with the environmental authorities, the Board is also to promote biological diversity and hence rich and varied populations of fish. This is clearly reflected in the environmental quality objectives laid down by the Board.

The strategies presented by the Board of Fisheries under the `action objectives and action plan' headings for fresh waters, coastal waters, offshore waters and salmon (*Salmo salar*) are basically in agreement with the Environmental Protection Agency's strategy.

The Agency welcomes the following aspects of the plan:

-- Surveys are to be carried out as a basis for the necessary action plans.

-- Efforts to restore disturbed areas will continue in collaboration with the Environmental Protection Agency. The two agencies are already involved in wide-ranging cooperation and in several joint projects. It may be justifiable to step up this cooperation.

-- Action programmes for individual fish species are to be drawn up and implemented. At the present time, the Board of Fisheries and the Environmental Protection Agency are jointly elaborating action programmes for wels (*Silurus glanis*) and noble crayfish (*Astacus astacus*) and, to a more limited extent, Baltic salmon. Similar programmes are to be drawn up for further species. These programmes should be based on the surveys that are planned. Where the need for an action plan is clear, as in the case of spring-spawning vendace (*Coregonus trybomi*), such a plan should be implemented immediately, without awaiting the results of a survey.

-- The Water Act and the Ordinance on Fishing, Aquaculture and the Fishing Industry are to be reviewed. It is important in this connection to emphasize, as the Board of Fisheries does, that special account needs to be taken of impacts on biodiversity, and that restorative measures, such as enhancing spawning and nursery areas for wild fish, should be given priority over stocking of

farmed fish. This should be taken into account in physical planning.

-- Wherever possible, water rights judgments are to be reviewed, to ensure that biodiversity is accorded far greater protection than has been the case up to now.

-- Vigorous action will be taken to achieve further reductions of discharges of acidifying, eutrophicating and toxic substances, bringing them down to levels which do not affect fish and the organisms on which they feed. It is important that the Environmental Protection Agency and the Board of Fisheries continue to work together to ensure that liming is maintained on a sufficient scale to avert any threat to Sweden's freshwater flora and fauna.

-- Steps are to be taken to improve the habitats of fish, shellfish and the organisms on which they feed -- e.g. man-made blocks to migration will be removed on rivers that could be used by species at some stage in their life cycle.

-- Selective methods of fishing are to be developed and introduced. Equipment and methods should be designed to ensure that only target species are caught and that bycatches of other organisms, such as birds, mammals, other fish species and invertebrates, are minimized. The Board of Fisheries and the Environmental Protection Agency are currently involved in joint projects relating to seals and fish, protection of porpoises in connection with fishing, and a study of bycatches. The latter project is intended, among other things, to provide basic data for an action plan to protect marine fish species.

-- Action will be taken to reduce the problem of `lost' fishing gear (`ghost fishing').

-- An action plan to conserve naturally reproducing salmon populations is to be implemented. This plan should cover the Baltic Sea, Lake Vänern and the west coast area. It should be designed as a coherent project to preserve wild salmon populations, but should also seek to utilize the full reproductive potential of salmon rivers and rivers which can be restored so that they once again support salmon. This project should naturally include an international dimension, and should be run as a joint venture between the Board of Fisheries and the Environmental Protection Agency.

-- Should a fisheries conservation levy be introduced, part of the revenue from it will be used to finance action to maintain biodiversity.

Sections and proposals which need to be developed

Closer attention should be paid to proposals to avoid any adverse effects of recreational fisheries. Since it is pointed out that it has not been possible in the framework of the Board of Fisheries' action plan to quantify the environmental problems associated with recreational boating and fishing (pollutant emissions to air and water, litter, disturbance of soil, benthic substrates, flora and fauna, etc.), proposals to quantify these problems should be included among the measures suggested. The Board of Fisheries should in addition elaborate tangible proposals to reduce the amount of lead introduced into the environment by anglers. One possibility is for the Board to become involved in the cooperation already existing between the Swedish Anglers' Association and the National Chemicals Inspectorate,

which has the aim of reducing the use of lead sinkers in sport and recreational fishing.

Measures to reduce the environmental impacts of aquaculture need to be further developed. Aquaculture has several significant effects on biodiversity, e.g. the ecological effects of deliberately stocked and escaped organisms, the spread of parasites and diseases, effects on the genetic make-up of farmed organisms, the effects of supportive breeding on the genetic composition of natural populations, the effects of genetically modified organisms, the effects of nutrient discharges from feed, and the effects of the use of antibiotics and toxic anti-fouling agents. Alongside the other authorities concerned, the industry and interest organizations, the Board of Fisheries has an important part to play in creating greater awareness of existing guidelines on translocation and stocking of organisms used in aquaculture.

The plan presents action objectives and plans for fresh waters, coastal waters, offshore waters and salmon. Many of the excellent proposals reappear in a similar form in the different sections. Closer interaction between these different spheres of concern would probably enable the action plans to be more efficiently implemented, as well as optimizing the various measures undertaken.

4.5 The Board of Housing, Building and Planning's action plan

The action plan drawn up by the National Board of Housing, Building and Planning consists of measures to conserve biological diversity in the built environment. Its assessment of the importance of green spaces and natural countryside in and around urban areas is shared by the Environmental Protection Agency. The main significance of biodiversity in the urban context is that it offers urban dwellers opportunities for contact with nature, recreation etc. The Agency is keen to underscore that this outlook should form the basis for conserving biodiversity in the built environment.

The elaboration of objectives (where possible, measurable objectives) for biodiversity in the built environment is an important area for further collaboration between the two authorities.

The Environmental Protection Agency welcomes the following points in the plan:

-- It emphasizes the need for greater ecological expertise within municipal authorities.

-- It proposes that authorities in the transport sector (e.g. the National Maritime Administration, the National Road Administration and the National Rail Administration) should be even more fully involved in activities to promote biodiversity. This view accords with one of the measures proposed in the Environmental Protection Agency's plan.

-- The importance of further data collection is underlined, e.g. concerning the consequences of the barrier effects of roads and railways, and methods of greenspace management in urban areas.

-- The plan highlights the need for better data on which to base planning and nature conservation activities (e.g. in its proposals on greenspace programmes, vegetation-based planning maps and municipal nature data

banks).

Comments on the action proposed

Although many of the measures proposed in this plan are of a more general character, they do establish guiding principles for biodiversity conservation in the built environment. The Environmental Protection Agency supports these proposals, and considers that some of them could usefully be developed further.

The Board of Housing, Building and Planning proposes that the conservation of biodiversity should be identified in the Natural Resources Act as a specific public interest. The Environmental Protection Agency agrees that it is important to emphasize in the Act, and in the forthcoming Environmental Code (which will draw together all the main legislation on the environment), that biodiversity is a key concept. However, several chapters of the Natural Resources Act have a bearing on biodiversity, and the Agency therefore suggests that attention should be drawn to biological diversity in the opening section (Ch. 1, Sect. 1) of that Act and in the general provisions on due care that are to be included in the Environmental Code.

The Environmental Protection Agency wishes to emphasize the strategic importance of structure plans (master plans) in the conservation of biodiversity. The proposal on greenspace programmes as part of the input into structure plans is important. These programmes should describe the existing structure of green spaces and identify critical zones/points. Structure plans should then describe what the municipality intends to do to safeguard the green structure of the area.

An important instrument in municipal efforts to conserve the biodiversity of the built environment is the local plan provided for in the Planning and Building Act. However, no explanation is offered in the Board's action plan as to why it is so difficult for `green' interests to assert themselves in the planning process, especially in larger towns. An analysis of the manner in which large towns have developed reveals that their network of green spaces has constantly been eroded and fragmented and its value undermined. It should be possible under the provisions of the Planning and Building Act to create instruments to safeguard the green spaces of built-up areas.

The Act's provisions on local plans should make it clear that the latter can also be used to reserve sites as green spaces or `green structure' in a broad sense. In towns and other settled areas, and in their vicinity, it should be just as natural to set aside land for these purposes as it is to reserve it for housing, factories, offices or infrastructure. In view of this, amendments to Ch. 5 of the Act should be considered. The Environmental Protection Agency will follow with particular interest the guidelines on local plans currently being drawn up by the Board of Housing, Building and Planning, which are intended *inter alia* to examine the link between local plans, structure plans and greenspace programmes.

The greenspace structure of an area -- and hence the conservation of its biodiversity -- is often an issue on which several neighbouring municipalities need to cooperate. In this context it is important to further develop planning at a level cutting across municipal boundaries. Where regional plans are drawn up, they should address issues relating to green spaces.

The proposal on `compensatory habitats' is interesting and should be looked into in greater depth. There is some common ground here with the discussion presented in

the Environmental Protection Agency's action plan. It must be stressed, however, that compensatory action has to be regarded as a last resort, to be turned to only after the precautionary principle and the principles of prevention and relocation have been scrupulously applied. It is often debatable whether it is really possible to compensate successfully for a loss of biodiversity (e.g. by recreating old or establishing new habitats). A compensatory approach must not result in less stringent demands being applied when the permissibility of projects is examined, or in more harmful locations being accepted.

The idea of seeking to internalize the environmental costs of different development projects is a good one, in principle. However, the issues involved are extremely complex and require further investigation.

Information and training on the management of urban green spaces is important. Urban biodiversity is characteristically associated with man-made environments (buildings, parks, verges etc.). To maintain diversity, there is often a need for specialist knowledge concerning the different methods of management that need to be applied in different contexts. Here, the Board of Housing, Building and Planning, the Swedish University of Agricultural Sciences and other bodies have an important part to play.

CHAPTER 5

5. Action proposed

Introduction

The Environmental Protection Agency has chosen to focus in its action plan on a *limited set of proposals* relating to the various areas or dimensions of biological diversity. It is *not*, in other words, an *exhaustive* programme of action. However, the Agency feels that the plan will be all the more effective for being confined to the measures judged to be most urgently required. It nevertheless includes a relatively large number of different actions.

It is important to stress that, to get an overall picture of what needs to be done to maintain the biodiversity of the marine, agricultural or forest environments, for example, the measures put forward here must be viewed alongside those set out in the sectoral agencies' action plans.

[BOX:]

Priority areas of action have been identified on the basis of the following principles and criteria:

Actions should
- relate to existing objectives concerning biodiversity;
- be linked to identified problems on which action needs to be taken (here, the country study has been the main source of guidance);
- be clearly addressed to specific bodies or groups;
- be tangible;
- be cost-effective (in as far as this can be assessed); and
- be realistic (feasible).

[END OF BOX]

As far as the feasibility of different measures is concerned, present levels of funding have not been regarded as decisive *per se*. Quite a number of the actions proposed will require either increased allocations, new and/or broader-based funding, or a reordering of priorities within existing budgets. The proposals have been drawn up in the light of current policies. Possible future changes in environmental policy, energy policy etc. have not been taken into account.

How to read this chapter

The proposals set out below vary in character. Some involve tangible measures to ensure that areas of particular value for biodiversity are protected and managed. Others have the aim of increasing our stock of knowledge, e.g. further surveys, research, or improvements in environmental monitoring. A third type consists of studies of specific, fairly well-defined problems or issues, ultimately as a basis for action to conserve biodiversity. The various actions proposed range from measures which will need to be implemented by the environmental protection and nature conservation authorities, to those for which other actors will be responsible.

Measures within the spheres of responsibility of the relevant sectoral agencies are set out primarily in those agencies' action plans.

This introduction is followed by a *summary* of the action proposed, in which the different measures are grouped as follows:

a) Proposals which need to be considered in some way at the political level. These proposals are addressed primarily to the Government. They may, for example, involve legislative amendments or increased or broader funding, or highlight a need for international cooperation.
b) Proposals not requiring further consideration at the political level.

Consequently, the proposals are not arranged in the same order in the summary as in the rest of the chapter.

The summary is followed by a section describing a number of measures of general relevance, after which the proposals are presented in the following order. First, action relating to the major ecosystems is described, i.e. the agricultural and forest landscapes, wetlands, mountain areas, lakes, rivers and streams, and the marine and coastal environment. The next section presents actions relating *specifically* to the species level and to genetic variation. The proposals included in these two sections are relevant above all to Article 8 of the Convention (*in situ* conservation), but also to Article 7 (identification of components of biodiversity).

Subsequent sections of the chapter are devoted to action relating to pollution, tourism and recreation, monitoring (Article 7), research (Article 12), legislation and economic instruments (Articles 11 and 14) and education and information (Article 13). They are followed by sections dealing with action at the local and municipal level (linked to Chapter 15 of *Agenda 21*) and relating to international cooperation.

Many of the measures proposed could be considered to belong under several of these headings. Such measures are presented under the heading judged to be most relevant, with cross-references in most cases.

Each section and subsection begins with a general background, to put the proposals in context. We have attempted to keep these introductions as brief as possible; it was not possible, or our intention, to include all the relevant background information in this action plan. In some cases, other documents are referred to for the benefit of readers wanting a fuller picture. The emphasis is on describing the proposed actions themselves, generally with the help of a number of recurring subheadings (based on the terms of reference set by the Government):

Background and reasons for proposal: Here the background to and the thinking behind the action proposed are outlined. In many cases, links with specific problems and existing objectives are also highlighted.

Implementation: It is important to make it clear which body or group is expected to carry out the action proposed. Where several different bodies are expected to be involved, the intended division of responsibilities is also described (e.g. who does what in each phase, roles of national and regional authorities etc.). In some cases, a strategy for implementing the action is also presented.

Timetable: Indicates the date by which the action described should be carried out. Time-frames have been determined by the nature of the measures proposed. The action plan has been drawn up with a primary focus on the period 1996-98, but many of the proposals are defined in relation to a much longer time-scale (10 years or more)

when this is considered important. In some of these cases, a timetable is given for the initial steps to be taken over the next three years.

Estimated cost: Cost estimates are included wherever possible, i.e. where the necessary data are available. Many of these estimates are very approximate, the costs involved depending on a number of factors which could change. Space has not permitted the inclusion of detailed cost estimates in the action plan. In certain cases, the Environmental Protection Agency is prepared to present estimates at a later date.

Funding: Funding proposals are presented for most of the actions. In some cases, new funding arrangements are recommended (broader-based or completely new funding); in others, we highlight the need to look into new or broader sources of funding (see section 5.11).

Briefly, our aim has been to frame the proposals in such a way as to answer -- as far as possible -- the question: `Who does what and when, what is it likely to cost, and how will it be paid for?' In certain cases, e.g. local action, international cooperation, and research, we have not deemed it possible or appropriate to express our proposals in quite such concrete terms.

Important background reports

As part of the groundwork for the action plans, the Swedish Threatened Species Unit carried out an analysis of the measures needed to conserve red-listed species. The results of this analysis are set out in a separate background report. This report provided valuable data for the action plans presented by both the Environmental Protection Agency and the sectoral authorities.

In addition, the Agency intends to publish a separate background report on biodiversity in the *marine environment*.

Summary of the measures proposed

The proposals for action to reduce pollution outlined in section 5.4 are not included in the table below, since they are intended to be presented as fully elaborated proposals elsewhere (see 5.4). For more details on the various proposals, see the relevant sections of this chapter. The figures within parentheses are the numbers assigned to the actions in the main body of the text.
The relative importance of the different measures is indicated as follows: (v) = very important, (i) = important.

Action (and degree of importance)	Implementation	Timetable	Cost/funding
A) Proposals that will need to be considered at the political level			
Action of general relevance			
* Continue to develop monitorable objectives and action programmes for biodiversity at national, regional (incl. county administrative boards' STRAM programmes) and local levels (v) (1).	National, county and municipal authorities, bodies and individuals within sectors etc.	From 1996 on. Environmental quality objectives for major ecosystems (forest, marine etc.) to be defined in first phase, by 1998.	Within budgets o authorities/bodi concerned.

* When taking decisions that may be expected to have an adverse impact, direct or indirect, on biodiversity, apply principles set out in 2.3 (incl. EIA). Statement detailing how these principles have been applied should be compulsory (v) (2).	All parties concerned, e.g. central government agencies, municipal authorities, bodies and individuals within relevant sectors.	Ongoing.	Should form inte part of all plar and decision-mak (partly with a v to internalizing environmental costs).
* In line with Art. 6(b) of Convention, broaden biodiversity activities to involve more sectors and sectoral authorities, e.g. transport (transport agencies), energy production (NUTEK etc.), defence, tourism and education, and clarify meaning of sectoral responsibility (v) (3).	Government (political decisions, terms of reference etc.). Sectors concerned.	In conjunction with next generation of action plans (or sooner). Sectoral responsibility should be clarified on ongoing basis by appropriate means, e.g. legislation, appropriation directions, terms of reference.	Should be seen a part of process sectoral integration.

Action in the framework of the EU and other international cooperation

* In general: In international forums relevant to biodiversity (e.g. EU, Convention on Biological Diversity, HELCOM, OSPARCOM and LRTAP), Sweden should promote greater sectoral integration and responsibility (v) (59, 63).	Government, Environmental Protection Agency and other authorities.	Ongoing.	In framework of intergovernmenta cooperation.
* Within EU, pursue issues with a major bearing on biodiversity in Sweden, e.g. · acidification, · climate, · a second NO_x/VOC protocol, · an environmentally sound transport system in Europe, · the Baltic Sea environment, · reform of CAP, to minimize adverse impact of general agricultural policy on biodiversity and create better conditions for maintaining biodiversity, · environmental classification schemes, backed by economic instruments (v) (38, 60).	Government, as part of ongoing environmental cooperation within EU (revision of fifth environment programme, discussions on CAP etc.).	To be coordinated with EU process.	--

* Under LRTAP, seek international agreements regulating emissions of nitrogen oxides (new agreement), ammonia, certain hydrocarbons and the heavy metals mercury, cadmium and lead (v) (62).	Government, assisted by Environmental Protection Agency and other bodies.	--	Priority in convention activities.
* Improve monitoring of oil discharges at sea and respond more effectively to illegal discharges, to avoid damage to marine organisms (i) (19).	Government (intergovernmental cooperation). Environmental Protection Agency within IMO, HELCOM and OSPARCOM, in collaboration with National Maritime Administration and Coast Guard. At national level: Coast Guard and prosecution authorities (reporting and prosecution).	International initiatives 1995-96. Prosecution initiatives immediately (training).	Priority in convention activities.

* Initiate elaboration of international agreements to prevent undesirable introductions of non-native organisms to sea areas (i) (21).	Government (intergovernmental cooperation). Environmental Protection Agency within HELCOM and OSPARCOM, National Maritime Administration within IMO and HELCOM.	International agreements covering Baltic Sea to be concluded within ten years.	Priority in convention activities.

Action within Sweden

* Make certain amendments to environmental legislation when Environmental Code is introduced, incl. following: · introduce a legal definition of biological diversity (i) (47), · introduce additional substantive requirements (link with biodiversity) (v) (48), · introduce supplementary provisions to regulate impacts on wider environment (v) (49), · define more precisely municipal nature conservation responsibilities (i) (50), · extend protection of rivers/stretches of rivers covered by Ch. 3, Sect. 6, Natural Resources Act (i) (13), · extend area in which land drainage is prohibited, to include parts of coastal region of N Sweden (v) (7), · clarify broader grounds for shore protection, by amending Nature Conservation Act (v) (51), · examine possible introduction of form of species protection (for	Government and Parliament. If further inquiries required, should be undertaken by Environmental Code Committee (proposals here should be transmitted to that committee for consideration). Proposal on Ch. 3, Sect. 6, Natural Resources Act should be taken into account by Watercourses Commission. Proposal to extend area where drainage is prohibited should be able to be implemented by Government without further inquiries.	Amendments should -- be introduced when Environmental Code comes into force.

certain species) which also safeguards species' habitats (v) (52), · revise provisions of Peat Act to bring into line with requirements of Nature Conservation Act (i) (53), · ensure that biodiversity expertise is available when water rights cases are determined; re-examine rules on review of water-related operations (v) (54).			
* Analyse how decision in principle to eliminate environmentally harmful subsidies has been implemented. Examine need to amend regulations in light of this analysis (i) (55).	Government (commission necessary study). Sectors concerned (implementation of decision in principle).	As soon as possible.	--
* Examine how different principles and methods of monetary valuation of biodiversity can be applied in different situations in order to internalize environmental costs (v) (56).	Government (commission necessary study).	1996 (issue terms of reference).	--

* Allocate greater resources to bodies managing protected areas and to police, prosecution and customs authorities for monitoring, investigation and training concerning flora- and fauna-related crime (i) (36).	Government (resource allocation).	1996 on.	SEK 2 m.
* Request county administrative boards in mountain region to establish nature reserves in mountain areas to replace crown forest reserves which ceased to exist when National Forest Enterprise was reconstituted as a company (i) (11).	Government (issue terms of reference), county administrative boards in mountain region (implementation).	1996 (terms of reference issued), 1999 (reserves established).	Former crown for reserves to be designated as na reserves at no c (other than administrative costs).
* Make available funds for a repeat nationwide survey based on aerial infrared photography (i) (41).	Government (funding). Central Office of National Land Survey (aerial photography). National authorities, county administrative boards, municipalities etc. (users).	1996-2005.	Approx. SEK 2.5 m./year.
* Strengthen position of taxonomy (v) (46).	Government, universities, museums.	1998 at latest.	--

* Earmark funds to enable biodiversity monitoring to be developed and upgraded. Should be achieved partly by extending funding responsibility to various sectors, e.g. agriculture and forestry (v) (40).	Government (allocation of funds, earmarking sectoral funds for biodiversity monitoring).	1996 at latest.	One-off cost: SE 26 m. Annual cos SEK 16 m. These estimates do not include cost of CORINE Land Cove (see 5.6.1).

B) Proposals not considered to require further political consideration (other than decisions to allocate necessary resources)

Agricultural landscape

* Phase Landscape Conservation and NOLA schemes into EU Agri-Environment Programme and in conjunction with this implement habitat protection rules (Sect. 19 c habitats) and include management of small-scale habitats in agreements (v) (4).	County administrative boards. At national level, collaboration between Environmental Protection Agency, Board of Agriculture and Central Board of National Antiquities. Farmers (undertake to perform environmental services).	1996-2000.	As part of Agri-Environment Programme.
* Draw up national conservation plan to protect and manage most valuable agricultural landscapes (v) (5).	Environmental Protection Agency, in consultation with Board of National Antiquities, Board of Agriculture and county administrative boards.	December 1995.	Within existing allocations.
Forest landscape			
* Elaborate new forest reserves strategy and implement it by creating new reserves. This will include · evaluation of existing reserves, · elaboration of management guidelines, and · evaluation of unproductive forest land (v) (6).	Environmental Protection Agency, county administrative boards, with involvement of forestry sector.	1996-2005. Strategy to be presented in 1996.	Approx. SEK 190 m./year (new reserves). Corresponds to existing allocat

Wetlands			
* Protect mires included in Swedish Mire Protection Plan and extend plan to include Norrbotten county (v) (8).	Environmental Protection Agency, county administrative boards.	1996-2010. Plan to be extended by 2000 (depends on date of completion of survey work).	Depends on proportion of dry-site forest (within investme allocation). Extension of pla approx. SEK 125 (within existing allocation).
* Elaborate a national plan to protect wet forests. Further surveys and dissemination of information (i) (9, 10).	Environmental Protection Agency, working with Forestry Administration.	Begin 1998 at latest.	SEK 1.1 m.
Lakes, rivers and streams			
* Carry out nationwide inventory of lakes and watercourses and draw up site safeguard plan (v) (12).	Environmental Protection Agency, county administrative boards, consultants.	1998 (stage 1 = most valuable sites). Safeguard plan: 2000.	Approx. SEK 26 m

* Identify water bodies of high conservation interest threatened by acidification, carry out liming (v) (14).	Environmental Protection Agency, working with county administrative boards.	1996-97.	Government grant and funds from bodies undertaki liming.
Marine environment			
* Study need for and feasibility of marine resources database for Swedish sea and coastal areas (i) (15).	Environmental Protection Agency, working with marine research centres and county administrative boards concerned.	Study to be completed by 1997.	Within existing allocations.
* Develop and assess methods for biological surveys of marine environment and draw up a plan for such surveys in Swedish sea areas (i) (16).	Environmental Protection Agency and county administrative boards concerned, working with marine research centres.	1996-97 (elaboration of plan).	Within existing allocation.

* Establish more marine reserves on basis of plan, and evaluate and supplement criteria for such reserves. Protect shallow coastal waters (v) (17).	County administrative boards concerned and Environmental Protection Agency (coordinator). Collaboration between marine research centres. Protection of shallow waters: county administrative boards and municipalities.	1996-98.	SEK 1.5 m.
* Study diffuse inputs of petroleum hydrocarbons (i) (18).	Environmental Research Institute, working with Environmental Protection Agency.	Complete by end of 1998.	Within existing allocations.
* Draw up regional contingency plans for accidents involving oil and chemicals at sea and in Sweden's largest lakes (i) (20).	County administrative boards concerned, working with several national authorities.	To be drawn up no later than 1997.	Within each authority's allocations.

* Develop technical and/or operational methods, acceptable in terms of both environment and safety at sea, to control unintentional introductions of non-native organisms resulting from shipping (ballast water) (i) (22).	National Maritime Administration, Environmental Protection Agency and NUTEK, working alongside shipping industry, ports, universities and colleges.	Programme should be ready by 1998.	SEK 2 m. (cost o studies and development).

Action relating specifically to species and genetic variation

* Prepare and adopt Red Lists of groups of plants and animals not covered by such lists, and of habitats. Analyse red-listed species' habitat requirements etc. Conduct surveys of sites hosting red-listed species (v) (23, 25, 26, 27).	Swedish Threatened Species Unit, working with WWF, marine centres, Museum of Natural History, Stockholm, and Environmental Protection Agency (adoption). County administrative boards (surveys).	In stages, 1996-98.	SEK 3 m. 1996-98 surveys. Other measures within existing allocations.

* Develop system to select priority species, for which special conservation measures required (i) (28).	Threatened Species Unit and Environmental Protection Agency.	1996.	Within existing allocations.
* Study concept of `species of international importance' and draw up preliminary list of such species etc. (i) (29).	Threatened Species Unit and Environmental Protection Agency.	Complete in 1996.	Approx. SEK 200 in 1996 (within existing allocations).
* Adopt action programmes for those species for which species-specific measures are most urgently required, and for certain particularly important habitats (v) (24, 30).	Environmental Protection Agency, working with Threatened Species Unit and species experts.	1996-98 (approx. 30 species programmes).	SEK 4.5 m. (preparation of programmes). Implementation: estimated SEK 10 Within existing allocations.

* Develop better basic documentation and procedures for risk assessment of introductions of alien species/genetic material, and restrict introductions which have/could have detrimental consequences. Step up and improve dissemination of information (i) (31).	Government (commission study). Swedish Biodiversity Centre (carry out study). Information activities: various bodies concerned.	Complete study no later than 1997.	SEK 2 m.
* Review existing lists of protected species etc. (i) (32).	Environmental Protection Agency and others.	Complete by 1997.	Approx. SEK 200 Within existing allocations.
* Develop a hunting and game conservation policy, with conservation of biodiversity as its basic aim. Study certain questions concerning hunting and biodiversity (i) (33).	Environmental Protection Agency.	Policy should be developed by December 1996.	Within existing allocation.
* Study impact of ungulate populations on distribution of fully grown deciduous trees, especially rowan, aspen and goat willow (v) (34).	Universities and colleges.	--	--

* Assess how new arrangements for small-game hunting on state land above limit of arable farming and in mountain reindeer-grazing areas are affecting biodiversity (v) (35).	Board of Agriculture and Sami Parliament, as part of current inquiry commissioned by Government (proposal should be transmitted to those authorities for consideration).	Complete by April 1996.	Within authoriti allocations.
* Develop programme to analyse genetic variation in a selection of species/populations where the existing variation may be of particular interest from standpoint of conservation or use (i) (37).	Environmental Protection Agency, working with researchers, Museum of Natural History, Stockholm, etc.	1997 (programme to be elaborated).	SEK 1 m.

Tourism			
* Develop criteria, policies and strategies for sustainable tourism (v) (39).	Swedish Tourist Authority, working with tourist industry, landowners' organizations, Environmental Protection Agency and others.	Complete by 1997.	Approx. SEK 600 Within Swedish Tourist Authorit allocation.
Environmental monitoring			
* Elaborate environmental index reflecting state of biological diversity in Sweden (i) (42).	Environmental Protection Agency, working with Statistics Sweden and others.	Ongoing development effort. Foundations laid by 1997.	Approx. SEK 700

* Improve monitoring of biodiversity in agricultural landscape (v) (40).	Environmental Protection Agency, working with county administrative boards, agricultural sector, Central Board of National Antiquities, Swedish University of Agricultural Sciences, consultants and others.	To be developed in 1995-96 and subsequently brought into operation in stages.	Total estimate f extended program of environmental monitoring: One- costs SEK 27 m. 72 m. incl. CORI Land Cover). Anr cost: SEK 16 m. 18 m. incl. CORI Land Cover).
* Improve monitoring of biodiversity in forest landscape (v) (40).	Environmental Protection Agency, working with Forestry Administration, National Forest Inventory/Soil & Vegetation Survey etc.	Most elements should begin in 1996.	--
* Improve monitoring of wetland biodiversity (v) (40).	Environmental Protection Agency, working with county administrative boards and others.	Operational plans to be drawn up by 1997.	--

* Improve monitoring of biodiversity of mountain areas (v) (40).	Environmental Protection Agency, working with county administrative boards, Board of Agriculture (reindeer grazing) and others.	Operational plans to be drawn up by 1996.	--
* Improve monitoring of biodiversity of lakes, rivers and streams (v) (40).	Environmental Protection Agency, working with county administrative boards and others.	Operational plans to be drawn up by 1996.	--
* Improve monitoring of biodiversity in marine environment (v) (40).	Environmental Protection Agency, working with county administrative boards, marine centres and others.	1995 (programme development), 1998 (operational).	--
Data management etc.			
* Develop arrangements and procedures for collection, handling and presentation of biodiversity data. Among other things, every county administrative board should introduce Natural Environment Database (DBN) system (i) (43-45).	Environmental Protection Agency, county administrative boards (introduce DBN), Statistics Sweden and other bodies.	Ongoing.	SEK 3.6 m.

Research

Error! Unknown switch argument.

* Undertake research, with special emphasis on following areas, among others (all `v'), referred to as `important research': · analysis of genetic variation, · impacts of acidification, eutrophication and toxic pollutants, · conservation biology and landscape ecology, · effects of introduced species, · indicators of biodiversity, · critical habitat size, · methods of landscape description and evaluation, and · effects of liming and forest soil revitalization. Research of broader relevance includes: · mechanisms behind biodiversity losses, · methods of monetary quantification, and · analysis of feasibility of reconciling human prosperity with sustainable natural and human-influenced ecosystems.	Research-funding agencies, i.e. Environmental Protection Agency, MISTRA, Forestry Research Institute of Sweden, Council for Forestry and Agricultural Research, Royal Academy of Sciences, Council for Planning and Coordination of Research, University of Agricultural Sciences etc. Researchers.	Ongoing.	MISTRA and EU research funding will hopefully h to meet existing needs. However, allocation to Environmental Protection Agenc Research Council will also need t increased.

Information and education			
* Undertake information and education activities (v) (57).	Environmental Protection Agency, NGOs and many other bodies.	1996-98 (also longer-term).	Approx. SEK 4 m.
Action at the local level			
* Address biodiversity issues in framework of local Agenda 21 activities, municipal nature conservation programmes etc. and strategic planning (v) (58).	Municipal authorities and other bodies at local level.	1996-98.	Within each municipality's budget.
Action at the international level			
* Implement EC Birds and Habitats Directives, including protection of sites (v) (61).	Environmental Protection Agency and county administrative boards.	Phase 1: 1995-96 Phase 2: 1998-2004.	Phase 1: Approx. 1.4 m. Phase 2: No esti possible at pres Increased fundir will be necessar however (Environmental Protection Agenc investments allocation).

* Continue exchange of experience and know-how between Nordic countries regarding national application and implementation of Convention on Biological Diversity (i) (64).	Environmental Protection Agency participating in Nordic project.	1995-96.	SEK 200 000 (tot budget for proje Within budget fo Nordic environme cooperation.

5.1 Action of general relevance

In this section, we present a number of measures of a more general character. By their very nature, these actions are difficult to define in operational terms. Typically, they involve a wide range of different bodies and are concerned more with establishing processes than with implementing clearly delimited courses of action.

ACTION 1: **Continue to develop *monitorable objectives and action programmes* for biodiversity -- designed to take account of existing conditions -- at the national, regional and local levels.**

Background and reasons for proposal: See chapter on objectives (chapter 3).

Implementation: At the *national* level, the process of developing objectives etc. should continue to be coordinated by the Environmental Protection Agency, on the basis of the objectives presented in this plan. Projects focusing on different ecosystems should be undertaken, with the involvement of the relevant sectors, sectoral authorities, researchers etc. The Environmental Protection Agency and the National Board of Forestry, for example, intend to mount a joint project to establish environmental quality objectives for forests. Gaps in existing knowledge should be identified and filled. At the *regional* level, county administrative boards have a key part to play; there is a strong link here with their work on regional environmental strategies (STRAM), for example. At the *local* level, municipal authorities should offer a lead (link with local Agenda 21 process, structure (master) plans etc.). At all levels, the approach should be cross-sectoral. It is important that the different sectors concerned -- from forestry companies down to individual forest or farm holdings, for instance -- are also involved in elaborating monitorable objectives and measures.

ACTION 2: **When taking decisions that may be expected to have an adverse impact on biodiversity, *apply the principles* set out in section 2.3. A statement detailing *how* these principles have been applied should be compulsory.**

Background and reasons for proposal: See section 2.3.

Implementation: The sectors concerned (i.e. those exerting an impact on biodiversity), both authorities and enterprises. These principles should be applied in relation to both specific projects and day-to-day operations, and every minor operation should be considered in its wider context (for example, the combined effect of many similar actions should be analysed).

ACTION 3: **In line with Article 6(b) of the Convention, *broaden* biodiversity activities *to involve more sectors* and sectoral authorities. Suggested sectors: transport (including the transport agencies), energy production (e.g. NUTEK and Vattenfall), defence and education. In addition, sectoral responsibility needs to be *clarified* in several respects, e.g. in terms of what it entails, allocation of roles, and reporting requirements.**

Implementation: The concept of sectoral responsibility should be clarified and defined by appropriate means: legislation, terms of reference for specific studies etc., directions on the use of appropriations, or supplementary provisions in agencies' standing orders. This clarification should be based on the analyses of sectoral

responsibility and integration already carried out, e.g. by the Ministry of the Environment (`Government guidance to sectoral agencies in the environmental sphere -- agency standing orders and directions on the use of appropriations').

Several of the sectoral agencies mentioned above are already involved in activities in support of biological diversity, a case in point being the National Road Administration's work on the flora of road verges. It is important to continue and step up work of this kind.

5.2 Action at the ecosystem level

5.2.1 The agricultural landscape

Fundamental factors in maintaining the biodiversity of farming areas are the continued management of types of land of particular value, above all meadows and unimproved pastures, and a varied agricultural landscape in terms of land and vegetation types, landscape features, moisture gradients etc. Biological diversity is not confined to the more valuable types of land, however.

Proposals relating directly to agriculture are set out in the action plan presented by the Swedish Board of Agriculture.

ACTION 4: **Phase the Landscape Conservation and NOLA schemes into the national Agri-Environment Programme (EU). Draw up regulations and guidelines concerning (a) elements of the programme relating to the purchase of environmental services in the form of management of, primarily, meadows and pastures and `smaller areas of land and water' covered by habitat protection rules; and (b) site-by-site qualitative monitoring of the programme by county administrative boards (in accordance with the *Strategy for Biological Diversity*).**
When implementing the Agri-Environment Programme, county administrative boards should:
a) implement the provisions on protection of certain habitat types (Sect. 19 c habitats) in the agricultural landscape, and
b) include stipulations on the management of landscape features, including Sect. 19 a and Sect. 19 c habitats, in agri-environment agreements.

Background and reasons for proposal: In the agricultural landscape, the new Agri-Environment Programme will be a key factor in ensuring the traditional management of areas of particular value. It is very important to maintain the philosophy underlying the NOLA (Nature Conservation Measures in the Agricultural Landscape) and Landscape Conservation schemes, i.e. that what is involved is a payment to the farmer for a service performed (or for the production of a `public good', e.g. in the form of biodiversity). Habitat protection regulations should be implemented in parallel with agri-environment agreements in the case of sites where this is relevant (Sect. 19 c, Nature Conservation Ordinance). While agri-environment payments are payments in return for land being managed in a particular way, the habitat protection rules should be seen as a means of perpetuating an existing type of land use, i.e. the type of land use which the authorities are paying to maintain.

The new Agri-Environment Programme has a broader approach. It includes a component designed to promote the management of remnant habitats/landscape features.

Implementation: County administrative boards (implementation and monitoring). At the national level (regulations and guidelines, coordination), collaboration between the Environmental Protection Agency, the Board of Agriculture and the Central Board of National Antiquities. In its directions on the use of appropriations for the present financial year, the Environmental Protection Agency has been entrusted with responsibility -- in consultation with the Board of Agriculture and the Board of National Antiquities -- for national monitoring and evaluation of those elements of the Agri-Environment Programme which relate to hay meadows and unimproved pastures.

Timetable: Regulations and guidelines should be drawn up by the end of 1995. The new agri-environment payments should be phased in gradually, and be fully introduced in the course of 1996. The habitat protection scheme should be fully introduced by 1998. By the year 2000, the total areas referred to in environmental quality objectives should be appropriately managed on the basis of decisions on agri-environment payments or similar measures.

ACTION 5: **Draw up a national conservation plan for the agricultural landscape.**

Background and reasons for proposal: Only a small proportion of the agricultural landscape has been safeguarded. The proposed plan is intended to form the basis for statutory protection of a selection of Sweden's most valuable farmed landscapes, representative of the different natural geographical regions of the country. The Environmental Protection Agency was specifically entrusted with preparing such a plan in the directions on the use of appropriations issued to it for 1995/96, and intends to present the plan in line with the terms of reference set out in that document.

Implementation: The plan is being drawn up by the Environmental Protection Agency, which intends to consult the Central Board of National Antiquities, the Board of Agriculture, county administrative boards and other agencies.

Timetable: An initial version of the plan should be presented no later than December 1995 (as requested in the appropriation directions). The process of implementing it should begin immediately after that. It may prove necessary to add to the plan in stages after 1995, as more data become available concerning features of cultural historical value.

Cost and funding: Within existing allocations.

* * *

Other important measures relating to the agricultural landscape:

- Update the Environmental Protection Agency's nature conservation register by the end of 1996 with regard to farmland falling within protected areas (Environmental Protection Agency).

- Draw up and implement follow-up plans/programmes in every county (beginning in 1995), involving site-by-site monitoring of management within protected areas (county administrative boards).

- Carry out thematic `audits' of farmland management in a random sample of

protected areas during 1996. These audits should focus on the question of conservation value/quality/cost (Environmental Protection Agency and county administrative boards).

· Review management plans for protected areas to assess whether they need to be revised (county administrative boards).

· Implement the Habitats Directive with respect to the habitats and species of the agricultural landscape (county administrative boards, coordinated by the Environmental Protection Agency) (see also section 5.10).

· Carry out a review (from the viewpoint of farmland nature conservation) of areas of national conservation interest and decide which agricultural landscapes should be classed as being of national interest from this point of view (Environmental Protection Agency, to be completed in 1996).

· Develop structure (master) plans so that they clarify municipal authorities' strategies for conserving biodiversity etc. and their overall policies regarding agriculture as a primary economic activity. One aim is to make it possible or easier for people to continue to live in sparsely populated areas. (Municipalities; at the national level, Board of Housing, Building and Planning, Board of Agriculture and Environmental Protection Agency.)

· Publish the book *Äldre fodermarker...* (`Old meadows and pastures -- The importance of the management regime in the past -- A model for the use of objectives to promote conservation -- Methods of documentation and monitoring') (in the course of 1996).

5.2.2 The forest landscape

General background

It should be stressed that *reserves are only one component part -- albeit an important one -- of an overall strategy* in which the modification of forestry practices in the direction of sustainable use is of equal importance. This latter element of the strategy for conserving biological diversity is dealt with in the National Board of Forestry's action plan. In the following, we describe the *role of reserves* within a broader strategy to conserve the biodiversity of the forest landscape.

Needs and objectives regarding the areas of productive forest that should be safeguarded in the long term are set out in the objectives chapter. Action over the next ten years should be guided to a significant degree by the expected future development of the country's natural forests.

Natural forests in Sweden, today and tomorrow

It has been estimated that natural forest, i.e. old forest created by natural regeneration and not substantially changed by silvicultural intervention, makes up 10-20 % of Sweden's productive forest area. This type of forest is above all to be found on marginal forest land in the interior of northern Sweden, in coastal areas, on damp sites and on land earlier subject to non-intensive use, e.g. old, overgrown pastures. Old forests are also to be found scattered throughout the wider forest landscape.

[BOX:]

Protected productive forest land

At present, some 600 000 ha of natural forest are protected in montane forest areas, with a further 100 000 ha in other areas. One-third of each of these totals consists of former crown forest reserves. The area safeguarded makes up less than 3 % of Sweden's productive forest area. Outside the montane zone, protected productive forest land makes up only about 0.5 % of the total, compared with almost 40 % within that zone.

[END OF BOX]

Role of reserves

The most important function of reserves is to safeguard *extensive* forest ecosystems of particular value, which cannot be expected to be adequately protected by means of new forestry methods alone. Apart from the general precautionary argument in favour of large, coherent reserves, there are important ecological reasons for such an emphasis:

- Large reserves can include a mix of forest types representative of the wider landscape, providing conditions for a representative mix of species.
- Large reserves allow for natural disturbances in parts of the area protected, such as fires, windthrow, snow damage or drought, with the resultant natural successions which benefit or are essential to many species.
- Large reserves mean that edge effects and dependence on surrounding areas are less marked.
- Large reserves make better reference areas for monitoring and research, and are of particular value for walking, recreation and contact with nature.

Efforts to conserve forest biodiversity in the years ahead must be practical in their approach and coordinate as effectively as possible the contributions of the different bodies and individuals concerned. If we assume that new forestry methods will preserve a structure of key habitats, stream- and riverside corridors, felling sites which retain individual trees and groups of trees etc., then it is the nature conservation authorities' responsibility to extend the system of larger refuges in the form of reserves. This system should be developed in the light of the many advances in our understanding of forest biodiversity that have been made in recent years.

Action proposed

ACTION 6: **Elaborate a *new forest reserves strategy* and implement it by *creating new forest reserves*. The aim is to establish a systematic, effective method for selecting, protecting and managing forest areas of particular conservation value. As part of this process,**

- **existing forest reserves should be evaluated,**
- **a study should be made of the management of certain forest reserves, and guidelines drawn up, and**
- **unproductive forest land should be evaluated from the viewpoint of biodiversity.**

Background and reasons for proposal: The forest reserves strategy should involve *large* areas of natural forest which may be assumed to function as reasonably stable ecological entities and which will normally be considerably larger than the habitats that can be conserved by means of new forestry practices. Different minimum areas will apply in different parts of the country, and depending on the scale of the landscape and the type of forest involved. 25 ha may be considered a small area in the case of a coniferous forest, but a large area if the forest is made up of warmth-demanding deciduous species (oak, beech etc.). As part of the reserves strategy, standards and criteria must be elaborated regarding this and other questions relevant to the selection, protection and management of the country's most valuable forests.

The strategy should cover the forest types and forest areas of Sweden which, according to the latest evidence, are of most importance from the viewpoint of conserving the habitats and species of the forest landscape. It should thus primarily encompass large natural forests of the following types:

[BOX:]

Types of forest to be given priority in the forest reserves strategy:

Coniferous forests (existing natural forests and restored areas)
Forests made up of or including warmth-demanding deciduous trees
Other deciduous forests
Coastal/archipelago forests
Forests in forest/mire complexes (Mire Protection Plan)
Wet forests
Certain special types within the groups above, especially herb-rich spruce forests, pine forests on calcareous and rocky substrates, and grazed forests.

[END OF BOX]

Only general data are available on existing virgin forest reserves etc., providing little detailed information about different forest types, for example. It is important to undertake a detailed assessment to clarify the mix of forest types present in reserves, the key habitats and threatened species which they contain, and how representative they are of their respective natural geographical regions.

For certain types of forest, an active management regime may be important. This is particularly true of certain warmth-demanding deciduous forests and grazed forests. It is also important to establish methods of controlled burning for conservation purposes in coniferous forest areas with a history of fire. Management issues of this kind have not been given priority up to now, but should be considered as part of the process of preparing the strategy.

A fairly significant proportion of Sweden's forest area is classed as unproductive (i.e. yielding less than 1 m^3 of timber per hectare per year). Most of this land consists of forested mires, land with large exposures of rock, and unproductive montane coniferous forest. Such areas currently enjoy a certain degree of protection under the Forestry Act. However, there are no general safeguards for features of conservation interest such as old trees, standing dead trees etc. A closer study should be made of the state of these forest areas and their significance for biodiversity, with a view to ascertaining whether significant conservation gains could be achieved by simple,

general measures, information etc., or whether reserves should also be set up to protect certain types of unproductive forest land.

Forest reserves are currently being created in line with the principles set out in the Nature Conservation Plan for Sweden (Environmental Protection Agency 1991).

Implementation: The Environmental Protection Agency is responsible for implementing all the measures proposed here, with the exception of the creation of new reserves, with regard to which the Agency and county administrative boards have a joint responsibility for selecting sites and deciding priorities. An annual funding allocation plan should be prepared by the Environmental Protection Agency on the basis of the implementation plans produced by county administrative boards.

Timetable: The strategy should be drawn up in 1995-96. New forest reserves should be set up between 1996 and 2005.

Estimated cost: The scale on which reserves can be designated is determined by the funds made available. The existing allocation (SEK 190 m.) allows some 10 000 ha of productive forest land to be set aside as reserves each year. If reserves are created primarily in the higher-yielding forests of southern Sweden, only around 5 000 ha will be able to be protected annually. In the end, however, forest reserves will cover a considerably larger area than this, and be of much greater ecological value, since they often also incorporate valuable wetlands and unproductive forest land.

Funding: Environmental Protection Agency's investments allocation.

5.2.3 Wetlands

General background

In proportion to its surface area, Sweden is one of the wetland-richest countries in the world, with 9.3 million ha in all. It also has a great diversity of wetlands, in terms of species, habitats, substrates, and vegetation and wetland types. Wetlands, with their considerable habitat and species diversity, are of great conservation interest. They also provide habitats for a number of species which only occur in wetland environments or which are dependent on them at some stage in their life cycle. Wetlands are thus of great importance for biodiversity.

Many wetlands have been destroyed by drainage and other types of disturbance, e.g. regulation of lake levels and river flows. Such projects have primarily been carried out over the last 150 years, with the aim of transforming wetlands into more profitable types of land. The plains have been affected particularly severely by drainage, and in such areas there is a case for active efforts to recreate wetlands.

Compared with the situation in other countries, however, a relatively large proportion of Sweden's wetlands remain intact or have only been disturbed to a limited degree. The most serious threats to wetlands are drainage, liming, eutrophication and peat extraction. Other adverse factors include felling of wet forests and wooded mires with long forest continuity, and inadequate safeguards in conjunction with tree felling on adjacent dry land.

The majority of Swedish wetlands have been used for haymaking over varying periods of time. With the changes that have occurred in agriculture in recent decades, this form of management has seen a rapid decline, often ceasing altogether

in the case of certain types of wetlands, chiefly mires. Continued management is essential to the survival of valuable flora and fauna which cannot cope with scrub invasion.

Actions proposed

ACTION 7: **Extend the area in which land drainage is prohibited, to include parts of the coastal region of northern Sweden (Norrland). The Nature Conservation Ordinance should be amended so as to include the following areas within the scope of Sect. 18 d of the Nature Conservation Act:**

- **The county of Gävleborg, with the exception of the municipality of Ljusdal, but including Järvsö parish.**
- **The county of Västernorrland, with the exception of the municipalities of Ånge and Sollefteå, Liden and Holm parishes in the municipality of Sundsvall, and Anundsjö, Björna, Sidensjö and Skorped parishes in the municipality of Örnsköldsvik.**
- **In the county of Västerbotten: the municipalities of Bjurholm, Nordmaling, Robertsfors, Umeå and Vännäs, and Skellefteå with the exception of the parishes of Kalvträsk and Jörn.**

Background and reasons for proposal: To conserve the biodiversity of wetlands, it is essential to maintain their natural hydrology. This can most effectively be achieved by prohibiting drainage. Another reason for banning drainage which should be highlighted here is the general importance of wetlands as nitrogen traps (relevant to objectives concerning reduced nitrogen inputs into lakes and sea areas).

In a report presented in 1992, it was pointed out that the surveys under way at that time would provide new and valuable data. Since then, surveys covering several of the counties of northern Sweden have been completed as part of the nationwide Wetlands Inventory. Survey data are now available for the counties of Gävleborg, Västernorrland and Västerbotten, among others. A survey of Norrbotten county is currently in progress.

The overall picture emerging from the northern Swedish surveys is as follows. The area closest to the Baltic Sea is naturally poor in wetlands; here, they rarely account for more than 5 % of the land surface. In addition, the hydrology of many wetlands in this coastal region has been disturbed in various ways, chiefly by drainage. The Västerbotten survey shows that only 10 % of wetlands in the coastal zone are undisturbed, compared with 45 % of those fringing the mountain region. The same dearth of undisturbed wetlands is found in all the northern Swedish coastal areas surveyed. To safeguard the biodiversity of the northern coastlands, it is very important to ensure that further wetlands are not disturbed by drainage projects.

The general arguments for a very restrictive policy on land drainage, combined with the new survey results, justify extending the area in which drainage is prohibited, as proposed above. As far as Norrbotten is concerned, the results of the wetlands survey being carried out there should be awaited before further steps are taken.

Implementation: The Government (amendment of the Nature Conservation Ordinance).

Timetable: The area should be extended no later than 1997.

[FIGURTEXT:]

area to which Nature Conservation Act, Sect. 18 d, should be extended

area currently covered by Sect. 18 d

Fig. 3. Proposed extension of area in which land drainage is prohibited.

ACTION 8: **Protect the mires included in the Swedish Mire Protection Plan which are currently unprotected. Initially, priority should be given to areas with a large proportion of productive natural forest and management-dependent mires. As part of this measure, decisions and management plans relating to existing reserves set up under the Mire Protection Plan should be reviewed.**

Background and reasons for proposal: The Environmental Protection Agency drew up the Mire Protection Plan in order to establish a systematic basis for protecting Sweden's mires. A decision on what areas were to be included in the plan was taken in spring 1994. They were selected according to a number of criteria, the aim of which was to ensure that the entire spectrum of biological diversity to be found in the country's mires was represented, from species to mire types. When the plan is fully implemented, a further 210 000 ha of wetlands will have been safeguarded.

At the time sites were selected for the plan, the biological interest of the wetlands concerned was well documented, but the information available about adjacent dry forest land was incomplete, and in some cases out of date. The biological interest of these dry-site forests must therefore be ascertained, to enable the nature conservation authorities to reach sound decisions on priority sites over the next few years. A review of some earlier decisions on reserves is called for.

Implementation: County administrative boards are responsible for introducing protection for all the sites which are currently unprotected. The Environmental Protection Agency has a coordinating role at the national level.

Timetable: The process should be completed by 2010. One-fifteenth of the area should be protected each year over the period 1996-2010.

Estimated cost: The cost of implementing the Mire Protection Plan is difficult to estimate, since the biological interest of forests on adjacent dry land has to be carefully assessed for each site in question. The cost relating to the actual mire land is estimated at about SEK 10 m./year. Over the next three years, staffing requirements will amount to around 12 person-years.

Funding: Compensation and site acquisitions will be financed entirely by the state through the investments allocation. In so far as the involvement of municipal authorities can be secured, they will bear a share of the cost. Part of the cost will be met from the EU's Financial Instrument for the Environment (LIFE).

ACTION 9: **Draw up new conservation plans:**

a) Prepare a supplement to the Swedish Mire Protection Plan, covering the county of Norrbotten.

b) Begin work on a national plan to protect the most valuable wet forest sites.

c) Make a list of inundation fens and other lake-shore wetlands to be safeguarded as protected areas.

d) Draw up an action programme on rich fens.

Background and reasons for proposal:
a) The Swedish Mire Protection Plan is in fact a nationwide protection plan, excluding only the county of Norrbotten. The reason that Norrbotten was not included was that the relevant data were not available when it was drawn up. Since Norrbotten is Sweden's wetland-richest county and contains Arctic mire types not occurring to any appreciable extent in other parts of northern Sweden, the Mire Protection Plan needs to be supplemented to include mires in this county.

b) At present, no reliable nationwide overview of wet forests is available. Such an overview is necessary to enable forests of this type to be *safeguarded in a planned and systematic manner*. When the Wet Forests Inventory currently in progress has been completed, a national conservation plan should be drawn up on the basis of that inventory and the Wetlands Inventory.

c) Inundation fens and other wetlands fringing lowland lakes are included to some extent in the Swedish Mire Protection Plan and in the list of agricultural landscapes of conservation value. A review of these wetland types should be carried out, to make sure that no sites meriting protection have been overlooked because they did not meet the criteria for the nationwide listings mentioned.

d) Rich fens are of considerable biological interest and constitute a threatened habitat type. In addition, they have been given priority in EU nature conservation efforts and are covered by the Habitats Directive. The proposed action programme should include everything from habitat conservation to the protection of individual species.

Implementation:
a) The Environmental Protection Agency. Sites should be selected in consultation with the Norrbotten County Administrative Board.
b) The Environmental Protection Agency should draw up and adopt the wet forests plan, in consultation with county administrative boards, the National Board of Forestry and county forestry boards.
c) County administrative boards in consultation with the Environmental Protection Agency.
d) The Environmental Protection Agency in consultation with county administrative boards and the Swedish Threatened Species Unit.

Timetable:
a) Work should begin as soon as the results of the wetlands survey of Norrbotten county have been presented in an accessible form, and be completed by the year 2000 at the latest.
b) Work should begin as soon as the results of the Wet Forests Inventory have been presented in an accessible form (no later than 1998).
c) Work should begin as soon as supplementary survey data on inundation fens and other lake-shore wetlands are available.
d) The action programme should be adopted no later than 1998.

Estimated cost:
a) A quarter of a person-year, plus SEK 50 000 for printing.
b) Two person-years, plus SEK 500 000 for printing.
c) One person-year, plus SEK 250 000 for printing.
d) One person-year, plus SEK 100 000 for printing.

Funding: Within existing allocations.

ACTION 10: **Surveys and dissemination of information:**

a) Carry out a supplementary wetlands inventory covering rich fens.

b) Survey lake-shore/river-bank environments, inundation fens and other lake-shore wetlands in parallel with aquatic biota and habitats, as part of the inventory of lakes and watercourses (see section 5.2.5).

c) Publish a report summarizing the results of the Wetlands Inventory for the country as a whole.

Background and reasons for proposal:

a) Small rich-fen sites were not included in the Wetlands Inventory, as they failed to meet the minimum area criterion. Rich fens are a significant habitat type in terms of biodiversity, and it is very important from the viewpoint of nature conservation to gather further data on this habitat type in Sweden, chiefly in southern and central parts of the country. Rich fens are also receiving attention under the EU's environment programme and are covered by the Habitats Directive. More information is needed to identify which sites are in most urgent need of protection.

b) When an inventory of lakes and running waters is undertaken, adjacent terrestrial environments should be included, as the basis for an overall assessment of their biological interest. Greater cost-effectiveness could be achieved by surveying the *shore/bank environment* in parallel with the aquatic environment of individual water bodies. Municipal authorities should have a considerable interest in access to reliable data on which to base their responses to applications under shore protection regulations (which now require the authorities also to take account of flora and fauna).

c) To be able to present the results of the Wetlands Inventory on a nationwide basis, a national summary of the data produced should be compiled.

Implementation: The Environmental Protection Agency, together with county administrative boards, should be responsible for carrying out the surveys. The summary report should be compiled by the Agency.

Timetable:

a) Inventory should begin as soon as possible and be completed no later than the year 2000.

b) Should be coordinated with the inventory of lakes and watercourses.

c) Work should begin when the Norrbotten survey and the supplementary surveys of rich fens and lake shores/river-banks have been completed, i.e. in the year 2000.

Estimated cost:

a) Depending on how ambitious an inventory is undertaken, 5-10 person-years will need to be committed to the inventory itself, plus SEK 500 000 for printing.

b) Will be estimated when plans for the inventory of lakes and watercourses are drawn up.

c) Approximately one person-year and SEK 500 000 for printing.

Funding: Within existing allocations.

* * *

Other important measures relating to wetlands:

- Continuously monitor the management of wetland sites with management-dependent biological features.
- Improve the state of knowledge concerning the management-dependent flora of nutrient-poor wetlands.
- Drawing partly on the experience of field trials, develop a better understanding of ways of restoring disturbed mires with a view to enhancing the basic conditions for biodiversity.
- Design wetlands which are established for nitrogen retention purposes in such a way as to promote biodiversity.

5.2.4 The mountain landscape

The Environmental Advisory Council was commissioned by the Government (in parallel with the preparation of this action plan) to study and make recommendations on ways of promoting sustainable development in Sweden's mountain areas. The Council reported in October 1995. These issues are consequently not examined in the present action plan. Reindeer herding is considered in the action plan presented by the Board of Agriculture.

The major national parks and a number of very large nature reserves in the mountains make up a substantial proportion of the total area of protected countryside in Sweden. Moreover, as a proportion of its area, the mountain region is more comprehensively protected than any other landscape type in the country. In view of this, efforts to protect sites of particular value will in future focus primarily on areas outside this region.

Action proposed

ACTION 11: **Request county administrative boards in the mountain region to establish nature reserves in areas above the limit of arable farming/in mountain reindeer-grazing areas, to take the place of the majority of the crown forest reserves which ceased to exist when the National Forest Enterprise was abolished.**

Background and reasons for proposal: When the National Forest Enterprise was reconstituted as a company, crown forest reserves in the montane forest zone ceased to exist. The area of protected forest in the country was thus reduced by some 200 000 ha (corresponds to a third of the area of protected productive forest in the montane zone). The majority of these sites are regarded by the relevant county administrative boards and the Environmental Protection Agency as being of great conservation value. It is therefore important to give them statutory protection as nature reserves. Certain boundary adjustments may be necessary (among other things, the possibility of linking some areas to existing reserves should be considered). Crown forest reserves in the rest of the country (i.e. the great majority of such reserves in area terms) have already been safeguarded by an agreement between Assidomän and the Environmental Protection Agency.

Implementation: The Government should request the county administrative boards concerned to establish the reserves. The Environmental Protection Agency should coordinate the process.

Timetable: Terms of reference should be issued in the course of 1996. Reserves should be established by county administrative boards no later than 1999.

Estimated cost: The former crown forest reserves should be designated as nature reserves without payment of compensation.

* * *

Planned national parks (provided for in the National Parks Plan) and reserves should be established as planned. A proposal for an assessment of small-game hunting in mountain areas is presented in section 5.3 under the heading `Hunting'.

5.2.5 Lakes, rivers and streams

General background

The biological diversity of lakes, rivers and streams is influenced by a wide variety of human activities. Three factors have a dominant impact: regulation of water levels and rates of flow, acidification and eutrophication. Pollution is dealt with in section 5.4. Important proposals to ensure that expertise on biodiversity is available when water rights cases are determined and concerning reviews of water rights judgments are set out in the section on legislation. Emergency plans for accidents involving oil and chemicals are proposed in the marine environment section. The proposals below should be considered alongside the proposals in the National Board of Fisheries' action plan concerning fresh waters.

Actions proposed

ACTION 12: **Carry out a *nationwide inventory* of lakes and watercourses, including an assessment of their *biological interest*, and draw up a plan to safeguard individual sites.**

Background and reasons for proposal: Chemical studies of fresh waters have been undertaken for a long time. More recently, a number of surveys of benthic fauna and fish have also been carried out. Our understanding of the characteristics, particularly the *biological* characteristics, of standing and running waters nevertheless remains patchy and incomplete. By and large, no coherent inventory and evaluation of the biological and conservation interest of Sweden's lakes, rivers and streams has been performed. Certain counties have undertaken such surveys and/or assessments on their own initiative, but a uniform, systematic inventory has not been carried out.

At the request of the Environmental Protection Agency, the Swedish University of Agricultural Sciences is currently developing a system of biological assessment criteria, known as `System Aqua', which will provide an instrument for undertaking such an inventory and evaluation. The system will cover both lakes and running waters, and also include a model for weighing together biological data and other information from a hydrologically coherent area. The proposed system is being studied and tested during 1995. In 1994, a systematic review was made of existing information about the biological characteristics of the lakes and watercourses of most conservation interest. This review will form a basis for deciding priorities for additional survey work in these and other water bodies.

It is very important that the inventory and evaluation process described in System Aqua is implemented as soon as possible and in a uniform manner in all the counties of Sweden. Without a basic inventory of the biological features of lakes and

watercourses, it is difficult to design either tangible, meaningful action programmes to promote biodiversity or a sound programme of environmental monitoring of the freshwater environment, geared to existing needs.

Compared with terrestrial habitats, lakes in particular are poorly protected under the Nature Conservation and Natural Resources Acts, and their protection must be improved. A plan to achieve this, including a listing of priorities, should be drawn up.

Implementation: The Environmental Protection Agency will be responsible for finalizing assessment criteria, planning and coordinating the inventory, and elaborating the site safeguard plan (in consultation with county administrative boards). Actual surveys and assessment will be undertaken by county administrative boards.

Timetable:

Assessment criteria	Completed in 1995
Plan of national inventory	1995
Inventory to be carried out	1996-2000
Site safeguard plan	2000

Estimated cost:

In all	Approx. SEK 26 m.

Funding: The Environmental Protection Agency will fund the development of biological assessment criteria and planning and coordination of the inventory. County administrative boards are expected to contribute SEK 12 m. and the Environmental Protection Agency SEK 14 m. to the cost of the inventory. An additional allocation to the Agency will be necessary if the inventory is to be carried out. The Swedish Power Association has so far (during the planning stage) contributed approx. SEK 100 000.

ACTION 13: **Extend the protection of water bodies and stretches of rivers in which hydroelectric development is currently prohibited under Ch. 3, Sect. 6, of the Natural Resources Act to cover other operations besides hydroelectric projects and to include the river-bank environment.**

Background and reasons for proposal: The water bodies and sections of rivers protected under Ch. 3, Sect. 6, of the Natural Resources Act are only protected in the sense that hydroelectric schemes are not permitted there. A closer study should be made of how this protection could be extended to include other operations, too, with a view to conserving the biological interest of the water bodies concerned. In addition, protection should be broadened so as expressly to include *river-banks* up to the normal high water level (a very important zone in terms of biodiversity). It may be noted that the supplementary terms of reference issued to the Watercourses Commission (Dir. 1994:106) include the task of `analysing the need for protection from other forms of development and, if necessary, proposing the statutory amendments required'.

The basic approach in the case of rivers/stretches of rivers covered by Ch. 3, Sect. 6, of the Act should be to take the entire *river ecosystem* into account. Land use throughout the catchment area should be considered, with a view to avoiding changes in the river's hydrology etc. One approach could be a reinforcement of the protection provided under the Natural Resources Act, as suggested above, combined with an additional protection zone in which the authorities could require

modifications of land use, e.g. restrictions on clear felling, buffer zones along streams and rivers in connection with timber harvesting, avoidance of drainage, restoration of tributaries cleared for timber floating etc. In Norway, protected rivers are managed on the basis of a zone system, in which land use plans -- guidelines -- are drawn up for each zone. The lessons learnt from this system should be applied and tested in Sweden.

Implementation: Should be studied by the Watercourses Commission. The above proposal should be submitted to the Commission for consideration.

Timetable: Should be introduced when the new Environmental Code comes into force.

Liming

ACTION 14: **Identify water bodies of high conservation interest which are threatened by acidification. In these waters, liming and biological restoration should be carried out in such a way as to promote biodiversity.**

Background and reasons for proposal: In June 1995, Sweden's liming programme encompassed 7 500 lakes and over 10 000 km of running waters. To maintain a programme on this scale, an annual budget of around SEK 200 m. is required. The aim is to lime not only bodies of water of considerable biological interest, but also those of more local interest.

The Swedish liming programme should be geared to improving and maintaining conditions for acid-sensitive species/populations and their distribution within their core range. Limed lakes and streams offer refuges for acid-sensitive species, from which recolonization will be possible if and when the acidification situation improves. Species in this category include salmon (*Salmo salar*), brown trout (*S. trutta*), Arctic char (*Salvelinus alpinus* species complex), roach (*Rutilus rutilus*), noble crayfish (*Astacus astacus*), freshwater pearl mussel (*Margaritifera margaritifera*), glacial-relict crustaceans, the mayfly *Baetis rhodani* (an important food of brown trout) and the net-spinning caddis-flies *Philopotamus montanus* and *Arctopsyche ladogensis* (food of the dipper). Liming has probably also improved the survival prospects of species such as the otter (*Lutra lutra*), osprey (*Pandion haliaetus*) and dipper (*Cinclus cinclus*) by reducing levels of mercury and cadmium in their prey.

Liming can also be detrimental to biodiversity, however (e.g. it can damage bryophytes). It must be ensured that its net effect on biodiversity is beneficial, i.e. the favourable effects in the water must be greater than any adverse effects on land (e.g. on wetlands).

Implementation: The Environmental Protection Agency, in collaboration with county administrative boards, will be responsible for ensuring that liming is undertaken in such a way as to preserve/
recreate biological diversity and that it is incorporated in the forthcoming site safeguard plan.

Timetable: 1996-97.

Funding: State funding as provided in the Liming Ordinance, together with funds from the bodies undertaking liming.

* * *

In addition to the proposals above, attention should be drawn to the following measures:

- Develop methods of enhancing the biodiversity of disturbed rivers and streams and, in conjunction with reviews of old water rights judgments, apply these methods (see section on legislation for further details). Develop methods of restoring lakes and running waters with a view to improving the basic conditions for biodiversity.
- Increase nutrient levels in certain water bodies where they have been depleted by acidification and regulation of water regimes.
- Further develop environmental quality objectives relating to acidification and eutrophication of surface waters, on the basis of critical loads and chemical/biological assessment criteria (Environmental Protection Agency).
- Promote the integration of water-use planning in structure (master) plans and other physical planning documents, by distributing to municipal authorities the information `toolbox' produced jointly by the Environmental Protection Agency and the National Board of Housing, Building and Planning.

5.2.6 The marine environment

General background

Sweden has an international as well as a national responsibility for marine biodiversity. As the littoral state with the longest Baltic coastline, it is responsible for some 40 % of the area of the Baltic Sea, which in turn corresponds to almost 40 % of the country's land surface. Sweden is also home to 50 % of the grey seals (*Halichoerus grypus*) and 75 % of the common (harbour) seals (*Phoca vitulina*) of the Baltic. And a substantial proportion of the wild salmon (*Salmo salar*) of this sea area spawn in Swedish rivers.

We need to develop a better understanding of marine biodiversity. The present gaps in our knowledge make it difficult to define objectives and actions relating to habitats, species and the genetic make-up of species. Further work therefore needs to be done to compile existing data and develop methods for biological surveys of the marine environment, with a view to making such surveys more effective.

It should be noted that the action plan presented by the National Board of Fisheries also includes a wide range of measures relating to the marine environment.

Actions proposed

ACTION 15: **Study the need for and feasibility of a marine resources database for Swedish sea and coastal areas.**

Background and reasons for proposal: There is a need for basic data on the distribution of marine habitats and species, the abundance of species in different parts of their ranges, and genetic variation within species. This information is important in the identification of marine ecosystems and habitats in need of protection, species which are threatened, or sensitive to various human activities, and genetic variation which may be unique to Swedish sea areas.

The aim in creating a marine resources database should be to establish an important source of knowledge that can be used in assessing problems associated with the conservation of marine biodiversity. At present, a tool of this kind is not available to those working in the area of marine environmental protection and conservation. The first step will be to examine what types of information should be stored in the database, the second to consider how the information can be held in a readily accessible form. One approach might be to develop the Environmental Protection Agency's Natural Environment Database (*Databas Natur, DBN*) to enable it to accommodate data on Swedish sea areas and to provide access to data from the three marine research centres (in Umeå, Stockholm and Gothenburg), county administrative boards, the Swedish Threatened Species Unit and the Museum of Natural History, Stockholm. This will only be possible if marine survey methods are developed and standardized and a system for classifying marine habitats within the DBN database is elaborated.

In the longer term, it should be possible to link the database to other Swedish databases holding information on the marine environment (e.g. those of the National Board of Fisheries, the National Maritime Administration and the Swedish Meteorological and Hydrological Institute) and to marine databases in other European countries (e.g. the BioMar project in the United Kingdom and the ESAS database, on European seabirds in the North Sea area). See also the proposal on DBN in section 5.6.2.

Implementation: It would be appropriate for the study to be carried out by the Environmental Protection Agency, in association with the marine research centres (in relation to their respective areas of responsibility: the Gulf of Bothnia, the Baltic Sea proper, and the Kattegat and Skagerrak), the Threatened Species Unit, the Museum of Natural History, Stockholm, and county administrative boards.

Timetable: The study should be completed by 1997. Its findings should clarify what needs exist and how a marine resources database should be developed.

Cost: SEK 300 000 (for the study).

Funding: Within the existing allocations of the authorities concerned.

ACTION 16: **Develop and assess appropriate methods and techniques for *biological surveys* of the marine environment and draw up a plan for such surveys in Swedish sea areas, setting out priority geographical areas and ecosystems/habitats. Cooperation between the Baltic Sea states is particularly important. Standardization of sampling methods should continue through various working groups within the Baltic Marine Biologists.**

Background and reasons for proposal: Biological surveys of marine areas have hitherto mainly been carried out in conjunction with the establishment of marine reserves. Few counties or municipalities have plans for systematic surveys of the marine environment. No comprehensive evaluation and analysis of different survey methods has been undertaken. Plans should be drawn up for a survey of different habitats, and they should include an analysis and assessment of methods and set out priority survey needs for different coastal areas. Assessment criteria need to be developed. These surveys must be coordinated with sampling under environmental monitoring programmes, in terms of methods, analysis and evaluation.

Implementation: The Environmental Protection Agency, in collaboration with county administrative boards and the marine research centres, should draw up a programme to develop marine survey methods and techniques and elaborate a short- and long-term plan setting out key survey needs in Swedish sea areas. The programme and the plan should include tangible proposals for future action.

Timetable: The programme should be drawn up within two years (i.e. be completed by 1997).

Cost: The estimated cost is SEK 300 000/year over two years.

Funding: Within the Environmental Protection Agency's allocation.

ACTION 17: **Establish more marine reserves on the basis of a plan for such reserves. Update and supplement the study of marine areas of conservation value, `Marine reserves in Sweden'. Work in a methodical manner to protect shallow coastal waters, especially soft-bottom areas.**

Background and reasons for proposal: The Environmental Protection Agency has published several reports giving details of valuable coastal waters and open sea areas along Sweden's coastline. The current `Marine reserves' project highlights nine areas in particular. A number of international projects affecting Sweden are also in progress, e.g. under the auspices of the Nordic Council of Ministers, HELCOM, the WWF in association with the Baltic Marine Biologists, and the EU (Habitats Directive). One important function of marine reserves is to serve as reference and monitoring areas, e.g. to elucidate the effects of fisheries. However, as a conservation measure, they have built-in limitations, partly because sea water and the pollutants present in it are constantly on the move, and partly because most marine organisms move with the water as plankton at some stage in their life cycle.

It is important to gain a better understanding of marine plant and animal species and of habitats, ecosystems and sea areas in general. The areas proposed for designation as marine reserves should be priority areas for surveys (to furnish additional data as a basis for the design of monitoring programmes). The possibility of dividing marine reserves into zones with different management rules should be considered, as a means of finding out more about the effects of fisheries, and an assessment should be made of how networks of reserves could be created to protect migratory marine organisms.

This proposal includes an inventory and analysis of the threats to and measures needed to safeguard the flora and fauna of the fissure faults of Kosterfjorden and the elaboration of a programme of action to protect this area. Kosterfjorden forms part of a larger area proposed for designation as a marine reserve, which hosts an invertebrate fauna found in no other Swedish waters and is, for example, one of the country's best areas for anthozoans (corals, sea-pens, sea anemones etc.). The habitats in question are currently threatened by trawling (with more efficient trawling methods, it is now possible to fish in areas where in the past trawls could not be used).

The use of shallow coastal waters for fishing, aquaculture, engineering projects, recreation and the extraction of mineral resources has, overall, had a considerable impact on the biodiversity of Sweden's sea areas. Shallow-water sites are of very great significance as spawning and nursery grounds. High priority must be given to protecting such sites (e.g. soft-bottom areas, eel-grass meadows and mussel beds).

Implementation: County administrative boards (creation of marine reserves). Study of marine areas: The Environmental Protection Agency in association with the marine research centres in Gothenburg, Stockholm and Umeå. The inventory of Kosterfjorden should be carried out by the Tjärnö Marine Biological Station. It is necessary both to collate existing data and to carry out new survey work.

Protection of shallow waters: The county administrative boards of the coastal counties in question should methodically apply the site protection provisions of the Nature Conservation Act with a view to safeguarding these important habitats.

Timetable: Five new marine reserves should be established over the period 1996-98. Further reserves should be proposed as new data emerge. The work on Kosterfjorden can be undertaken in stages over a three-year period.

Cost: Creation of marine reserves: SEK 500 000/year for three years. Inventory of Kosterfjorden: SEK 250 000.

Funding: Environmental Protection Agency (investments allocation), county administrative boards (staff). Kosterfjorden: Environmental Protection Agency, Göteborg & Bohus County Administrative Board, National Board of Fisheries, if possible also the County Council and the Municipality of Strömstad.

[BOX:]

Areas covered by plans to establish marine reserves. Nine areas are included in the Environmental Protection Agency's project `Marine reserves in Sweden 1993'. Seven of these are listed below, marked with an asterisk. The other two, Holmöarna and Kopparstenarna/Gotska Sandön/Salvorev, have now been designated as marine reserves and are not included in this list.

1. Haparanda archipelago*
2. Bjuröklubb area
3. Norrbyskär/Snöan/Bonden/Järnäs udde
4. Trysunda/Ulvöarna/Ullånger/Ulvö Deep*
5. Gran
6. Gräsö/Singö archipelago
7. Storö/Bockö/St. Nassa/Sv. Högarna/Sv. Björn
8. Landsort/Askö/Hartsö/Landsort Deep*
9. St. Anna/Missjö archipelago
10. N. Kalmar archipelago
11. Torhamn archipelago and Utklippan*
12. Falsterbo peninsula and Måkläppen*
13. Kullaberg*
14. Nidingen/Sönnerbergen/Mönster*
15. Väderöarna/Tjärnö archipelago/Koster area/Kosterrännan

[END OF BOX]

ACTION 18: **Study diffuse inputs of petroleum hydrocarbons to the Baltic Sea, Kattegat and Skagerrak.**

Background and reasons for proposal: The Environmental Protection Agency's

action programme `Marine Pollution '90' drew attention to the need to develop greater knowledge concerning diffuse inputs of petroleum hydrocarbons to Swedish sea areas. It is necessary to clarify both the sources and the scale of oil pollution, and its effects on marine organisms.

Implementation: The Swedish Environmental Research Institute, working alongside the Environmental Protection Agency.

Timetable: The study should be completed by December 1998.

Cost: SEK 300 000.

Funding: Under the agreement between the Environmental Protection Agency and the Environmental Research Institute.

ACTION 19: **Improve monitoring of oil discharges at sea and respond more effectively to illegal discharges, in order to avoid damage to marine organisms:**
a) Intergovernmental cooperation to improve the monitoring of discharges of oil at sea and to reduce the number of illegal discharges. Within the IMO, OSPARCOM and HELCOM, Sweden should seek to ensure that detection of oil by remote sensing is accepted as legally binding evidence of infringements of regulations.
b) National measures making it possible to prosecute in cases where illegal discharges of oil are reported in Swedish waters.

Background and reasons for proposal: Every year large numbers of oiled birds are found in Swedish sea areas, chiefly as a result of illegal dis charges of oil. Larger-scale oil spills could have disastrous consequences for certain seabird populations. Roughly a million long-tailed ducks (*Clangula hyemalis*), i.e. virtually the entire Palaearctic population, winter in the waters to the south of Gotland. The Stora Karlsö population of guillemots (*Uria aalge*, red-listed as `care-demanding') is particularly vulnerable in June and July, when the season's brood of young, which are still unable to fly, are at sea with their parents. The northern Kattegat is north-west Europe's most important wintering ground for several species of seabirds, and is presumably the most important in the world for the common scoter (*Melanitta nigra*) and razorbill (*Alca torda*). Apart from visible damage, oil is harmful to plankton and marine invertebrates.

The number of illegal discharges of oil fell over a period of several years, but rose again in 1995. The volume of oil tanker traffic on the Baltic is expected to grow in the near future. Oil exploration and production in the Baltic, Kattegat and Skagerrak will presumably also increase in scale. International monitoring and other action to prevent oil pollution, under the auspices of the IMO, HELCOM and OSPARCOM, must continue and be stepped up. Action concerning port reception facilities, for example, needs to be coordinated between countries. In Sweden, more stringent monitoring and follow-up are called for, to ensure that prosecutions are instituted against vessels which contravene the regulations. Heavier penalties should be considered.

Information and training are also important in tackling these problems.

Implementation: Intergovernmental level: The Government and the Environmental Protection Agency, in the framework of the IMO, HELCOM, OSPARCOM and the North Sea Conference, in collaboration with the National Maritime Administration and the Coast Guard. In Sweden, the initiative as regards prosecutions must be taken

by the Coast Guard, preferably in consultation with the Environmental Protection Agency and the Office of the Prosecutor-General.

The Environmental Protection Agency intends to present more detailed proposals in December 1995, when it reports on its study of oil discharges, requested by the Government in the Agency's appropriation directions for the present financial year.

Timetable: At the intergovernmental level, initiatives to improve monitoring should be taken under the relevant conventions in 1997 (this question should be given priority). At the national level, initiatives regarding prosecutions should be taken immediately.

Funding: Costs should be met from the budget for intergovernmental cooperation and from the allocations of the authorities concerned.

ACTION 20: **Draw up regional contingency plans for accidents involving oil and chemicals at sea and in Sweden's largest lakes.**

Background and reasons for proposal: It is important to have contingency plans to deal with accidents from an environmental point of view. Regional `environmental atlases' are of particular importance in this connection. These atlases are intended to assist those in charge of operations to tackle accidents, to guide their decisions on what action to take and how to set about it in order to limit damage to the environment. They also identify areas which need to be particularly carefully protected in such situations. Environmental atlases still have to be produced for certain stretches of Sweden's coast.

Implementation: A concerted effort by the county administrative boards concerned, the Environmental Protection Agency, the National Maritime Administration, the National Board of Fisheries, the Coast Guard and the National Rescue Services Board.

Timetable: Environmental atlases should be available for the entire Swedish coastline and the largest lakes (Vänern, Vättern, Mälaren and Hjälmaren) no later than 1997.

Cost and funding: Within the allocations of the authorities concerned.

ACTION 21: **The Government should take initiatives to promote the elaboration of *binding international agreements*, with the aim of preventing undesirable introductions of non-native organisms to sea areas around Sweden, e.g. in ballast water.**

Background and reasons for proposal: International shipping is an important vector for introductions of alien species. Many of the new species that have become established in Swedish sea areas have ended up there as a result of introductions (deliberate or unintentional) in other countries of Europe. More attention is now being paid to this question at the international level: the IMO, for instance, has drawn up voluntary guidelines on the handling of ballast water. These will be incorporated in regulations to be issued by Sweden's National Maritime Administration and will possibly be adopted as an annex to MARPOL. If tangible action is to be achieved, however, someone needs to keep the issue in the limelight and to offer a lead. Sweden should therefore take initiatives at the international level

with the aim of preventing undesirable introductions, in the first instance with regard to the Baltic Sea (HELCOM) and the North Sea (OSPARCOM), but in the longer term also within the EU and world-wide.

Implementation: Intergovernmental cooperation (the Government). The Environmental Protection Agency should pursue the issue within HELCOM and OSPARCOM, the National Maritime Administration within IMO (Marine Environment Protection Committee) and HELCOM (Maritime Committee).

Timetable: This should be a priority issue in discussions under the conventions in question. International agreements covering the Baltic Sea should be concluded within ten years.

Funding: The Environmental Protection Agency and the National Maritime Administration, within their allocations.

ACTION 22: **Develop technical and/or operational methods, acceptable in terms of both the environment and safety at sea, to control unintentional introductions of non-native organisms resulting from shipping. Draw up realistic proposals concerning the handling of ballast water.**

Background and reasons for proposal: Shipping facilitates the spread of alien species, both those which grow on ships' hulls etc. and those transported in their ballast water. The voluntary operating guidelines developed by the IMO on the handling of ballast water are not sufficient to solve this problem. Sweden's geographical location creates particular difficulties, too, since the guidelines are based to a large extent on exposing the organisms occurring in tanks to substantial changes in salinity, which is difficult to achieve on shipping routes within Europe, for example. Technical means of preventing organisms spreading via ballast water need to be developed and coordinated at an international level, primarily for the existing fleet, but eventually also for future generations of ships. Research and development is in progress in several parts of the world, but as yet no effective methods have been brought into commercial use. By developing technical and biological expertise of its own in this area, Sweden can help to bring about international R&D cooperation, e.g. in the framework of EU research programmes.

It should be stressed that there is a need for both technical means of handling the water in a cost-effective manner, and effective means of enforcing compliance with the regulations (including international coordination).

Implementation: The work already in progress should continue (for example, a working group representing the National Maritime Administration and the Environmental Protection Agency has been established). The Maritime Administration and the National Board for Industrial and Technical Development (NUTEK), together with the industry and the higher education sector, should elaborate a programme to develop technical and operational solutions.

Timetable: The programme should be ready to be implemented by 1998.

Cost: SEK 2 m. (cost of studies and development).

Funding: The National Maritime Administration, NUTEK and the shipping industry (including ports).

5.3 Action relating to species and genetic variation

This section brings together the Agency's proposals relating specifically to the species and population level and to genetic variation. Implementation of the EC Birds and Habitats Directives is dealt with under the heading `Action at the international level'.

Conservation of species

Sweden is home to an estimated 50 000 species of plants, fungi and animals. Within the groups assessed so far in terms of their status and the threats facing them, some 3 500 species have been placed on the country's Red Lists. In the great majority of cases, measures focusing on ecosystems and habitats are needed to safeguard viable populations of these species within their natural ranges. In the case of some of Sweden's native species, however, the situation is so critical, or they have such specialized requirements, that direct, *species-specific* action is called for to ensure that they survive in the country. In general, the survival of these species cannot be safeguarded by general measures at the ecosystem or habitat level.

Species' habitats

Certain types of habitat are of particular importance when it comes to conserving especially vulnerable species, and some types are rare or exposed to considerable anthropogenic disturbance. Proposals relating to habitats are mainly set out in the previous sections, dealing with the different ecosystems.

ACTION 23: **Prepare a Red List of habitats no later than 1998. Should be implemented by the Environmental Protection Agency in collaboration with the Swedish Threatened Species Unit, among others.**

ACTION 24: **Draw up action programmes for a number of particularly important habitats, including rich fens, no later than 1998 (Environmental Protection Agency and others).**

Red-listed species

One of the overall objectives in this area is to ensure that no species occurring naturally in Sweden disappear from the country. An initial step towards achieving this is to draw up Red Lists (Red Data Books).

A Red List is a list of species which are judged to be at risk of disappearing from the country in the shorter or longer term. Depending on how great this risk is judged to be, species are assigned to different `categories of threat' (see `Red-listed species' in Annex 1). Inclusion in a Red List does not, *per se*, entail an assessment of the need for or urgency of action to conserve the individual species concerned. This should be decided on the basis of a separate system for setting priorities, in which other factors are also taken into account (see below).

ACTION 25: **Prepare and adopt Red Lists of marine plants and animals and of certain groups of invertebrates. Draw up and publish check-lists of Swedish macroalgae.**

Produce species fact-sheets for all species red-listed as of 1995.

Background and reasons for proposal: In the case of marine species, the primary concerns are to analyse the need for red-listing and draw up Red Lists of macroalgae (apart from stoneworts) and invertebrates (macrofauna), and to revise the Red List of fishes. There are also groups of terrestrial invertebrates for which lists have not yet been prepared. It is important to ensure that the Threatened Species Unit is able to continue to compile Red Lists. Such lists can only be drawn up provided that identification guides and taxonomic expertise are available. This point is discussed in section 5.7.

For several groups of marine organisms, check-lists of species/species groups (e.g. micro-organisms, phytoplankton, zooplankton and invertebrates) should be drawn up. Modern identification guides should be prepared for these groups.

Implementation: The Threatened Species Unit, working alongside the WWF, the Museum of Natural History, Stockholm, the marine research centres and the Environmental Protection Agency (which will officially adopt the lists).

Timetable: Marine species can be reviewed in stages over a three-year period. Red Lists of certain invertebrate groups, and species fact-sheets, should be compiled by 1998.

Cost: Estimated total cost: approx. SEK 1 m.

Funding: Within the allocations of the Threatened Species Unit and the Environmental Protection Agency.

ACTION 26: **Continue to study and analyse the *habitat requirements* of red-listed species and the action that is required.**

Background and reasons for proposal: An outline analysis of the measures needed to safeguard red-listed species was undertaken as a contribution to the basic documentation for the action plans now being presented (see separate background report from the Threatened Species Unit). It is very important, however, that this work should continue: a uniformly designed analysis should be made of each species' habitat requirements and of the resultant need for action, special precautions etc.

Implementation: The Threatened Species Unit and its committees, within existing allocations.

ACTION 27: **Supplement existing surveys at the county level with regard to sites hosting red-listed species. Cost: SEK 1 m./year over three years.**

Background and reasons for proposal: A great deal more information is needed about the distribution of red-listed species in the different counties of Sweden. The necessary surveys should be regarded as a *complement* to other major inventories.

Implementation: The county administrative boards concerned, in collaboration with municipalities, county forestry boards, voluntary organizations and others.

In addition to the measures proposed above, *the Threatened Species Unit intends to take the following action* between 1996 and 1998:

- Compile Red Lists of fishes, bryophytes and lichens in the *Baltic Sea area*.
- Participate within the IUCN in adapting the new global categories of threat for use at the regional, national and local levels.
- Record finds of species assigned to the threat categories Extinct (in Sweden), Endangered and Vulnerable (in the case of vascular plants, bryophytes, lichens and fungi, also those in the Rare and Care-demanding categories).
- Continue its voluntary `flora wardens' scheme, to ensure that all vascular plants and roughly half of the bryophytes and lichens in the Endangered and Vulnerable categories are regularly monitored.
- Perform an analysis of the geographical patterns and variation of biodiversity.

System for deciding priority species-specific measures

ACTION 28: **Develop and begin to apply a system for deciding priorities, with the help of which it should be possible to select species for which special conservation measures are required. Should be ready for use in 1996.**

Background and reasons for proposal: In the case of the most vulnerable species, action is already urgently required. Given the limited resources available, however, species-specific measures have to be correctly prioritized. To do this, a carefully thought-out system for establishing priorities is called for. It should be based on such factors as the degree of threat and the proportion of a species' total population that is to be found in Sweden. If possible, account should also be taken of biological characteristics, such as the species' ecological function or value as an indicator. A preliminary draft of a prioritization system has already been elaborated.

The system should be designed for use with *all categories of species* (red-listed, non-red-listed, internationally important etc.). It should be harmonized with the criteria that apply to red-listed species and species of international importance. One use of the system will be in deciding for which species specific action programmes are to be drawn up first.

Implementation: The Threatened Species Unit and the Environmental Protection Agency.

Cost and funding: Within existing allocations.

Species of international importance

There has been some discussion about the possibility of identifying `species of international importance', for which Sweden has a special responsibility. The term refers to species whose Swedish populations make up a comparatively large proportion of the world population or are otherwise of significance for the species' global survival. Identifying such a species in a given country would not, however, mean that that country alone was responsible for its survival.

ACTION 29: **A study should be made of the concept of `species of international importance', and of whether this concept could form a component part of a system to determine priorities. If there proves to be a need to draw up a list of Swedish species of international importance, such a list should be prepared for vascular plants, birds, mammals, reptiles and amphibians in the course of 1996. This work should be undertaken by the Threatened Species Unit and funded by the Environmental Protection Agency. Cost: SEK 200 000 (within existing allocations).**

Action programmes

An action programme for a given species or habitat sets out the measures needed to secure its long-term survival. Such a programme should have a stated objective, e.g. in terms of the population size, number of sites or geographical range which needs to be maintained if the long-term survival of the species/habitat is to be regarded as assured. Programmes should run for a limited period of time, and then be reviewed so as to incorporate new measures where necessary.

Action programmes should be adopted by the Environmental Protection Agency. In most cases, they should be prepared by specialists working for the Agency on a contract basis. A list of priority species for such programmes should be drawn up in consultation with the Threatened Species Unit and its fauna and flora conservation committees. A corresponding list of priority habitats should be prepared by the Environmental Protection Agency. These priority lists should be regarded as working documents which can be revised as and when necessary or at stated intervals.

Up to now, four action programmes have been adopted, for sand steppe grasslands, the woodland brown butterfly (*Lopinga achine*), the freshwater pearl mussel (*Margaritifera margaritifera*) and the peregrine falcon (*Falco peregrinus*). Draft programmes exist or are being prepared for a number of other species and habitats, e.g. common porpoise (*Phocoena phocoena*), green tree frog (*Hyla arborea*), white-tailed (sea) eagle (*Haliaeetus albicilla*), the water-plantain *Alisma wahlenbergii*, and the moss *Dichelyma capillaceum*. For many species, e.g. invertebrates, the focus will be on the habitat rather than the species level.

ACTION 30: **With the help of the system for determining priorities (see above), draw up a list of species for which it is intended that action programmes should be considered (to be completed in 1996). On the basis of this list, prepare programmes for those species for which action is most urgently required. Over the next three years, some 30 programmes should be adopted. The following are examples of species for which action programmes need to be considered:**

Certain stoneworts
The fungus *Sarcosoma globosum*
The fungus *Holwaya mucida*
The lichen *Usnea longissima*
The lichen *Lobaria amplissima*
The lichen *Diploicia canescens*
The moss *Bryhnia novae-angliae*
The moss *Dichelyma capillaceum*
The moss *Hamatocaulis vernicosus*
The moss *Hookeria lucens*
The moss *Neckera pennata*

Black vanilla orchid (*Nigritella nigra*)
Field fleawort (*Tephroseris integrifolia*)
One-leaved bog orchid (*Microstylis monophyllos*)
Yellow marsh saxifrage (*Saxifraga hirculus*)
The water-plantain *Alisma wahlenbergii*
The eyebright *Euphrasia rostkoviana* ssp. *rostkoviana*
White frog orchid (*Pseudorchis albida*)
Pepper saxifrage (*Silaum silaus*)
The vetch *Vicia pisiformis*
The coral *Lophelia prolifera*
The bush-cricket *Metrioptera bicolor*
Wels (*Silurus glanis*)
Green toad (*Bufo viridis*)
Fire-bellied toad (*Bombina bombina*)
Green tree frog (*Hyla arborea*)
Natterjack toad (*Bufo calamita*)
Sand lizard (*Lacerta agilis*)
Tawny pipit (*Anthus campestris*)
White-tailed (sea) eagle (*Haliaeetus albicilla*)
White-backed woodpecker (*Dendrocopos leucotos*)
The four large predatory mammals: wolf (*Canis lupus*), wolverine (*Gulo gulo*), lynx (*Felis lynx*) and brown bear (*Ursus arctos*)
Seals: common (*Phoca vitulina*), grey (*Halichoerus grypus*) and ringed (*Phoca hispida botnica*)
Common porpoise (*Phocoena phocoena*)
Otter (*Lutra lutra*)

Implementation: Programmes should be drawn up by the Environmental Protection Agency in collaboration with the WWF, the Swedish Society for the Conservation of Nature (SNF), the Threatened Species Unit and consultants/commissioned experts. The bodies responsible for *implementing* programmes may vary, e.g. county administrative boards, county forestry boards or the National Board of Fisheries.

Estimated cost: Drawing up programmes: SEK 4.5 m. Cost of *implementation* will be specified in the individual programmes. Total over the three-year period: approx. SEK 10 m.

Examples of action that will be taken to safeguard species/habitats covered by programmes: (1) Protection and management of localities or breeding areas by the creation of nature reserves etc., (2) restoration of habitats, e.g. wetlands, grasslands or deciduous forests, (3) monitoring of species' populations, and (4) information and education.

The panels below show *examples* of measures that could be taken to safeguard four of the species above:

[BOX:]

Alisma wahlenbergii

The water-plantain *Alisma wahlenbergii* is endangered in Sweden and now has only one known Swedish locality, compared with the roughly 30 previously recorded. This species is endemic to the Baltic Sea area and is listed under the Bern Convention in

the `strictly protected' category. To safeguard the species' long-term survival, the Environmental Protection Agency will commission the preparation of an action programme including the following measures: (1) an inventory to locate any additional sites where the species grows, (2) appropriate action at the species' localities to protect it from interference, (3) a reduction of nutrient leaching to the waters in which the species occurs, and (4) reintroduction of the species at suitable sites.

[END OF BOX]

[BOX:]

Seals

Three seal species occur in Sweden: the grey, common (harbour) and ringed seal. The grey seal (*Halichoerus grypus*) is classed as Vulnerable/Endangered in the sea areas surrounding Sweden, where it has a population of at least 5 000, and as Care-demanding in the North Sea. The common seal (*Phoca vitulina*) is Endangered in the Baltic Sea and in the Care-demanding category in other marine waters. The species currently has a population of about 300 in the Baltic and around 3 300 in the Kattegat and Skagerrak. The ringed seal (*Phoca hispida botnica*) has been assigned to the Vulnerable category in Sweden. Its Baltic population now numbers 5 000-6 000.

Overall quality objective for these seal species:
The long-term objective for Sweden's seal species is to increase their numbers so as to achieve viable populations throughout most of their natural ranges. A closer study of how large these populations should be will be made in the action programmes. Over the next three years, seal populations should increase by 10 % a year.

To achieve the objectives set for seals, action programmes will be drawn up. The following are examples of the measures to be included: (1) improvements in marine water quality, to be achieved by reducing inputs of nutrients, heavy metals and chemical compounds not occurring naturally in the environment; (2) measures to eliminate disturbance in areas important to the species, i.e. where they pup, mate, moult etc., e.g. the creation of more seal sanctuaries; (3) technical and legal means of resolving conflicts between increased seal populations and fisheries, e.g. measures to prevent and reduce damage by seals to fishing gear and catches; (4) surveys and monitoring of the development of seal populations.

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Sweden's *large predatory mammals* (wolf, wolverine, lynx and brown bear) have long been under threat as a result of human persecution. The individual species currently vary in their threat status, but they all require some form of action to safeguard their survival. They also play a special role in ecosystems, being top predators, at the apex of the `ecological pyramid'. In addition, they are key species, in that they create opportunities for other species to feed, and they are of great `symbolic' value.

Over the next three years, a number of measures -- to be defined in more detail in action programmes -- should be implemented to achieve the objectives set for these mammals. The kind of action that needs to be taken includes: (1) a ban on hunting, or rules which permit hunting only where there is a clearly demonstrated need for it in

order to prevent damage; (2) surveys and guarding/monitoring of populations; (3) information and education; (4) research on factors such as reproduction, juvenile mortality, migration and genetic variation; (5) compensation in certain cases for harm to domesticated animals; and (6) greater efforts to fight fauna-related crime.

Introduction of alien species and genetic material

Species, subspecies or climatically determined races which are alien to the country or to its various regions (non-indigenous provenances) have been introduced by human beings over a very long period of time. Several thousand years ago, artificially reared frogs were introduced to Sweden, for example. Subsequently, more and more species etc. have been introduced, deliberately or unintentionally. The 17th and 18th centuries saw a marked increase in such introductions, and the rate of increase has since risen. In several cases, introduced species have subsequently become part of Sweden's cultural heritage. In the last few decades, new species etc. have been introduced into the country on a scale never previously witnessed. A key issue as regards the nature conservation aspects of this phenomenon is whether the organism, plant or animal species concerned remains dependent on constant human attention for its survival, or whether it is able to establish itself and spread in the natural environment. Only in the latter case is it possible to talk of a real problem. The Convention includes a clause dealing with this issue (Article 8(h)).

A special problem in this area is the introduction of alien races, adapted to different climates, and of alien subspecies and in certain cases species which are closely related genetically to native wildlife. These can cross with indigenous species and `contaminate' their gene pool, in tum reducing the genetic variability of the species as a whole.

Introductions may have a number of undesirable consequences for biodiversity:
a) Introduced species may outcompete native species.
b) Introduced species may disturb the ecological balance, by influencing functional/structural relationships.
c) Introduced genetic material may infiltrate native species and cause genetic changes as a result of the incorporation of unfavourable traits (e.g. poorer cold-hardiness).

Nowadays, introductions occur by a variety of routes, one of them being various modes of transport: e.g. marine organisms are carried in ballast water, and diaspores attach to vehicles and are transported across borders by them. Other means of introduction include imported goods (e.g. insects and fungi in timber), animals escaping from captivity, and the release of introduced pets. There are also examples of deliberate introductions, e.g. cultivated plants (exotic tree species), fur-bearing animals, honeybees, pollinating bumble-bees, and stocking of fresh waters with fish or crustaceans for fishery management purposes.

The introduction of alien species and genetic material is a problem that has many dimensions. National frontiers are rarely biologically relevant in this context; instead, an approach based on biogeographical regions is called for. What is more, EU membership and free trade agreements restrict Sweden's scope to regulate introductions across its borders.

In the case of plants, policies and assessments should differ according to the *phytogeographical regions from which they are imported*, i.e. whether they come from a different phytogeographical region or from the same or a very closely related

one. It is also important to take into account the *different categories of plants* involved, e.g. (1) species entirely new to Sweden, (2) species and lower taxa naturalized in Sweden, (3) genotypes new to Sweden of species which already occur in the country, (4) species native to Sweden with important genotypic differences (of ecological or historical origin) at a local or regional level, (5) species native to Sweden with a very restricted geographical range, (6) species endemic to Sweden, and other categories.

ACTION 31:

- **Develop *better basic documentation and procedures for risk assessment* relating to introductions. As part of this action, an assessment should be made of the risk of `genetic contamination' of various Swedish plant species (if possible also of other groups of organisms).**
- **Establish a conceptual apparatus, preferably geared to the EU context.**
- **Highlight this problem within the EU and seek to ensure that national controls can be established in certain cases. Restrict introductions where there is a danger that they will cause problems in terms of biodiversity. A closer study needs to be made of how this should be done; among other things, the feasibility of measures to control introductions of non-native animal species should be examined (by the Environmental Protection Agency).**
- **Document introductions that have already occurred.**
- **Document the present situation and projections concerning the economic losses and ecological damage caused by earlier introductions.**

Background and reasons for proposal: The problems involved in this area should primarily be addressed by means of *better risk assessments.* The scope for national controls is very limited. It should be established as soon as possible which alien species etc. could have adverse effects and steps should be taken to avoid their release into the natural environment.

Documentation on which to base risk assessments (relating to plant species), similar to that proposed, has been elaborated in Norway. Lessons should also be learnt from the work done on risk assessment of genetically modified organisms. The parameters to be taken into account in these assessments may include:

-- powers and methods of dispersal,
-- dominance (competitiveness),
-- propensity to cause genetic changes in native or regional/local populations by means of hybridization or changes to native or local genotypes,
-- carriers of diseases and parasites,
-- weeds in agriculture and forestry.

A number of important questions of scope also need to be clarified. Should risk assessments and policies apply to all types of dissemination of taxa by human agency, for example, or should their scope be limited to some extent? Should the spread of species etc. *within* the country also be included? How should unintentional introductions be dealt with? What account should be taken of the relationship between biogeographical range and national borders when these assessments are made?

In parallel with its own studies, Sweden should raise this issue within the EU and seek to ensure that member states have the option of introducing national controls on imports assessed as posing a risk to their biological diversity. The basic principle should be that in certain cases *ecological* grounds are a sufficient basis for

preventing introductions. The feasibility of national controls should be examined, along with the technique of using `positive lists'.

Dissemination of information is an important area in which efforts need to be stepped up. It should be made clear that information activities are the responsibility of both public bodies, such as the Environmental Protection Agency, the Board of Forestry and the Board of Agriculture, and organizations (e.g. the Federation of Swedish Farmers, county agricultural societies) and specific sectors.

Implementation: The Swedish Biodiversity Centre should be entrusted with drawing up basic documentation for risk assessments. Information activities should be undertaken by the bodies mentioned above, among others.

Timetable: Study should be completed no later than 1997.

Protected species

At present, the fact that a species is protected only means that it is an offence to damage or kill the species itself. There is nothing to prevent people harming the species' habitat or the wider landscape in which it lives. This weakness means that, even though a species is protected, human activities may eliminate it from one site after another. The aim should be to introduce more effective protection for plant and animal species, extending also to their habitats (see proposal in the section on legislation).

ACTION 32: **The Environmental Protection Agency should review existing national and regional lists of protected species, *inter alia* with a view to**

- **modifying the lists to take account of the present situation,**
- **coordinating species protection between counties,**
- **proposing protected status for the species included in the EC Birds and Habitats Directives, if this is necessary for their conservation, and where necessary also proposing protection of their habitats, and**
- **meeting the requirements of the Bern Convention as regards protection of the Swedish plant species listed in Appendix I of the Convention (strictly protected plant species).**

Should be implemented by 1997. Estimated total cost: SEK 200 000 (within existing allocations).
In addition, a study should be made of the feasibility of introducing a form of species protection which also safeguards the habitats of the species concerned (see proposal in section on legislation).

Hunting

Hunting of certain mammals and birds is a long-standing tradition in Sweden. It not only makes a substantial contribution to the country's food supply, but is also of significance in terms of recreation and enjoyment of the natural environment. In 1994-95, for example, Sweden had a winter population of over 200 000 elk (moose, *Alces alces*) and in the region of 1 million roe deer (*Capreolus capreolus*) (the figures vary from one year to another).

ACTION 33: **Develop a *hunting and game conservation policy*. In connection with**

this, make a closer study of the following questions, among others:

- **The possible detrimental effects of sex and age imbalances resulting from hunting.**
- **Appropriate population sizes (for certain species) from the point of view of achieving optimum conditions for conserving genetic, within-species variation.**
- **The need to adjust numbers hunted and total populations of game species for which Sweden has an international responsibility.**
- **The need to and feasibility of reducing numbers of certain non-native, introduced species.**

Background and reasons for proposal: A coherent policy on hunting and game conservation is of great importance. To help elaborate such a policy, a study should be made of criteria to determine which species may be hunted, and adjustments to existing hunting legislation should be considered (in the light of the environmental quality objective relating to hunting, see section 3.5.7). In certain cases, population sizes desirable from the viewpoint of biodiversity should be more precisely defined.

Even if legal hunting poses no threat to the numbers of the species concerned, it may nevertheless represent a threat to their genetic diversity. Further studies and monitoring are therefore called for. It is particularly important to assess how new forms of hunting and hunting in new areas are affecting biodiversity. A study should also be made of ways of reducing populations of introduced, non-native species by hunting. Alternatively, if such species have only limited harmful effects, it should be assessed whether they can be accepted in Sweden and what populations or ranges are acceptable.

This work should be undertaken by the Environmental Protection Agency. A hunting and game conservation policy should be drawn up by the end of 1996 at the latest.

ACTION 34: **Carry out more research into the correlation between the size of ungulate populations and the distribution of deciduous trees -- primarily rowan (*Sorbus aucuparia*), aspen (*Populus tremula*) and goat willow (*Salix caprea*) -- that have attained the natural growth form of trees.**

Background and reasons for proposal: Although the elk (moose) population has declined since the beginning of the 1980s, many parts of Sweden still have the world's densest populations of this species. In winter, elk browse heavily on deciduous trees such as rowan, aspen and goat willow, so heavily that there is a danger that the abundance of these species will be greatly reduced in future forest rotations (in certain parts of Sweden, at least). The roe deer population is also of significance in this connection, at least in the south of Sweden. In the 1980s, roe deer numbers were higher than ever before in historical times, and they remain high.

The decline of deciduous trees is also partly the result of intensive forestry, which has favoured conifers. Some of the beneficial effects of the favourable trend now discernible in forestry, towards greater tolerance of a deciduous component in forests, may be lost if browsing pressure is too high. Research has shown that in a coherent forest landscape species preferred by browsing animals, such as rowan and aspen, have only a limited chance of attaining the natural growth form of a tree.

Aspen and goat willow play a particularly key role in the coniferous forest landscape. They are hosts to a wide range of lichens, bryophytes, fungi and small animals. Several plants of significance to the forest ecosystem, such as bilberry (*Vaccinium*

myrtillus) and rosebay willowherb (*Epilobium angustifolium*), are also very heavily grazed. Bilberry, especially, plays an important part in the ecosystem.

More needs to be known about the correlation between elk and roe deer numbers and the chances of the deciduous trees referred to attaining a natural tree shape. Bilberry is also unable to develop fully, being grazed down to a `stump', with short shoots and few berries. The situation in different parts of the country should be studied. Different possible solutions to this problem should be examined more closely.

Implementation: Studies should be carried out in the higher education sector. Methods of measuring population development in ungulates should be developed, making use of surveys of browsing/grazing pressure on preferred plant species and regular counts of droppings. Surveys of browsing/grazing pressure and droppings could be carried out by the Forestry Administration and hunters' organizations.

ACTION 35: **Make an assessment of how small-game hunting (and fishing) on state land above the limit of arable farming and in mountain reindeer-grazing areas is affecting biodiversity.**

Background and reasons for proposal: It is very important to make a biological assessment of how the new arrangements for access to small-game hunting in Sweden's mountain areas are -- directly or indirectly -- affecting biodiversity. Particular attention should be paid to

-- how the new system influences hunting pressure and whether the latter needs to be controlled,
-- how populations of species which are dependent on the species hunted are affected, and
-- whether hunting needs to be excluded from certain areas, e.g. to avoid disturbance of areas that are particularly sensitive from a nature conservation point of view, or to ensure that a sufficient number of reference areas undisturbed by hunting are available for research and environmental monitoring.

Implementation: Should be undertaken as part of the Government-commissioned inquiry already being carried out by the Swedish Board of Agriculture and the Sami Parliament. The above proposal should be transmitted to those authorities for consideration.

Flora- and fauna-related crime

Some *illegal hunting* does occur, and it may represent a threat to biological diversity at the national or local level. It is very important to take effective action to prevent this and to bring those responsible to justice. If sufficient resources are not made available for this purpose, there is a danger that illegal hunting will continue or even become more widespread. *Illegal collecting of plants* is also a problem of increasing significance. Sought-after orchids and other species are clearly being dug up on an organized basis. Illegal trade in plant and animal species is another problem that has grown in recent years.

A particular difficulty in this area is the fact that, with Sweden now a member of the EU, the Board of Customs has no power to intervene at an internal frontier to stop illegal imports and exports of endangered animals and plants and of products manufactured from them, which occur on a large scale between EU countries. This

problem needs to be addressed without delay. In this connection, the Environmental Protection Agency would draw attention to the possibility referred to by the Board of Customs in its response to the EU border controls inquiry, i.e. that of introducing legislation modelled on Sect. 2 of the Act concerning Coast Guard Participation in Police Surveillance Operations. This would enable a customs officer to intervene on discovering that someone was unlawfully carrying such items on arrival in Sweden from another EU country, if it was suspected that an offence had been committed under the Act on Measures relating to Animals and Plants of Protected Species, for example.

ACTION 36: **Allocate greater resources to the bodies responsible for managing protected areas and to the police, prosecution and customs authorities for monitoring, investigation of hunting offences and training concerning flora- and fauna-related crime.**

Background and reasons for proposal: If results are to be achieved, surveillance and monitoring and also more extensive training and dissemination of information need to be undertaken by the authorities mentioned above. Cooperation with voluntary organizations should continue to be used to good advantage. This problem is of such a specialized nature that, almost without exception, it is beyond the scope of the normal operations of the police and customs authorities, for example. A special commitment of resources is therefore necessary.

Implementation: Increased allocations: The Government and Parliament. Should be coordinated with the authorities referred to above, taking into account, among other things, the recommendations already put forward or to be submitted by the one-man inquiry set up by the National Police Board.

Timetable: Should be implemented as soon as possible.

Cost: Approx. SEK 2 m.

Conservation of genetic variation

It is often difficult to measure genetic variation, and the process generally involves time-consuming and expensive analyses. For the great majority of species, we must simply work on the assumption that *genetic variation will be preserved if viable populations of each species concerned are maintained throughout most of its natural range and in the entire spectrum of niches which it occupies*. In the case of certain species, however, we know that the situation regarding genetic diversity is critical. This is true of the salmon (*Salmo salar*) of the Baltic Sea, for example. And new findings indicate that Sweden's brown bear (*Ursus arctos*) population very probably consists of two genetically distinct populations.

In many cases, conserving the genetic variability of a species may be an important factor in ensuring its long-term survival. If the species' genetic variation is reduced too drastically, it may no longer be able to adapt to a varying environment. It may also become more sensitive to disease, for example. Quite clearly, it is not possible to take species-specific action to preserve the within-species diversity of all of the country's species or populations. The focus of conservation efforts must therefore be on measures which may be assumed to create, indirectly, conditions for maintaining genetic variation.

Among the various plant genetic resources that are utilized in Sweden, a special position is occupied by forage crops, especially grass and clover species. For one thing, all the species concerned occur in the wild in Sweden, and for another, both wild-growing, semi-domesticated and fully domesticated forms of the individual species are to be found within this group. The dividing lines between these categories are not always sharply defined. The same phenomenon can be observed among species of trees and shrubs planted in semi-natural landscapes, ornamental plants and medicinal plants. There should be a *clear division of responsibilities* between different authorities, so that no species or population runs the risk of `falling between two stools'.

ACTION 37: **Develop a programme to analyse genetic variation within and between populations of *a selection of species* (within different groups of organisms) for which there are grounds to assume that the existing genetic variation may be of *particular interest from the standpoint of conservation or use*, e.g. Baltic seals, brown bear and wild salmon (see also the section on research -- population level).**

Implementation: The programme should be drawn up by the Environmental Protection Agency. Analyses should be performed on a contract basis by suitable institutions. It is important to put the latter in a position to maintain the expertise needed to carry out such analyses.

Timetable: A programme should be elaborated no later than the end of 1997.

5.4 Action to reduce pollution

5.4.1 Introduction

This section discusses proposals to reduce emissions of pollutants that are judged to be particularly detrimental to biological diversity. In its directions on the use of appropriations for 1995/96, the Environmental Protection Agency was entrusted with a number of studies relating to the reduction of various types of emissions. These include work on emissions from small-scale burning of wood, further reductions of sulphur emissions beyond the year 2000, and discharges of oil in the Baltic Sea, and a review of the provisions of the Vehicle Emissions Ordinance. The Agency was also asked to submit follow-up reports, for example on the reduction targets relating to metals and persistent organic pollutants, and on nitrogen inputs to sea areas (for which the target is a reduction of 50 %). The Agency therefore intends to submit more specific proposals when it presents the results of these various studies and the reports referred to. The outline account below deals with activities in progress in other contexts (various projects, inquiries etc.).

The *Strategy for Sustainable Development* drew attention to the serious threat to biodiversity posed by pollution. Toxic pollutants and chemicals, and widespread environmental perturbations such as acidification, eutrophication and climate change, can have very appreciable and undesirable effects on biodiversity, by disrupting ecological processes and altering the composition of plant and animal communities and the distribution patterns of individual species. Some of these changes are irreversible, i.e. they will persist even if the causes are eliminated. In freshwater and marine environments, toxic pollutants can represent a threat to individual species of top consumers.

In the forest landscape, air pollutants are a very serious threat. Soil acidification,

nitrogen over-enrichment due to heavier atmospheric deposition, and high atmospheric concentrations of ozone affect large areas of forest land in Sweden. As a result of pollution, at least a fifth of the country's forest area runs a tangible risk of future production losses and erosion of biodiversity.

Over time, the biodiversity of farmland is also affected by pollution. Atmospheric inputs of nitrogen modify the flora of unimproved pastures, for instance, in favour of nitrophilous species. Acidification can increase leaching of certain nutrients and thus result in nutrient deficiencies, despite a surplus of nitrogen.

Nutrients, heavy metals and toxic organic compounds have resulted in ecosystem changes in many lakes and running waters. Regional-scale acidification has disturbed the species composition of around 20 % of Sweden's lakes.

In marine environments, too, pollutants have brought about changes in biodiversity in recent decades. Fisheries and to some extent the exploitation of shallow areas of the seabed have been contributory factors, but pollution has to be regarded as the biggest threat. Increased nutrient loads, resulting in higher primary production and oxygen depletion, and exposure to toxic pollutants have had particularly noticeable impacts.

The following groups of substances have the most marked effects on biodiversity, and need to be tackled most urgently:

- sulphur oxides, nitrogen oxides and ammonia,
- volatile organic compounds (VOCs),
- the nutrients nitrogen and phosphorus,
- persistent, toxic organic pollutants,
- mercury and cadmium, and
- carbon dioxide and other greenhouse gases.

The *Strategy for Sustainable Development* discusses these different types of pollution in detail and includes proposals on action to tackle them. The proposals set out there concern every sector of society -- industry, transport, energy, sewage disposal, agriculture etc. -- and underline the need to intensify international cooperation. In the case of the pollutants judged to be of most significance for biodiversity, other countries make very substantial contributions to the total loads affecting Sweden. This is particularly true of atmospheric pollutants, but other countries also account for a significant share of nutrient inputs and direct discharges to water of persistent chlorinated compounds.

To diminish the threat to biodiversity, then, emissions of a wide range of pollutants need to be significantly reduced across Europe, and action in Sweden has to be seen against this background. On the other hand, in most cases the largest single contribution to the pollutant loadings affecting Swedish land and water is that of Sweden itself.

Since the *Strategy for Sustainable Development* was published, a good deal of action has been taken in Sweden and other countries in line with the proposals contained in it. The following are some of the key developments and initiatives:

- Sweden's sulphur emissions have been cut by 80 % since 1980, as planned.
- A second Sulphur Protocol has been adopted, providing for substantial emission reductions in Europe. This agreement primarily covers the period up to the year 2000.
- A second protocol to reduce emissions of NO_x/VOCs in Europe is under active consideration. Progress towards lower NO_x emissions is proving slower

than previously planned, however, chiefly because of growth in traffic. The intended 30 % reduction compared with 1980 will probably not be achieved until around 2000. Progress on VOCs has also been somewhat slower, and the target of a 50 % reduction will not be attained until a few years into the 21st century.

In addition, it may be noted that an acidification strategy is now being drafted within the EU.

In June 1991, the Government asked the Environmental Protection Agency to draw up a ten-year programme to review the emission conditions attached to permits for industrial operations. The aim of this programme (the `review plan') was to ensure that, by the beginning of the 21st century, modern and appropriate conditions would be in place for every plant engaged in environmentally hazardous activities, and that emissions from such plants would have been brought down to levels which cause no harm to the environment and have no appreciable impact on health. Possible means of achieving this objective were presented in the report `Environmentally hazardous plants -- 10-year programme for a review of emission conditions' (Environmental Protection Agency 1992, in Swedish). In conjunction with the elaboration of this programme, an assessment was made of what types of technology could be regarded as `Best Available Technology' (BAT).

Many countries have shown a growing interest in action to deal with persistent organic pollutants (POPs), and measures have been introduced in many sectors. Sweden's programme to reduce pesticide use in agriculture has been successful and has been emulated to some extent in many other countries. Work on POPs has continued within HELCOM, OSPARCOM and the North Sea Conference, and negotiations have begun under the Convention on Long-Range Transboundary Air Pollution (LRTAP). Within the EU, a major programme on environmentally hazardous chemicals is now under way.

As regards metals, progress has been slower. Sweden's action programme on mercury is moving ahead as planned, but problems have been encountered regarding cadmium in fertilizers and recycling of nickel-cadmium batteries. At the international level, action plans have been implemented under HELCOM/OSPARCOM auspices and discussions are now in progress under LRTAP. Unfortunately, agreement on wider-ranging measures, including action to curb the use of cadmium and mercury (OECD), has proved elusive.

Turning to nutrients, nitrogen discharges from coastal sewage works have been reduced according to plan, and the action programme for the agricultural sector is at least now being implemented. Many of the measures required have still to be carried out, however. In the case of phosphorus, achieving adequate action by private households is still proving an uphill struggle.

Greenhouse gases and the climate change which might result from them could influence biodiversity in the long term. This is a global problem, and is currently being considered under the Convention on Climate Change. The Agency has not felt there to be any need in the present action plan to put forward additional proposals in this area.

5.4.2 Nitrogen oxides, ammonia and volatile organic compounds

Transport

An extrapolation of nitrogen oxide emission trends in line with the decisions now taken clearly shows that transport is and will remain a dominant emission source.

Thanks to the measures that have been introduced with regard to road transport, the present trend is favourable, with a fall in emissions. Taking into account the decisions now taken and the growth in traffic predicted by the transport agencies, however, we fear that this trend could make way for a rise in emissions around and beyond 2005.

Ships (Swedish and foreign) in the sea areas off Sweden's coasts emit substantial quantities of nitrogen oxides, together with other pollutants. Much of this nitrogen, too, is deposited on Swedish land and water. The technology needed to significantly reduce these emissions is already available. The difficulty lies in establishing effective incentives and other instruments to ensure that it is actually used in the international shipping industry.

Of the various modes of transport, civil aviation is expected to show the most rapid increase in volume and hence emissions. Improved engine technology has enabled emissions of hydrocarbons and carbon monoxide to be reduced. Technology to cut nitrogen oxide emissions has only been developed in the last few years, and has yet to establish itself commercially. Although present emissions are not particularly high in absolute terms, action within civil aviation will be necessary as part of a comprehensive strategy for the transport sector as a whole.

Transport is at present a dominant source of emissions of volatile organic compounds (VOCs). Future trends for these emissions look more promising, however. Extrapolations suggest that the transport sector will be able to reduce its VOC emissions by about 80 % compared with 1988 levels. Additional measures may be needed, though, to prevent a new rise in emissions after the turn of the century. In the framework of EU cooperation on vehicle exhausts, efforts are also being made to develop standards for cold starts (which are mainly of significance for VOC emissions) and in-use compliance requirements for emission abatement equipment.

[BOX:]

TABLE 2. Extrapolation of emission trends in the transport sector, from Environmental Protection Agency Report 4205

NITROGEN OXIDES, thousand tonnes

	1980	1991	2000	2005	2010	2015
Road transport	154	165	91	68	63	66
Air transport	6	8	12	16	20	25
Shipping	57	63	72	76	80	84
Rail transport	1	1	1	1	1	1
Total	*217*	*237*	*176*	*157*	*164*	*180*
Non-road mobile machinery	72	78	78	78	78	78

[END OF BOX]

Transport and Climate Committee

The terms of reference of this committee were (i) to propose measures to reduce emissions of carbon dioxide etc. from the transport sector, (ii) to study the possibility of environmental zones in urban areas, (iii) to examine the suitability of separate environmental objectives for different modes of transport, and to propose such objectives, and (iv) to study the competitiveness of public transport. It reported in June 1995.

Environmental Classification Commission

Membership of the EU means that Sweden is now in a different position as regards using economic instruments to promote the development of environmentally sounder vehicles. A special inquiry, the Environmental Classification Commission, has recently reviewed the scope to develop environmental classes for vehicles in the EU context and submitted recommendations to the Government.

Study of action to reduce NO_x and VOC emissions

At the request of the Government, the Environmental Protection Agency is drawing up proposals for further action to reduce emissions of nitrogen oxides and volatile organic compounds (VOCs) in all sectors. It is to report to the Government in January 1996.

Cooperation on an Environmentally Sound Transport System (ESTS)

To bring about the changes needed in the transport sector, a long-term approach is essential and development work must be undertaken in collaboration with the parties involved. An awareness that a new strategy is called for in this area has resulted in the various bodies concerned embarking on a joint project to lay the foundations for an action plan to achieve an Environmentally Sound Transport System (ESTS, in Swedish `MaTs'), within a time-frame of 25-30 years. The partners in this project are the National Rail Administration, the Association of Swedish Automobile Manufacturers and Wholesalers, the National Board of Housing, Building and Planning, the Commission for Forecasts and Development in the Transport Sector, the Communications Research Board, the Civil Aviation Administration, the Environmental Protection Agency, the National Board for Industrial and Technical Development (NUTEK), the National Maritime Administration, the Swedish Petroleum Institute and the National Road Administration.

It is important to define the various objectives that need to be set to achieve the ultimate goal of an Environmentally Sound Transport System. These objectives must include operational environmental objectives which define in a long-term perspective what bringing the transport system into line with the needs of people and the natural environment actually entails. It is necessary to lay down both long-term environmental quality and action objectives, but also very tangible, step-by-step objectives to guide the environmental protection activities of the various bodies and enterprises involved. A working group chaired by the Environmental Protection Agency has produced a report entitled `Action objectives for the transport sector -- preliminary points of departure'. This report was submitted to the Transport and Climate Committee in April 1995.

The development of an environmentally more sustainable transport system will affect a variety of key interests in society, both inside and outside the transport sector. It is

therefore important to be able to show how the various aspects involved are interrelated and identify ways of achieving change which reconcile different interests and points of view. Established and traditional outlooks will of necessity be called into question.

In this process of analysis, it is important to work on the basis of reasonable measures and incentives. A study will therefore be made to establish what courses of action are realistic and may be expected to be achieved on a time-scale of 25 years. This study will look at impacts on the total volume of traffic, the potential for using alternative and combined modes of transport, traffic management, technical development and land use.

A number of focused efforts will be made to develop different policy instruments, not least economic instruments and information activities. The hope is that the basic documentation produced by the ESTS project will provide the basis for a strategy to achieve an Environmentally Sound Transport System in practice.

The technology to substantially reduce emissions already exists, as is shown, for example, by the National Maritime Administration's report on action in the shipping sector. However, the legislation and powers needed to regulate emissions are not yet in place. Previously, therefore, the Environmental Protection Agency has recommended that regulation of the engine types concerned should be coordinated by means of uniform legislation, irrespective of their spheres of application. In the *Strategy for Sustainable Development*, the Agency proposed that the Government should amend the Vehicle Emissions Act to allow the introduction of standards for small petrol engines used in equipment such as lawnmowers and chain saws, as outboard motors on recreational boats, and so on. Solutions need to be found at the international level, however. The Agency intends to submit proposals in a report on another Government-commissioned study in January 1996.

Commission on Transport and Communications

In December 1994, the Government decided to set up a parliamentary-based Commission to draw up a national transport and communications plan for Sweden. According to the Commission's terms of reference, this plan is to be based on an integrated approach and be designed to help achieve an environmentally sound transport system, while also ensuring safety, prosperity, long-term sustainable growth, regional balance and a competitive business sector.

In practice, this means that the action programme intended to emerge from the ESTS project will largely be designed by this Commission, on the basis of documentation produced within that project and from other sources. The planned design of the ESTS project can thus be followed through, although certain adjustments will need to be made to bring its timetable into line with the work of the Commission.

Machinery

Outside the transport sector, very significant emissions are produced by non-road mobile machinery, e.g. tractors and forest machinery. According to present assessments, nitrogen oxide emissions from such machinery will, if no action is taken, be higher than those from road transport just a few years into the 21st century. International cooperation within the EU, however, is expected to result in more stringent standards for the engines used in non-road mobile machinery.

Small petrol engines, used for example in lawnmowers, snowmobiles etc., generally emit high levels of VOCs. The Environmental Protection Agency has estimated that total VOC emissions from these types of equipment and those mentioned in the paragraph above will by the year 2010 be at the same level as emissions from road transport (21 000 tonnes). To this figure we should add emissions from recreational boating (15 000 tonnes).

Energy

Nitrogen emissions from energy conversion processes mainly occur in the form of nitrogen oxides (NO_x) produced during combustion. NO_x emissions from combustion processes fell by about 55 % between 1980 and 1993. Further measures proposed:

- The nitrogen oxide levy should be extended to apply to all plants producing > 25 GWh (to be fully implemented by 1997), which will result in a further cut in emissions.
- As part of the Government-commissioned study of action to reduce NO_x and VOC emissions, the Environmental Protection Agency is examining the feasibility of standards/regulations for plants not subject to the NO_x levy and of environmental labelling of small solid-fuel boilers. Proposals will be presented in January 1996.
- Hydrocarbon emissions from the energy sector stem chiefly from small-scale burning of wood, and amounted to some 130 000 tonnes in 1992, i.e. 25 % of the total emission in Sweden. Using established technology (a modern boiler with a heat accumulator), emissions can be reduced by over 90 %. The majority of existing boilers have water-cooled fireboxes and lack accumulators, resulting in poorer combustion conditions and high emissions.

In December 1993, the Environmental Protection Agency and NUTEK recommended the Government to introduce a range of measures to reduce emissions, including the following (Environmental Protection Agency Report 4270):

- Introduce an Act on small-scale use of solid fuels. On the basis of this Act, general standards could be introduced for new wood-fired boilers and stoves.
- Amend public health legislation to give municipal authorities powers to introduce general regulations requiring technical improvements or restricting combustion in certain areas.

Government Bill 1994/95:119 proposed measures to reduce VOC emissions from small-scale burning of wood. These measures are not as far-reaching as those proposed by NUTEK and the Environmental Protection Agency in Report 4270.

* * *

Emissions of nitrogen oxides and ammonia in the *agricultural* sector are expected to be dealt with in the Board of Agriculture's action plan, in line with the division of responsibilities laid down and the principle of sectoral responsibility. The same applies to leaching of nutrients.

5.4.3 Nutrients

Sewage disposal

The *Strategy for Sustainable Development* presents a number of measures to reduce

discharges of nitrogen and phosphorus:

- Higher sewage treatment standards in sparsely populated areas.
- Action to reduce the amount of water not requiring treatment which reaches sewage treatment plants.
- Completion of the programme to introduce nitrogen removal and improve phosphorus removal processes at coastal sewage works, as decided by Parliament.
- Study of the need for and feasibility of further reductions in discharges in inland areas, in the STRAM framework.

It will take many years to upgrade sewage treatment facilities in sparsely populated rural areas. This is a municipal responsibility and, owing to inadequate statistics and reporting systems, it is not possible to monitor what progress has been made. The Environmental Protection Agency is currently drawing up a standard form for reporting on this subject.

It is estimated that more phosphorus is now discharged from drains in sparsely populated areas than from all of the country's major municipal sewage works put together. This is mainly because older houses generally lack sewage treatment facilities, although this is in direct contravention of the Environment Protection Act. The installation and upgrading of such facilities will require a total investment of several billions of kronor. The Environmental Protection Agency intends to initiate the setting up of an organizational framework for developing, assessing, testing, trying out and recommending different solutions.

Efforts to reduce the amount of water not needing treatment which reaches sewage works are being made on many different fronts at the municipal level, e.g. separation of surface runoff (storm water) from foul sewage, systematic efforts to make sewers impervious to inward leakage of groundwater, and regulation of sewage flow by means of a combination of storage reservoirs and advanced control technology.

Reviews of discharge permits and upgrading to include nitrogen removal facilities are still in progress. Some 15 of the roughly 70 plants originally identified have still to be reviewed. Since Sweden's accession to the EU, the 1991 Urban Waste Water Treatment Directive is applicable in this area.

To solve the problem of marine eutrophication, it is essential to reduce emissions of nitrogen compounds to air (e.g. from vehicle exhausts) and to ensure that action is taken in the other coastal states of the Baltic and North Seas. Impact assessments and action programmes have also been drawn up by HELCOM and OSPARCOM. It is important to ensure that the measures already decided on are in fact carried out and that additional action is discussed. Bilateral cooperation is taking place, in particular with the Baltic states, with a view to reducing sewage discharges into the Baltic, for example. The primary aim of this cooperation is to promote a transfer of knowledge relating to legislation, official action and strategic planning of investments.

Point-source discharges, in the sewage disposal and other sectors, have largely been dealt with. Eutrophication nevertheless persists, to the detriment of the biodiversity of aquatic environments. One lake in six in Sweden is now suffering severe eutrophication. Sewage disposal is still one of the principal causes, especially as regards phosphorus. At the same time, it is not possible to point to any single measure that would solve the problems in this sector. In addition, there are major differences between different parts of the country in terms of what measures are relevant and practicable. To assist municipal authorities, the Environmental Protection Agency has begun a system-oriented study, aimed at devising a

user-friendly approach for municipal-level projects to achieve environmentally sound sewage disposal, and at identifying suitable instruments to ensure its implementation.

5.4.4 Metals

As far as metals are concerned, emissions in other countries pose a serious threat to biodiversity. The Environmental Protection Agency and the National Chemicals Inspectorate will continue to be actively involved in efforts within HELCOM, OSPARCOM, LRTAP, the EU and the OECD to reduce European emissions of mercury and cadmium to both air and water.

At the national level, the programme to phase out the use of mercury will continue. A report will be submitted to the Government in 1996. The Government has appointed a one-man inquiry to look at the problem of batteries. Current levels of recycling of nickel-cadmium batteries (around 30 %) are far too low. In addition, further efforts to prevent leaching of the large quantities of metals stockpiled in many mining spoil heaps are urgently required. If these quantities of metals end up in streams and rivers, they will have a major impact on biodiversity.

5.4.5 Toxic organic pollutants

As part of a study on water conservation commissioned by the Government, the Environmental Protection Agency is trying to define more precisely the problem of toxic organic pollutants (report due in spring 1996). How large a threat to biodiversity do these pollutants represent?

As with metals, other countries' emissions are a serious threat to biological diversity, and the Environmental Protection Agency and the National Chemicals Inspectorate will be actively pursuing this issue within HELCOM, OSPARCOM, LRTAP and the EU. It is also now being discussed at a global level.

At the national level, the work being done on chemicals by the Chemicals Inspectorate and the Agency is of great importance. The `Observation' and `Restrictions' lists recently drawn up by the Inspectorate form an important basis for this work. In addition, further work on criteria of environmental hazardousness, a Government-commissioned project on risk reduction plans for a further 25 substances, and substitution of less hazardous chemicals in various sectors are all of great significance.

The Environmental Protection Agency's review programme for industry should be implemented. Here, there are good prospects of achieving results, e.g. with regard to the closed-system processes used in the forest products industry.

One important area as regards reducing discharges of toxic pollutants is the clean-up and restoration of contaminated sites. In a situation report in October 1994, the Environmental Protection Agency drew attention to the considerable risk of substantial discharges in the future if no action were taken over the next few years. The Agency intends to propose measures and funding arrangements in the autumn of 1995.

Action proposed

Specific, fully elaborated proposals to reduce pollutant emissions are intended to be presented in other contexts (see introduction to this section, 5.4.1). In many of the areas concerned, proposals have been submitted previously, *inter alia* in the *Strategy for Sustainable Development*. Further work is being done on all these proposals, either within the Environmental Protection Agency or as part of other inquiries in which the Agency is participating. Below, we list only a few examples of these proposals in point form. This does not mean that the Agency attaches less importance to action to reduce pollution than it does to the other measures set out in this action plan.

ACTION 38:

- **In the EU context, maintain an environmental classification system for vehicles which sets high environmental standards and is supported by economic instruments.**
- **Create an organizational framework for developing, testing and trying out technology for private sewage treatment.**
- **Implement the programme to review permits issued to industry, partly with a view to reducing the use of toxic, persistent and bioaccumulating chemicals and emissions of pollutants with such properties.**

5.5 Tourism and recreation

More and more tourists are now visiting Sweden: the country's natural environment is relatively unspoilt, and is regarded by many as `Europe's last wilderness'. Market research indicates that every year some 600 000 foreign tourists come to Sweden primarily to go fishing, walking or canoeing or to take part in some other nature-oriented activity. For another 600 000-700 000, such activities or experiences are a contributory factor behind their choice of Sweden as a holiday destination. Tourism is thus an important factor affecting biological diversity, while at the same time biodiversity is an important *asset* for both tourism and everyday outdoor recreation.

In addition to the proposal below, the Environmental Protection Agency wishes to draw attention to those set out in the report on `Public access to the countryside and the commercial sector', presented by the Agency earlier in 1995 (Report 4446, in Swedish). Several of those proposals touch -- at least indirectly -- on biodiversity.

ACTION 39: **Develop criteria, policies and strategies for sustainable tourism.**

Background and reasons for proposal: Tourism in Sweden -- both its passive (sightseeing) and more active forms (walking, water sports etc.) -- is based to a large extent on the natural environment. Pressure on the countryside may be expected to increase. The growing interest in nature tourism means that new visitors are making use of the countryside on the basis of the traditional right of public access, without always being aware of the accompanying obligation to respect the fauna and flora they find there. In certain areas, there is a danger of increasingly adverse impacts on the environment. At the same time, environmental awareness is gradually growing among both tourists and tour operators. There is an increasing interest in fauna, flora and the landscape, and sustainable tourism and ecotourism are now a growth sector.

There is a need for a discussion to establish what level of use for tourism and recreation the natural environment can withstand.

A strategy for sustainable tourism can be developed partly on the basis of the booklet `Sustainable tourism and ecotourism' (in Swedish), published by WWF-Sweden.

Implementation: It is proposed that this action should be implemented by the new Swedish Tourist Authority, in consultation with various other bodies, including the Environmental Protection Agency, the Swedish Association for the Promotion of Outdoor Life, WWF, the Swedish Society for the Conservation of Nature, and representatives of the tourist industry and landowners.

Timetable: The strategy should be drawn up by July 1997 at the latest.

Estimated cost: Approx. SEK 600 000.

Funding: Should be funded through the Tourist Authority's allocation.

5.6 Monitoring and data management

Keeping track of the state of biodiversity, evaluating action taken and assessing progress towards objectives etc. are important tasks. The main source of the data on the state of the natural environment which we need in order to analyse and assess whether we are moving closer to or further away from our objectives is *environmental monitoring.* To be able to collate and analyse all the data available -- from monitoring and other sources -- systematic *data management* is required. Data can in turn be worked up into *environmental statistics* and hopefully also *environmental indices* which reflect how the natural environment is developing.

5.6.1 Environmental monitoring

What is environmental monitoring?

Monitoring is one of the cornerstones of environmental protection, its purpose being to describe the state of the environment on a continuous basis, in order to provide evidence of trends and changes. An additional aim is to assess what the main threats to the environment are and to analyse the environmental impacts of different factors. Monitoring should be linked to defined overall environmental objectives (see section 3.3) and environmental quality objectives. The importance of monitoring is underscored in Article 7 of the Convention on Biological Diversity.

Increasing use is being made of objectives to shape and guide action to protect the environment. We wish to be able to see whether the aims that have been set, for instance as regards maintaining biodiversity, are being achieved. Monitoring is intended to describe the state of the environment and hence to serve as a means of assessing environmental protection efforts in the light of agreed objectives. The data which it produces should also be of use in defining environmental quality objectives and designing action programmes for different sectors. Effective environmental monitoring is thus basic to assessing progress towards goals, at both the national and the international level.

In recent years -- against the background of a number of policy decisions -- the

Environmental Protection Agency has been commissioned by the Government to carry out several projects involving monitoring and evaluation of the state of the natural environment. These include a study of the consequences of the 1990 food policy decision, *inter alia* for biodiversity (the LiM project), and a follow-up and evaluation (in collaboration with the National Board of Forestry) of Sweden's new forest policy and the environmental objective of that policy, which is now placed on a par with the production aims of forestry. To be able to assess and report on the state of the environment -- e.g. the situation as regards biodiversity -- the Agency needs to have access to relevant data, clearly reflecting the environmental changes that are occurring. Essentially, these data will be gathered through the various environmental monitoring programmes in operation in the country. *To enable monitoring to serve its purpose -- that of supplying the data and information needed to assess whether we are achieving the objectives that have been set regarding biodiversity -- it must be developed and extended to bring it to the level described in the present plan.* If it is not, there is a clear danger that it will be very difficult in the years ahead to draw any definite conclusions about whether we are moving closer to or away from the objectives decided on.

This section summarizes the Environmental Protection Agency's views on how environmental monitoring should be developed and extended so that it is better geared to providing the biodiversity data that are needed for the work in hand and for future tasks.

[FIGURTEXT:]

Coordination

Monitoring, other national authorities

Environmental Protection Agency's
handbook on environmental monitoring

National environmental monitoring
Environmental Protection Agency

Regional environmental monitoring
County administrative boards

Municipal environmental monitoring

State-funded environmental monitoring system

Fig. 4. Division of responsibilities for environmental monitoring in Sweden.

To achieve an efficient and comprehensive system of environmental monitoring, individual programmes need to be coordinated. Coordination also means that the monitoring undertaken should be performed in a uniform manner. A balanced monitoring system must comprise a mix of several components:

-- *Research -- monitoring*. There needs to be close interaction between research and monitoring. New environmental threats are discovered through either research or monitoring, they are investigated by researchers, and their incidence is mapped out by monitoring programmes, using known methods and indicators.

-- *Established methods -- development*. The bodies involved in monitoring also have to carry on where research leaves off and undertake a certain amount of development of their own. In particular, this may involve running pilot schemes in which methods that work in theory are tested and fine-tuned in practice and compared with other methods. *A significant development effort is called for in the area of biodiversity monitoring.*

-- *Long-term approach -- flexibility: core programmes -- special programmes.* Programmes recording data at regular intervals at the same stations or sites should form the core of the monitoring system. At the same time, it is important not to tie up all the resources available in these programmes. There must also be scope to follow up more episodic environmental events (e.g. mass deaths within an animal population) or to undertake special surveys or inventories to meet new national or international requirements.

-- *Intensive and integrated -- extensive and geographically more comprehensive.* Many important environmental factors not only show considerable variation over time; they also exhibit a more or less marked and small-scale pattern of spatial variation which it is important to map and monitor. This is particularly true of biodiversity, the most valuable components of which are often concentrated in certain (often quite small) habitat areas, and one of the key threats to which -- land use of one kind or another -- also varies on a very small scale geographically. Priorities have to be carefully considered, striking a balance between intensive and extensive programmes and the distinct purposes which they serve, as described in the table below:

[BOX:]

Intensive programmes	Extensive programmes
Characteristics (all four not always present):	
· few stations/sites	· many stations/sites
· high frequency of recording/sampling	· low frequency of recording/sampling
· highly accurate, expensive methods	· less accurate, cheaper methods
· many variables measured (integrated monitoring)	· few variables measured
Are suitable for:	
· time-series analysis	· analysing and describing spatial patterns of variation in state of environment
· analysing processes and mechanisms behind environmental impacts	· comparative analysis, data for regional typologies (e.g. as basis for formulating environmental quality objectives) or critical loads
· analysing interactions between environmental threats	· analysing link with geographical patterns of variation (e.g. natural geographical regions)
· calibrating and validating models	· supplying data for existing operational models
· development work	· establishing a link with physical planning
· establishing a link with research (field experiments) on same site	· discovering episodic environmental disturbances

[END OF BOX]

-- *Measurements -- models:* The `interpretation gap' which arises between the sparsely scattered network of intensively monitored sites and the denser, but less detailed extensive network has to be bridged using models which extrapolate the more detailed information obtained from a small number of points to give a more comprehensive picture with the help of data from the extensive network.

Monitoring of biodiversity -- strategy

Monitoring of biological diversity is an important -- and hitherto neglected -- aspect of environmental monitoring. All the various components of biodiversity would merit monitoring, but it is necessary to pick out a number which can be handled at a practical level. Diversity at the genetic level is comparatively poorly understood and at present analysis of it is also generally expensive, so it is not a high priority at present. Monitoring of species is vital, but for reasons of cost cannot possibly be carried out on a taxonomically comprehensive basis. Within the ecosystem level, it is above all essential to have a high enough resolution to capture the most important variations in biodiversity and land use, that is to say, it is necessary to work at the level of the habitat type. Biodiversity monitoring will thus focus primarily on *habitat types and species.*

Our strategy for monitoring biodiversity can be divided into three levels. The first is *extensive monitoring of habitats* -- distribution, structure, degree of disturbance by environmental threats. This can be achieved either by repeating earlier baseline inventories, such as the Wetlands Inventory, or by looking at a statistical sample of habitats, e.g. from the National Forest Inventory. The ideal is to carry out broader mapping of habitats using remote sensing, combined with verification on a random-sample basis in the field (`ground truthing').

The next step is to *monitor the important species and species groups found in the different habitats.* This is done both in conjunction with the ground truthing element of the extensive habitat monitoring mentioned above, and by establishing sample plots in a representative selection of important habitats and there monitoring vegetation and certain non-plant species more intensively.

The third step is *monitoring of species,* using special methods for individual species or groups of species. For example, the distribution and abundance of Sweden's larger predatory mammals have to be monitored using methods designed for each of the species concerned. Many other species are also of interest from a monitoring point of view, e.g. species which are indicators of important environmental factors.

Monitoring of *red-listed species* calls for a strategy of its own. We have a responsibility to keep a watchful eye on what is happening to these species. In most cases it would probably be unrealistic, not least from the point of view of funding, to try to monitor species with a very limited range using objective, repeatable methods. For the majority of red-listed species, therefore, monitoring will only be possible through the voluntary wardens scheme (at present, mainly `flora wardens') administered by the Threatened Species Unit and funded by the WWF.

There also needs to be a separate monitoring strategy for *cultivated and domesticated species*. As far as cultivated plants are concerned, this could possibly be easier now that the five Nordic countries have established a special institution, the Nordic Gene Bank, to conserve and utilize the variation occurring in such species.

Action in this area (including monitoring of domesticated components of biodiversity beyond the scope of the Nordic Gene Bank) should be proposed by the Swedish Board of Agriculture.

Forestry, agriculture, reindeer herding and fisheries are sectors in which choices of methods have major impacts on biodiversity. It is important for these sectors to shoulder their responsibility for monitoring such impacts.

Monitoring of biodiversity cuts across most of the `programme areas' in which environmental monitoring takes place in Sweden -- lakes, rivers and streams, marine, forest land, farmland, wetlands, mountains and landscape. The strategy for biodiversity monitoring is the same in all these areas, although the methods used will vary, depending on the types of habitats involved. For reasons of cost and efficiency, monitoring of biodiversity should as far as possible be integrated and coordinated with other aspects of environmental monitoring.

The preliminary overview below gives a brief outline of proposals for improving and developing biodiversity monitoring, which will be described in greater detail in a separate report. The measures proposed are judged to be necessary as a basis for assessing progress towards the biodiversity objectives which have already been adopted by the Government and Parliament, or which follow from ratification of the Convention on Biological Diversity. *Further details of resource requirements and priorities will be presented in conjunction with the Environmental Protection Agency's application for funding on 1 March 1996.* The Agency will at that time, as requested by the Government, present a comprehensive programme describing the scope and emphases of future environmental monitoring; that document will, among other things, explain under what conditions the objectives previously laid down for monitoring can be achieved. The proposals included in the programme-by-programme overview therefore do not represent the definitive position of the Environmental Protection Agency; the Agency will continue to work on the more precise details up to the time it submits the comprehensive programme referred to above.

[BOX:]

National environmental monitoring currently in progress

Environmental monitoring activities are divided into ten `programme areas': *air, farmland, forest land, wetlands, mountains, groundwaters, lakes, rivers and streams, marine, landscape,* and *health and the urban environment.* Monitoring of biodiversity has been developed to varying degrees in these different areas, being best established in relation to forest land. A certain amount of biodiversity monitoring is taking place with regard to wetlands and farmland, whereas in the mountain, marine, landscape and urban areas it has hardly yet begun. (The programme areas concerned with air and groundwaters are hardly relevant in this connection, other than in terms of monitoring threats that could affect biodiversity in other areas.)

Farmland

- *Experimental fields:* Monitoring with a focus on leaching from arable soils into fresh waters, rather than on the state of the farmland itself.
- Regional environmental monitoring includes monitoring of *type areas* with a similar emphasis, but covering larger areas.
- Up to and including 1996, the Environmental Protection Agency is monitoring changes in the agricultural landscape in 20 areas (parishes) covered by the

`LiM project' (see introduction to this section). This is a joint project, also involving the Central Board of National Antiquities and the Swedish Board of Agriculture.

Generally speaking, environmental monitoring of agricultural soils and the farmed landscape has been neglected. Only a few projects are currently financed under the national monitoring programme. One national scheme which is planned, but has not yet started, is a programme of *soil/crop monitoring*, focusing on measurements of chemical parameters in certain crops and the soil in which they grow; a one-off survey is, however, being carried out during 1995. None of these programmes measure parameters of direct significance to assessments of biodiversity.

Forest land

- Vegetation: Monitoring of permanent sample plots in 19 reference areas over 10 years.
- Birds: Monitoring is being carried out in the majority of established reference areas (breeding bird surveys, line-and-point transect surveys, migratory and wintering bird censuses).
- Small mammals: Trapping by standardized methods at four sites.
- National Forest Inventory and the associated Soil & Vegetation Survey: The vegetation part of the survey is of interest in terms of biodiversity, but the data on vegetation cannot be interpreted in isolation from the other parameters covered by the survey.
- Measurements of atmospheric deposition and a nationwide survey of heavy metal concentrations in mosses.

The majority of terrestrial monitoring has hitherto been carried out on forest land. The main emphasis in current monitoring is on parameters relating to forestry and soil chemistry.

Wetlands

- Wetlands are represented in vegetation sample plots at 15 sites.
- A programme to monitor the effects of wetland liming has been established.
- An evaluation of the significance of wetlands for nitrogen retention has been carried out.
- Recording of atmospheric deposition, carried out as part of the air monitoring programme, also provides the necessary data concerning wetlands.

Mountains

- Vegetation surveys and bird monitoring in two areas.
- One or two stations monitoring atmospheric deposition are planned, and the toxic pollutants monitoring programme includes several species to be found in the mountain environment, including reindeer (*Rangifer tarandus*).
- The Swedish Hunters' Association has begun monitoring of willow grouse (*Lagopus lagopus*) and ptarmigan (*L. mutus*) at three sites in the mountains of northern Sweden.
- Monitoring of small mammals has begun.

Some of the monitoring schemes in this area are not running at present, and, taken as a whole, this programme area is lagging behind the others. Since mountains make up a large proportion of Sweden's land surface and no real monitoring has been undertaken there to date, it is very important to establish a monitoring programme for the mountain environment. For monitoring purposes, mountain areas (*fjäll*) are defined as areas above the upper limit of coniferous forest. Wetlands above this boundary also fall within this programme area, but not lakes and streams.

Lakes, rivers and streams

In principle, monitoring of lakes and running waters is divided into three distinct

types of programme. Certain schemes monitor the chemical and biological properties of lakes and watercourses and the distribution of specific freshwater habitats on an extensive, geographically more comprehensive basis. In others, the chemical and biological characteristics of standing and running waters and of specified freshwater habitats are monitored on a more intensive, integrated basis. Finally, the water quality of lakes, rivers and streams is monitored in relation to the effects of different anthropogenic factors, under programmes of local monitoring of receiving waters, provided for in the Environment Protection Act, or as part of the programme to monitor the effects of liming. Certain species associated with lakes and watercourses and identified as being of conservation interest are also monitored.

Seas and coastal waters
Marine environmental monitoring consists of a combination of recording programmes, designed to reveal large-scale changes in the marine ecosystem. Each individual programme focuses on a particular threat, eutrophication and toxic pollutants being the most important at present. Monitoring of open sea areas is largely coordinated with other countries under marine environment conventions and bilateral agreements.

Marine monitoring geared specifically to observing variations in biodiversity is not being undertaken at the present time. On the other hand, qualitative information about the range of organisms present in Swedish waters is available. For certain parts of the marine ecosystem, quantitative time-series data also exist. Individual programmes which include quantitative estimates of marine fauna and flora relate to:

- soft-bottom macrofauna
- bottom areas with vegetation cover
- phyto- and zooplankton
- estimates of fish populations in the coastal zone
- estimates of the populations and reproductive potential of one bird species (white-tailed eagle, *Haliaeetus albicilla*) and three mammal species (seals).

Quite a number of these programmes have generated runs of data going back some 15 years, while others have only been operating for a couple of years. Apart from the Environmental Protection Agency's marine environmental monitoring programme, the National Board of Fisheries has a responsibility to monitor the development of commercially important populations of fish and shellfish.

[END OF BOX]

Action proposed

ACTION 40: **Modify and extend Sweden's environmental monitoring system, in order to be able to describe the state of biological diversity and how it is changing; in particular, monitor biodiversity in relation to threats and action to protect it, and monitor progress towards relevant environmental objectives.**

Comment: The operational aspects of this proposal are described in the overview below.

Cost
Estimated cost of the proposals in the overview, excluding the proposals on infrared photography and an environmental index:
One-off costs:
SEK 27 m.

SEK 72 m. (incl. the whole of CORINE Land Cover)

Annual cost:
SEK 16 m.
SEK 18 m. (incl. the whole of CORINE Land Cover)

Programme-by-programme overview of proposal to develop environmental monitoring (Action 40)

Finalized proposals are intended to be presented in the comprehensive programme for future environmental monitoring, commissioned by the Government.

Proposal	Description	Priority	Cost	To be performed/funded by	Timetable
Farmland					
1. Regular repeat survey of valuable meadows and pastures	Primarily, repeat survey of random sample of sites identified in Meadows and Pastures Inventory. Relevant parameters include management status and outline survey of limited list of plant species. Some methods development still needed.	Methods development within existing allocations. Not urgent priority -- can be deferred for a few years, and study then funded within existing allocations.	SEK 150 000 (for methods study). Operating cost: SEK 250 000 (if coordinated with functioning site-based monitoring of management measures).	Study: Environmental Protection Agency or consultant. Monitoring: county administrative boards (or consultants engaged by them).	In 1996: further trials, methods established. Systematic (random) repeat survey probably 1997-2006.

2. Intensive monitoring of habitat sample sites	`Habitat sample sites' = small areas (approx. 1 ha-1 km^2), intensively monitored by means of vegetation surveys, quantitative analysis of tree, shrub, field and ground layers and presence of non-typical substrates. Various components of fauna may also be monitored.	Not urgent priority. Can be introduced gradually with existing funding, primarily regional (and in conjunction with site-based monitoring of management measures). Full development will require additional funds.	Depends on how ambitious a programme is attempted. Fully developed (approx. 100 sites x 1/5 x SEK 75 000): SEK 1.5 m.	Dept. of Environmental Assessment (University of Agricultural Sciences), other consultants, or county administrative boards.	Can be introduced in stages, beginning in 1995.

3. Use methods of National Forest Inventory/Soil & Vegetation Survey to monitor pasture-land	Just over 550 of permanent inventory areas covered by Soil &Vegetation Survey include `unimproved pasture-land', defined as `land used to a significant extent for pasture and not regularly ploughed'. Relevance of existing programme of measurements to pasture-land monitoring should be evaluated, and necessary modifications and additions to programme should be proposed. Interpretation of sites based on infrared/satellite imagery could be considered.	Study should be funded by Environmental Protection Agency.	SEK 250 000 (for study). Operating cost: estimated SEK 1 m./year.	Working group representing Environmental Protection Agency, Soil &Vegetation Survey, National Forest Inventory etc.	Study should be carried out autumn 1995-spring 1996. After that, decision on possible trials.

4. Programme to monitor the intensively farmed landscape	No fully developed programme design is available for habitat-level biodiversity monitoring of `ordinary', intensively farmed agricultural landscape. Development work is called for in this area.	**High priority.** Requires additional funding (could possibly be co-funded by interested parties, e.g. Federation of Swedish Farmers).	SEK 500 000 for two years (for studies and pilot project).	Working group representing Environmental Protection Agency, various bodies in agriculture, e.g. Board of Agriculture, Federation of Swedish Farmers, KRAV (ecological farming association), etc.	Should be able to start in autumn 1995 and be completed by end of 1996.
5. Intensive monitoring of cultural landscape in `type parishes' (continu-ation of LiM)	LiM project is to be wound up in present form within next year or two, and long-term plan is to transfer monitoring of LiM areas to environmental monitoring programme. Should be evaluated and revised in that context.	**High priority.** Additional funds will be needed to meet operating costs.	SEK 100 000 (study). Operating cost: estimated SEK 1 m./year.	Working group representing Environmental Protection Agency, Board of National Antiquities, Board of Agriculture etc.	Implementation probably autumn 1995-spring 1996.

6. Species monitoring (especially butter-flies/moths)	Simplified method for breeding bird surveys, geared to open countryside, is being developed. Swedish participation in Nordic moth monitoring project has been examined. Other possible species monitoring schemes cover butterflies, ground beetles and bats.	**High priority.** Funding has been granted for small-scale launch in 1995/96. Full-scale launch requires additional funding.	Operating cost: SEK 350 000/year (for moth project).	Should be operated on contract basis by suitable consultants or institutions.	Modified bird monitoring scheme could begin spring 1996. Moth monitoring could be initiated in 1995 and be fully operational by 1998.
Forest land					
7. Monitoring of forest habitats known to be of great biological interest	Forest habitats known to be of great biological interest (incl. key habitat sites) must be monitored. Purpose is partly to avoid felling etc. on sites of documented biological interest. In addition, a sample of sites should be monitored to check that they retain their biodiversity value.	**High priority.** Already being developed. Full-scale operation requires additional funding.	Operating cost: estimated SEK 1 m./year.	Regional monitoring, run jointly by county administrative boards and Forestry Administration.	Beginning 1996, on a 5- to 10-year cycle.

8. National Forest Inventory/Soil & Vegetation Survey	Environmental Protection Agency is discussing with Forest Inventory and Soil & Vegetation Survey changes in data collection/parameters within existing recording programme. More data are needed on dead wood and other substrates, more cryptogam species need to be surveyed etc. Also, choice of recording sites (areas) should be guided more by the habitats present.	**High priority.** Development in progress, paid for by regional environmental monitoring funds. Despite reallocations within pro-gramme, extra funding prob-ably necessary to meet cost of more complex data collection and habitat-guided site choice.	Additional funding: estimated SEK 1 m./year.	Environmental Protection Agency responsible for collaboration with Forest Inventory and Soil & Vegetation Survey.	In progress. Changes could be introduced in 1996.

9. Intensive monitoring of habitat sample sites	See proposal 2. Sites should be established in both undisturbed forest and forest managed by known forestry methods, e.g. experimental forest parks. Just over half of former PMK (National Environmental Monitoring Programme) sites could become habitat sample sites. Choice of sites will be guided partly by funding, but some 130 are needed in national programme.	Not urgent priority. Has begun to some extent within existing allocations (`old' PMK sites). Full-scale implementation will require additional funding.	Depends on how ambitious a programme is attempted. Full-scale programme (approx. 130 sites x 1/5 x SEK 75 000): SEK 1.95 m.	Environmental Protection Agency, working with Forestry Administration.	Can be introduced in stages, beginning in 1995.
10. Species monitoring (more small-mammal monitoring, possibly monitoring of game species)	Small-mammal surveys should continue and be expanded to include two more forest sites. Monitoring of game species: 1-2 species should be monitored under national programme. Methods etc. are being studied.	Not urgent priority. Full-scale implementation will probably require additional funding.	Two new sites for small-mammal monitoring: SEK 200 000/year.	Environmental Protection Agency. Additional species monitoring should be carried out within regional monitoring, in collaboration with Forestry Administration.	In progress. Changes could be introduced in 1996.

Wetlands

11. Extensive habitat survey	National monitoring of wetlands will give priority to regular follow-up of Wetlands Inventory. Will be carried out on basis of remote sensing (aerial photography) and ongoing processing of permit applications by county administrative boards.	**High priority.** Additional funds will be needed to meet operating costs.	SEK 750 000/year.	Environmental Protection Agency.	Ready to begin. Funding required.
12. Make use of National Forest Inventory/Soil & Vegetation Survey	National Forest Inventory and Soil & Vegetation Survey will continue to include wetlands. Should be possible to adapt methods to make them more relevant to wetlands.	**High priority.** Study should be funded by Environmental Protection Agency. Operating costs can probably be met from existing funding.	Study: SEK 250 000.	Environmental Protection Agency.	Study to be completed in 1996.

13. Intensive monitoring of habitat sample sites	See proposal 2. Given basic data from Environmental Protection Agency's Wetlands Inventory, all that remains is to select habitats and sites. Choice of sites will be guided partly by funding, but in our view about 100 are needed in national programme.	Not urgent priority. Full-scale implementation will require additional funding.	Depends on how ambitious a programme is attempted. Full-scale implementation (approx. 100 sites x 1/5 x SEK 75 000): SEK 1.5 m.	Environmental Protection Agency.	Can be introduced in stages, beginning in 1995.

Mountains

14. Extensive habitat survey	Study needs to be made of how an extensive habitat survey could be carried out in mountain areas. One alternative is to coordinate survey with Board of Agriculture's reindeer pasture inventories and use same core organization.	**High priority.** Most of work, however -- like initial studies -- would have to be funded by Board of Agriculture as part of planned reindeer pasture inventory.	Marginal cost to meet Environmental Protection Agency's specific needs: SEK 200 000/year (rough estimate).	Environmental Protection Agency, Board of Agriculture and county administrative boards in counties concerned.	Programme to be drawn up by 1 July 1996. Begin in 1997.
15. Intensive monitoring of habitat sample sites	See proposal 2.	Not urgent priority. Full-scale implementation will require additional funding.	Depends on how ambitious a programme is attempted. Full-scale implementation (approx. 30 sites x 1/5 x SEK 75 000): SEK 450 000/year.	Environmental Protection Agency, Board of Agriculture and county administrative boards in counties concerned.	Can be introduced in stages, beginning in 1995.

16. Species monitoring (more small-mammal monitoring)	Some bird monitoring is already included in national programme. Should continue, though possibly in modified form. Small-mammal monitoring, now in progress at three forest sites, should be expanded to include at least one, and preferably two, mountain sites.	**High priority.** One small-mammal site to be established 1995/96.	SEK 150 000/year within existing allocations. Second site will require additional funding.	Environmental Protection Agency.	One site to become operational 1995. The other could be brought into operation in 1996, if additional funding is forthcoming.
Lakes, rivers and streams					
17. Extend national inventory of lakes to include benthic fauna and running waters	Statistical design means that changes in biodiversity can be quantified on nationwide basis.	**High priority.** Inventory 1995-96 funded by Environmental Protection Agency. Future repeat inventories will require extra funding.	SEK 7.9 m. 1995-96.	Environmental Protection Agency.	To begin autumn 1995, on a 5-year cycle.

18. Monitor biological variables as part of national and regional time series covering lakes and water-courses	This programme should provide temporal/geographical baseline for monitoring biodiversity changes, in form of stable time series to which results of other studies/monitoring programmes can be related.	**High priority.** Additional funds needed to meet operating costs.	SEK 1.25 m./year.	Environmental Protection Agency.	Rolling programme.
19. Monitor additional biological variables as part of national intensive monitoring of lakes and water-courses	This programme will provide basis for interpreting, at process level, causes of biodiversity changes in lakes and running waters.	**High priority.** Additional funds needed to meet operating costs.	SEK 750 000/year.	Environmental Protection Agency.	Rolling programme.

20. Pay more attention to effects on bio-diversity in local monitoring of receiving waters	Existing coordinated local monitoring of receiving waters takes insufficient account of biological effects of discharges and other environmental impacts, according to evaluation commissioned by Environmental Protection Agency.	**High priority.** New guidelines can be drawn up within existing allocations.	0 (For dischargers, approx. SEK 5 m./year).	Industry.	Rolling programme.
21. Carry out assessments of biological interest of lakes	Basically no coherent inventory and evaluation of biological interest of Sweden's lakes, rivers and streams has been performed, in contrast with situation for many terrestrial environments. Biological assessment criteria, `System Aqua', should be used for this purpose.	**High priority.** Additional funds needed to meet operating costs.	SEK 26 m. (Environmental Protection Agency to meet about half the cost).	Environmental Protection Agency.	Ready to start.

Landscape (see also proposals 3, 5, 8 and 14)

22. Implement CORINE Land Cover using computer-ized clas-sification methods	As EU member, Sweden is in practice obliged to carry out CORINE Land Cover, a survey at a resolution of 25 ha. This scale is too coarse for most bio-diversity-related needs. However, Swedish pilot project has shown how CORINE map could be created by generalizing from a 25 m pixel map, created by computerized classification of satellite images, and this higher-resolution product could be of great interest. Coordination with National Forest Inventory and reindeer pasture inventory of mountains (proposal 14) should be considered.	Important to plan and implement CORINE project in a way which yields maximum benefits for Sweden as regards biodiversity. Unclear whether marginal cost of this will require extra funding. (CORINE Land Cover itself requires additional funds.)	Original argument for computerized classification was lower cost than basic CORINE methodology (approx. SEK 70 m. instead of SEK 90 m.) Extra cost of further adaptation of `Swedish' method to take account of biodiversity is probably moderate.	Environmental Protection Agency, if possible in association with Central Office of National Land Survey, National Forest Inventory and Board of Agriculture (reindeer pasture inventory).	Should be possible to start in 1996; 2-3 years to complete.

Seas and coastal waters

23. Monitoring of marine habitats within natural geograph-ical areas; some species monitoring	Monitoring of marine plant and animal communities should be carried out in reference areas along Swedish coast.	**High priority.** Methods development requires additional funding.	SEK 500 000 over three years for study and pilot project.	County administrative boards, or consultants engaged by them.	Study and pilot project 1996-99. Begin in stages in year 2000.
24. More monitoring of eco-systems in which alien species have become established	See above.	Not urgent priority. Should be coordinated with project above.	SEK 300 000 over three years for study and pilot project.	Environmental Protection Agency in collaboration with specialists.	Programme of work to be designed in light of project above.
25. Evaluation of methods to measure UV-B radiation	Evaluation of methods to study changes in species composition and primary production of pelagic plankton and algae on shallow areas of seabed.	Not urgent priority.	SEK 250 000/year over three years.	Environmental Protection Agency in collaboration with researchers.	Programme to be developed in 1996. Surveys to begin in 1998.
26. Aerial survey of filamentous algae	Survey of distribution of filamentous algae, based on aerial photography.	**High priority.**	SEK 300 000 over three years.	Researchers in Stockholm and Gothenburg.	Could begin in 1996 and be completed by 1999.

Proposals not linked to programmes

ACTION 41: **Repeat nationwide survey based on aerial infrared photography.**

Background and reasons for proposal: In the late 1970s and the 1980s, basically the whole of Sweden was covered by a systematic survey based on aerial infrared photography. The images produced have been widely used, in particular to interpret vegetation patterns (many more vegetation types can be distinguished in a false-colour infrared photograph than in a black-and-white one). Satellite images now offer an alternative to infrared photography, but often have too low a resolution for vegetation surveys. Pending the advent of higher-resolution satellite images, therefore, both the nature conservation sector and the forestry authorities are very much in favour of a repeat survey of the country using aerial infrared photography.

Infrared images are used in both regional and national environmental monitoring, their applications including mapping of wetlands and wet forests and monitoring of landscape features of significance for biodiversity. A repeat survey is necessary both to discover changes and as a basis for inventories. Infrared photographs are also an important source of general data, e.g. for municipal authorities.

The situation at present is that an initial phase of aerial photography has been assured by funding from the Central Office of the National Land Survey, the Board of Forestry, the Board of Agriculture, the Environmental Protection Agency, the defence forces and the Geological Survey of Sweden. The foundations have thus been laid for a repeat nationwide survey. Current plans cover 1995 and look ahead to 1996. Funds for a complete repeat survey have still be found, however.

Implementation: Aerial photography should be carried out by the Central Office of the National Land Survey (to ensure uniformity throughout the country).

Timetable: Should begin in the summer of 1995 and be completed within a ten-year period.

Cost: Total cost is estimated at around SEK 25 m.

Funding: Apart from the agencies mentioned above, interest in an infrared photographic survey exists among county administrative boards, municipalities, major forestry companies and other users. A prior condition for participation by the agencies referred to above is that they will be able to purchase images at a reduced price in their capacity as funding agencies and to have access to them on a loan basis.

ACTION 42: **Elaborate an environmental index reflecting the state of biological diversity in Sweden.**

Background and reasons for proposal: It is very difficult to design an environmental index reflecting the state of biological diversity. To create a reasonably meaningful index, it is essential to have access to relevant data on important determinants of biodiversity (often referred to as indicators in this context). Another important basic principle is that there should be a link with environmental quality objectives of relevance to biodiversity. Combining different indicators is a delicate balancing act. The end result may possibly be not one, but several indices of biodiversity. One alternative is to stop short of developing an index and confine ourselves to

elaborating `environmental profiles'.

Implementation: The Environmental Protection Agency is already working on the development of environmental indices and profiles, on the basis of reports previously submitted to the Government. As before, Statistics Sweden, among others, should be involved in this work.

Timetable: The aim is that, no later than 1997,

- there should be well-defined indicators that can be used to monitor the state of the environment with respect to biodiversity,
- these indicators should if possible be based on information linked to environmental quality objectives and deriving from biological assessment criteria, and
- funding for data collection on the indicators chosen should be secured and data gathering systems should be established.

Subsequently, the focus should be on elaborating a model to guide a combined interpretation of the indicators (an environmental index of biodiversity).

Cost: Additional funding is required (approx. SEK 700 000).

5.6.2 Management and presentation of data

This section examines how data need to be handled in order to document the state of the environment and environmental trends with regard to biodiversity, and the action taken to promote biodiversity.

To monitor the various actions presented in this plan, it is necessary to collect data. Two types of data are relevant, administrative, e.g. concerning decisions of various kinds, and environmental, describing the state of the environment. Data of the latter type are produced by the various environmental monitoring programmes.

One element in data quality assurance is the adoption of standards for the collection, handling, processing and presentation of data. Data must be gathered in a uniform manner, to permit comparisons over time. Specific methods should be used for the collection and subsequent handling of data. Lists of terms and definitions drawn up by the relevant authorities should be used. The terms employed in monitoring biodiversity should accord with the standards established by the Environmental Protection Agency. There is some overlap between the conceptual frameworks of the nature conservation agencies and other sectors, and careful coordination is therefore called for.

A large proportion of the data relevant to monitoring biodiversity will be recorded by county administrative boards. The Environmental Protection Agency recommends these boards to record the data in question in the Natural Environment Database system (DBN, see below). Where the Agency is responsible for the corresponding data, it will also use this system. Resources will have to be made available to ensure the full-scale implementation of the DBN database at the county level.

It should be stressed that each sector is responsible for monitoring the actions taken in its own sphere of interest. This section does not go into the data management requirements of the various sectors, however.

Division of responsibilities

In this action plan, we distinguish between data suppliers, data hosts and evaluators. *Suppliers* collect data, *hosts* hold these data in an accessible form and are responsible for archiving, and *evaluators* process and analyse the data. The supplier may be a county administrative board, a municipality, a university department or a private consultant. Potential data hosts include the Swedish University of Agricultural Sciences, the Threatened Species Unit, other universities and colleges, and county administrative boards.

Evaluations may be initiated by the Government -- as for example with the environmental objective of the new forest policy -- or by the Environmental Protection Agency or county administrative boards. The various sectors, too, have a responsibility for monitoring and evaluation, from the vantage point of their respective sectors and their activities and impacts. Which body is asked to carry out an evaluation will depend on the overall aims to be achieved.

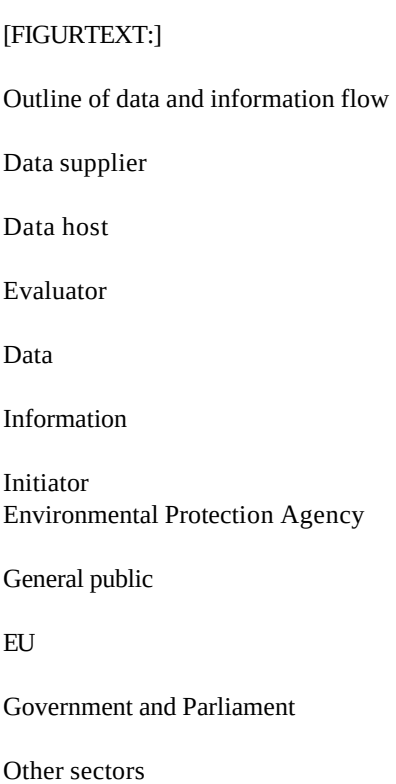

Fig. 5. Data and information flow in conjunction with monitoring of action to conserve biodiversity. The Environmental Protection Agency, for example, may commission an evaluator to carry out an evaluation. The resultant information will then be disseminated by the Agency to the Government and Parliament, the general public, other sectors, the EU etc.

Natural Environment Database (DBN)

The Natural Environment Database (*Databas Natur, DBN*) is the database in which biodiversity data will be handled at the regional and central levels. This system has been developed by the Environmental Protection Agency and the country's county administrative boards. Six boards (Södermanland, Östergötland, Kronoberg, Kalmar,

Skaraborg and Norrbotten) will be introducing it in the summer of 1995, and it is also being established in the Agency's Natural Resources Department.

The DBN database is designed in accordance with the general data management model elaborated at the Environmental Protection Agency. It has built-in quality assurance functions.

Administrative matters, e.g. decisions taken on the basis of a given statutory provision, are documented in the administrative portion of the database, while data generated by biological surveys and inventories are recorded in its surveys section. The DBN database will also be integrated with geographical information systems (GIS).

The Natural Environment Database is intended to be further developed to meet environmental monitoring requirements. The present action plan may also necessitate further development of the system.

Prior conditions

Objectives and measures relating to biodiversity have to be *monitorable*. Specifications of environmental data must guarantee their *continuity* over time and their *geographical coverage*.

In certain cases, management of biodiversity data is part of an authority's official responsibilities, while in others responsibility needs to be specifically negotiated.

Actions proposed

The following proposals are based on three phases of data management:
1) identifying data and establishing appropriate data processing systems,
2) making relevant data accessible, and
3) delivering, analysing and presenting data.

Information analysis

ACTION 43:
- **Determine how each action in the action plan is to be monitored.**
- **Identify relevant data flows.**
- **Determine the division of roles between data suppliers, data hosts and evaluators.**
- **Describe relevant structured datasets, together with their technical environment.**
- **Establish procedures for data transfer between the bodies concerned.**
- **Support implementation of the DBN system by county administrative boards.**
- **Identify any system development needs and develop existing databases.**
- **Supplement existing hardware and software as specific needs arise.**

Background and reasons for proposal: The first step to be taken is to ascertain how each of the measures included in this action plan is to be monitored. Where computer support is relevant, it should be established what data are to be recorded and in which system environment. Technical procedures should be drawn up for data transfer between the bodies involved, i.e. how often should data be transferred and

by what technology?

Data suppliers and hosts should be chosen with respect to data relevant to the various actions to be monitored. Contracts should be entered into.

The Environmental Protection Agency is supporting the introduction of the Natural Environment Database (DBN) by county administrative boards by assisting with training and supplying conceptual models and data input applications for environmental information of common interest.

Once it has been established how the measures in the action plan are to be monitored, system development needs may be identified by data hosts.

Implementation: The Environmental Protection Agency's role is to coordinate and give a lead in the implementation of the various measures. A coordinating group should be set up, including representatives of the Agency and the data hosts identified, and this forum should decide who is to be responsible for what.

Timetable: It should be possible to identify data flows, determine the respective roles of the different bodies and describe existing structured datasets within one year. This phase should be completed in the course of 1996. All county administrative boards should have established the DBN system by 1998. By then, the system should in addition have been adapted and brought into use for environmental monitoring.

Estimated cost and how it should be shared: The cost will depend on the number of measures specified and hence on the number of suppliers and hosts involved. Costs identified so far:

* DBN support to counties: SEK 500 000, funded by the Environmental Protection Agency.
* Development of existing databases in the light of needs arising from the action plan: SEK 500 000, funded by the Environmental Protection Agency and data hosts.

Funding: County administrative boards, Environmental Protection Agency and data hosts.

Data capture

ACTION 44:

- **Clarify the terminology standards that apply in the areas of activity concerned.**
- **Establish procedures for data input into the DBN and possibly other databases held by other data hosts, on the basis of the specifications defined for each action in the action plan.**
- **Appoint a member of the staff of each data host to be responsible for entering data in databases.**
- **Record data on an ongoing basis as decisions are taken concerning actions included in the action plan.**
- **Specify and program protocols for data transfer to the DBN database.**
- **Elaborate procedures for quality assurance of data.**
- **Adapt data to GIS.**

Background and reasons for proposal: If actions are to be monitored with the help of computer systems, access to updated data is essential. This means that decisions

of various kinds must be documented and recorded in data processing systems. As regards monitoring of the state of the environment, regularly recurring surveys need to be carried out and the results recorded.

The data supplier is responsible for ensuring that the data from a survey are delivered to the chosen data host in a form which can be inputted into the database in question. Sufficient resources must be made available to secure access to data in the data processing systems concerned. Data quality inspection and assurance programmes should be developed.

Data which are of interest in monitoring action to maintain biodiversity may be collected by suppliers working in different computer environments. Protocols for data transfer to the DBN database must exist to allow data to be retrieved from different technical environments for storage in regional or national DBN systems.

Implementation: The Environmental Protection Agency is responsible for clarifying the applicable terminology standards, establishing procedures for data input into the DBN system, specifying protocols for data transfer to DBN, and drawing up guidelines on adapting data to GIS. Data suppliers and hosts are responsible for ensuring that data relevant to monitoring the different actions are recorded in the host's database. Hosts, suppliers and the Environmental Protection Agency are responsible for developing quality assurance procedures.

Timetable: The time required for data capture depends on the type of measure defined in the action plan. Certain types of administrative data, e.g. concerning protected areas of countryside, are recorded continuously in the DBN database by county administrative boards. If a measure in the action plan involves a new inventory, data management should be included as an integral part of its methodology. The results of biological surveys should be recorded in the DBN system. Six months should be allowed for specifying and programming protocols for data transfer to the DBN database.

Estimated cost:
* Supplementary input of data prior to a major evaluation: SEK 500 000, funded by data host.
* Specification and programming of protocols for data transfer to DBN: SEK 150 000, funded by the Environmental Protection Agency.
The cost of day-to-day input of data by each data host is not included in the overview.

Funding: Data hosts and Environmental Protection Agency.

Analysis and presentation

ACTION 45:

- **Establish procedures for data transfer from data hosts to evaluators.**
- **Program procedures to extract data which are to be transferred from data hosts to evaluators.**
- **Establish methods and procedures for processing and analysis of data with a view to shedding light on implementation of the action plan.**
- **Work up and analyse data as necessary.**
- **Develop methods for quality assurance of statistical results.**
- **Decide on mode of presentation.**
- **Produce material presenting the results.**

Background and reasons for proposal: To monitor the implementation of actions in the action plan, it may be necessary to amalgamate data from several different data hosts and hence different databases. This can be done in an environment in which general tools are available, e.g. EXCEL. In other cases, statistics can be extracted directly from a database.

Several bodies may be involved in an evaluation. Individual parts of an evaluation may be carried out by different data hosts and the Environmental Protection Agency, for example.

The body commissioning an evaluation decides, in consultation with the evaluator(s) and those responsible for the specific areas concerned, how the data are to be processed and analysed and how the results are to be presented.

Implementation: The data host is responsible for data transfer to the evaluator, in line with the agreement entered into with the Environmental Protection Agency. The Agency is responsible for establishing methods and procedures for processing and analysis of data with a view to shedding light on implementation of the action plan. Close collaboration is needed between data supplier, data host and evaluator. The evaluator is responsible for the relevant processing and analysis and for presenting the results.

Timetable: The time needed to process and analyse data and present the results will depend on the scale of the evaluation requested. Wider-ranging evaluations should be ordered a year before the report is required. The time-scale will depend to an appreciable degree on whether the evaluator is expected to publish a final report.

Estimated cost: Costs identified for each major evaluation:
Program procedures to extract data which are to be transferred from data hosts to evaluators: SEK 100 000, funded from environmental monitoring programme budget.
Process and analyse data, produce statistics: SEK 250 000, funded by body commissioning evaluation.
Programme for quality assurance of statistical results: SEK 250 000, funded by commissioning body.
Production of basic material for report, maps, diagrams etc.: SEK 250 000.

Evaluators may also be asked to produce a final report, which will mean that printing costs could also be involved.

Funding: The body commissioning an evaluation, and the environmental monitoring programme.

The total estimated (identified) cost of the actions presented above is around SEK 2.5 m. In addition, there is the cost of purchasing powerful personal computers to run the DBN system at county administrative boards, approx. SEK 1 m. (funded by the boards).

5.7 Research

The overall aim of research on biodiversity is to produce knowledge which, when applied at a practical level, will improve the long-term prospects of maintaining the

variability of living organisms in all environments and the ecological relationships and processes in which they are involved.

Given that biodiversity manifests itself at different levels, research relating to it will involve a wide range of disciplines. Through research, we not only need gradually to improve our understanding of the fundamental structure and functions of biodiversity, but also to develop the best possible strategy for weighing up the arguments in favour of conservation and use of our `biological heritage'. In addition, it is of course important to identify methods of farming, forestry, fishing etc. which will ensure the long-term maintenance of biodiversity.

In view of the Environmental Protection Agency's limited scope to fund biodiversity research, we are not putting forward specific proposals in the present context. Instead, we intend primarily to give *examples of important areas of research* within this broad field. Research which is clearly linked to any of the sectors for which separate action plans are being prepared is not dealt with in any detail here, since it is *expected to be described in those action plans.* This applies to research into methods to ensure sustainable use of biodiversity, for example. In this context, we would stress the need to enhance arrangements for cooperation between the authorities concerned and to establish workable procedures, while also clearly defining, in some form of binding agreement, who is to do what.

Research is important in generating better data to guide the formulation of environmental quality objectives. In addition, there is a need for research which *assesses the effects of action taken*, a task on the borderline between research and environmental monitoring. Research of this kind is particularly vital when -- because of a lack of knowledge and/or measuring methods/resources -- it proves difficult to define environmental quality objectives.

In general terms, it is important to design and report on research projects in such a way that the results they produce can be *applied at a practical level* in support of biological diversity.

A detailed review of biodiversity research is presented in the book `The mysteries of biodiversity' (Environmental Protection Agency Report 4389, in Swedish).

Important research -- background and reasons for proposals

Population/genetic level

Important research: Study the population genetics of *marine organisms*. Certain studies of algae and invertebrates in the Baltic Sea have indicated that a process of speciation is taking place there, and several populations must be regarded as geographically isolated and hence as having distinct complements of genes. In the Kattegat and Skagerrak, too, many animals and plants are living at the limits of their range, which may result in their becoming isolated. Future studies in this field should cover both species diversity and functional diversity, and focus on invertebrates, lower plants and micro-organisms.

Important research: Clarify the genetic variation of isolated populations in the *terrestrial environment*, in relation to historical biogeography, landscape history and palaeobiology.

More research into the genetic variability of species will enhance our understanding

of taxonomy and help us to elaborate principles for selecting populations which are of particular interest in terms of nature conservation and whose conservation value should be studied; groups of interest here include quite a number of vascular plants, several reptiles and amphibians, and certain invertebrate groups (including butterflies).

Important research: Study the genetic variation occurring in threatened species, to assess whether important genes have been lost or inbreeding effects have arisen. In general, animals and plants with small, isolated populations are of interest here. Work on fauna should focus on mammals (large predators, seals etc.) and fish, while plant studies should look primarily at certain isolated vascular plants (species of the cultural landscape, alpine plants etc.).

In addition to the above, the following are important areas of research of sectoral concern:

-- The genetic and ecological effects of the spread of non-native spruces (`continental' origins).
-- The genetic and ecological effects of the release and spread of genetically modified organisms.

Species level

High priority must be given to collecting, documenting and conserving as many components of biological diversity as possible. Many countries are planning significant biodiversity programmes. In Sweden in recent years, work in taxonomy and systematics has mainly been undertaken at major museums with an active research capability.

ACTION 46: **Strengthen the position of taxonomy, by:**

- **creating more university posts in taxonomy;**
- **making a greater commitment to taxonomy in higher education;**
- **motivating university students to go on to do taxonomic research;**
- **increasing allocations to museums and/or reordering funding priorities in the area of research and documentation, including the production of faunas and floras (identification guides) for little-known groups of organisms (necessary as a basis for drawing up Red Lists, for example);**
- **facilitating the introduction of modern methods of taxonomic analysis;**
- **concentrating in fieldworker training on taxa that can serve as indicators of biodiversity in several different habitats.**

Apart from strictly taxonomic studies, much of the research on populations and species which is of significance from a nature conservation point of view is fundamentally ecological in character.

Important research:

- The validity of the *concept of `key species'* should be verified by experimental studies which examine the significance of such species in terms of maintaining the overall species diversity of communities. Research in this area, which needs to be undertaken in relation to all ecosystems, should result in generalizable knowledge (theory) that can form a basis for action to conserve biodiversity.
- The impact of *levels of hunting* on Sweden's game species should be studied and models developed in which the numbers shot can be related to natural

predation levels. There is a need for more knowledge about both small game species (grouse family, hares etc.) and many migratory species (ducks and geese). See also the proposals relating to hunting.

- More research on *toxic pollutants* needs to be carried out on wild populations, to verify the lethal and sublethal effects observed in laboratory conditions. Above all, sublethal effects on reproduction and survival should be determined and assessed from the viewpoint of population dynamics. To do this, other significant environmental factors need to be studied at the same time. This research should focus in the first instance on mammals (including seals, otter (*Lutra lutra*), elk/moose (*Alces alces*) and small mammals), fish (e.g. in coastal waters affected by paper mill effluents) and birds (seabirds, certain birds of prey, owls, passerines etc.), but should also cover insects and plankton, which, over and above their intrinsic value, play important roles in ecosystems. In addition, a closer study needs to be made of how acidification and nitrogen deposition affect vascular plant reproduction in different ecosystems, chiefly deciduous forests, pastures and certain types of wetland.
- Research in the area of *conservation biology*, concerning populations that are widely distributed but declining in abundance over large parts of their range. Should focus on identifying `source' and `sink' populations and the interaction between them. Suitable organisms for such studies include bats, birds, amphibians etc. Research in this field has a strong link with work on metapopulations. The spatial distribution of populations is also of great interest. Research on the population ecology of rare species (including the minimum population size needed to secure their long-term survival) is necessary as a basis for designing appropriate conservation measures.
- *Effects of introduced species, i.e. those not previously occurring in the country, on native organisms.* Knowledge is needed concerning both the direct effects of predation and competition and the harm caused to native organisms by the parasites (diseases) associated with non-native species. A number of introduced species should be studied more closely to elucidate what remedial action may be called for. In the case of the terrestrial environment, species of interest include the racoon dog (*Nyctereutes procyonoides*), muskrat (*Ondatra zibethicus*) and American mink (*Mustela vison*). Research on introductions of alien species in the aquatic environment has a link with natural resource issues (coastal zone planning, fisheries, aquaculture, water abstraction) and health matters (toxic algal blooms, introductions of pathogenic organisms), as well as biodiversity. The growing number of alien species introduced in recent decades -- chiefly due to an increase in the volume of shipping -- clearly justifies further research in this area (see also proposals in the marine environment section).

Plant and animal community/habitat level

Research on individual species or populations needs to be supplemented with work at the level of plant and animal communities. A carefully chosen selection of plant communities and habitats will include a large proportion of the country's vascular plants, although far from all of them, and obviously only a fraction of the total number of cryptogams. Animals, on the other hand, often tend to be excluded by such an approach. It is nevertheless at this less detailed level that nature conservation, and therefore some aspects of nature conservation research, have to operate. And of course, without functioning habitats in an ecological infrastructure, neither plants nor animals can survive in the long term.

Up to now, fairly meagre funds have been channelled into answering basic questions

concerning the factors which regulate the variation of biodiversity in time and space, e.g. the requirements of different species, and why certain taxa are highly diverse, while others are not. To generate the knowledge needed to answer these and similar questions, greater commitments need to be made to community ecology (what used to be referred to as synecology), biogeography, systematics and population genetics. A better understanding of natural fluctuations in plant and animal communities is also important in environmental monitoring, e.g. of changes in plant communities caused by fertilizer applications.

Important areas of research at the community level include:

- *Research in landscape ecology*, including *dispersal ecology*. More needs to be known, for example, about the patterns of movement of ecologically important species in composite (mosaic) landscapes, and about the significance of different degrees of habitat fragmentation. Our understanding of the `landscape ecology' of the marine environment is particularly limited. It is also important to study the dispersal biology of marine organisms which occur in areas where entire communities are eliminated by anoxic conditions and trawl fisheries.
- Work to develop *indicators of biodiversity*. Such studies should look primarily at the forest landscape, including running waters, but other ecosystems, such as the agricultural landscape, are also important. To begin with, the emphasis should be on developing methods, by means of a broad-based effort to collect possible indicators associated with different habitat structures (e.g. dead wood) in the landscape. This inventory of potential indicators should encompass species from different taxa (birds, insects, bryophytes, fungi etc.), occurring in forest areas representing differing degrees of disturbance. For the marine environment, there is a need for research on new methods which will enable environmental disturbances to be `read off' solely from higher taxa (e.g. families, functional groups, phyla), for example within the benthic fauna.
- Studies to determine *critical limits as regards the size and shape of habitats* and to analyse the *need for disturbance-based habitat dynamics* to preserve the original communities of boreal forests. Suitable objects of study can be found among birds (woodpeckers), insects, certain vascular plants and cryptogams.
- Research which looks at *how different landscape structures affect biodiversity in exclusively arable and mixed arable/forest landscapes*, as well as in forest, mire and mountain landscapes (including mosaics of these types). This work will require the development of integrated methods of processing data from satellite and aerial remote sensing and field surveys.
- Research to determine *critical size limits for traditional farmland habitats*, from the viewpoint of conserving the diversity of the cultural landscape. Suitable objects of study are likely to be found among higher vascular plants and insects, for example.
- Research into the *historical aspects* of the development of ecosystems, vegetation types, species and populations (this area of work could also have been described under the headings dealing with other levels, but is only listed here). This includes both palaeoecological and evolutionary aspects. Evidence of human interference and past land use, obtained by palaeoecological methods or from historical sources or other material, is of key importance here.
- Analysis of ways of conserving or enhancing *urban biodiversity*. Research should focus on the special ecological conditions created by all the differing demands that need to be met to achieve a good, functioning urban environment.

- *Freshwater ecology:* Here the main areas of interest are the *impacts of acidification, eutrophication and toxic pollutants* on the composition and food-chain functions of plant and animal communities, particularly with regard to the key and indicator species present. In the first instance, the effects of pollutants on the community, species and population structures of fish, benthic fauna and epiphytic algae need to be studied. It is particularly important to gain a better understanding of how decomposition processes and food-chain structures influence biodiversity.
- Regarding the *marine* environment, ecological research is needed to shed light on how *eutrophication and toxic pollutants* affect the species composition and food chains of the different ecosystems involved, including how they affect the various functional groups present. Studies need to be made of any changes in the algal flora of the littoral zone, in the composition of benthic fauna and in the age structure and species composition of the fish fauna, for example. Among the ecosystem functions which should be studied, mention may be made of primary production, nutrient cycling, and `top-down' effects (e.g. predation) on lower levels.

Landscape level

There are two main strands to research in landscape ecology, one concerned with analytical studies of the components or building blocks of the landscape (incorporating the research at the organism, community and habitat levels described above), the other involving an integrated approach, taking into account the links between natural and cultural factors. An inadequate understanding of the totality of the landscape may result in incorrect conclusions being drawn and erroneous advice being given as regards how the landscape should be used. Multidisciplinary work yielding an understanding of landscape development provides an important basis for multiple-use planning and is crucial to rational land use.

Important research at the landscape level:

- Develop an appropriate *methodology for describing landscapes*. Landscape analysis is dependent on a good understanding of the processes which create natural landscapes, and also of cultural landscape features, and, regarding the latter, an ability to analyse what physical features of the landscape are the result of human activities. An integrated approach and a more active nature and cultural conservation strategy are of increasing importance, given the growing intensity of use of the landscape and the mounting pressures on land.
- Develop a reasonably objective *method of landscape evaluation.* Every landscape type will obviously require its own evaluation standards, and it is therefore important to elaborate reliable criteria of quality. Fundamentally, this calls for further development of current research on economic valuation methods. A key issue here is how to estimate or calculate the value of conserving natural resources and biodiversity. An important question to be considered in that context is whether there is a simple principle for identifying forms of biodiversity which make a suitable basis for willingness-to-pay studies.
- Elaborate tangible principles for *multiple-use planning* of different types of forest land.

Research on *landscape restoration* could equally well have been listed under the species- or community-level heading, since to a large extent it is a matter of restoring the interaction between species within an ecosystem. In terms of scale, however,

restoration issues chiefly concern the landscape level.

Important areas of research relating to landscape restoration include:

- Research on forestry ecology, to clarify how much timber can be removed in conjunction with controlled burning without seriously detracting from the value of the burnt site as a habitat for fire-dependent species. At a methodological level, *procedures for setting and controlling forest fires* need to be developed, and an assessment needs to be made of how effective controlled fires are in terms of restoring biodiversity.
- Studies of how *liming and forest soil revitalization affect biodiversity*. Such work should provide important data for identifying areas where liming should be avoided. It should also shed light on the effects of liming on running waters and wetlands, e.g. how litter decomposition in freshwater ecosystems is affected and how liming should be combined with habitat improvements in order to increase biodiversity.
- *Restoration of coherent systems of managed habitats in the farmed landscape*, with a view to preserving the plant and animal communities of the traditional cultural landscape. Such studies should preferably be linked to larger-scale restoration projects in which key functions in the landscape, such as nutrient cycling, can be monitored. In the shorter term, the success of restoration work can be monitored by means of good floral and faunal indicators.
- *Wetland restoration* with the aim of enhancing biodiversity needs to be guided by research in landscape ecology. Such work should provide a basis for planning wetland ecosystems which can sustainably support metapopulations of different organisms. Certain birds and perhaps butterflies would probably be suitable as indicator organisms. In addition, more needs to be known about the management of wetlands which are suitable as habitats for organisms associated with different seral stages; appropriate indicators of these stages are primarily to be found among vascular plants and certain groups of bryophytes.
- The elaboration of guidelines on *environmental impact assessment of projects to restore biodiversity*. In this context, it should also be established how a *cost-benefit analysis* of restoration measures should best be carried out.
- Repeat visits to marine sites where reductions of emissions of nutrients and toxic substances have been recorded, and where sand etc. used to be extracted, the aim being to ascertain what effects are reversible and at what rate such sites are recolonized.
- Restoration of biodiversity in marine habitats from which species have disappeared owing to eutrophication and pulp mill effluents. Such projects are particularly relevant for species with a limited ability to disperse by means of larvae or spores (reintroduction of bladderwrack being a case in point). Biomanipulation in shallow eutrophicated waters, guided by trials carried out in lakes.

Research of broader relevance

This category chiefly comprises areas of research which have a clear link with the concept of biological diversity, but which cannot be directly assigned to any of the four levels mentioned above. These areas include questions such as why biodiversity should be conserved at all, what types of value should be attributed to it, and how valuation should be undertaken at a practical level, i.e. what documentation is needed as a basis for tangible strategies to conserve biodiversity.

Important areas of research are as follows:

- Developing *ethical and economic arguments, and arguments from the viewpoint of survival,* for conserving biodiversity, based on an analysis of fundamental ecological and economic principles and concepts.
- Research to determine *the threats to biodiversity which are of most importance in social and economic terms* and to analyse *the underlying mechanisms*. In conjunction with this work, recommendations on policy instruments to influence these mechanisms, so as to eliminate or at least minimize the threats to biodiversity, should be elaborated. *Research on policy instruments* is a very important area, of great relevance to biodiversity issues. We need to develop a better understanding of the effects of different administrative and economic instruments, and of how social influences in the form of knowledge creation, education and information operate.
- *Monetary quantification* of biodiversity *per se*, at all levels (see also proposals in section 5.8.2). It is quite conceivable that, just as we now submit tax returns detailing our financial assets, owners and users of land and water could in future file returns declaring their biodiversity assets (habitats, landscape features, possibly species). Valuations should take into account both the self-repairing capacity of the systems involved and their future use as genetic and biochemical resources. Valuations based on `environmental returns', describing the biodiversity of given areas in economic terms, would in general offer a broader basis for decision-making on conservation issues and lend greater depth to research on policy instruments. An analysis of the value of different forms of biodiversity at the household and local levels in developing countries, for example, would help to highlight where future support for the conservation of diversity is most urgently needed. Such studies would obviously have to be preceded by surveys of the species and habitat diversity of the areas concerned.
- Analysis of possible ways of *reconciling human prosperity with sustainable natural and human-influenced ecosystems*. In the industrialized countries, the opportunities offered by technical development need to be studied, sector by sector, in the light of ecological limits and economic expectations. One question to be examined here is how the extraction of materials from different ecosystems affects biodiversity as such.

Another task of broader relevance is to develop a more effective and direct interface between research results and their application.

Implementation

Biodiversity research can be broken down into an analytical, function-oriented component, an inventory and classification (taxonomic) component, and an action-oriented component.

Clearly, no one authority or organization can shoulder responsibility for conducting research in all of the areas highlighted above. The authorities and organizations with a part to play in biodiversity research are aware

- that the issues involved are often multidisciplinary in character;
- that existing problems relate to several different levels of biodiversity;
- that biodiversity research often forms part of a broader project on the use of land or water;
- that solutions can often only be achieved by means of research of broader scope in terms of time and space; the effects of large-scale exploitation cannot be established with certainty from small-scale experiments of short duration;

- that biodiversity research can be of international as well as national and local importance;
- that research is funded by a large number of different bodies, with different priorities and varying financial resources; and
- that all the bodies and individuals with an interest in biodiversity do not have access to adequate information on subjects that are of significance to its conservation; in other words, that there is a need in several sectors for more training on and coordination of the issues involved.

To promote research into the various aspects of biodiversity mentioned above, and others, the different bodies concerned have lent financial support to clearly delineated subsets of the sum-total of research being undertaken. Only a few of them, however, have spelt out their willingness to provide support or their views on the necessary scale of research in explicit policy documents or tangible research programmes. The biodiversity research being conducted by a range of research institutes (including Swedish bodies) within the European Conservation Institutes Research Network (CONNECT) represents one attempt to establish a more coherent programme. Here, attention is being devoted on a European basis to both land use problems and more methodological questions. In the European context, it is important to stress that we in Sweden have a special responsibility for `our' habitats and ecosystems.

A complete, coherent picture of the biodiversity research in progress can scarcely be offered at the present time, given the breadth of this field, the lack of clarity about who does what, differing views on what areas of research are relevant, and also the fact that biodiversity research forms a constituent, and not always clearly defined, part of many different development programmes.

At present, the majority of funding bodies obtain the information they need from informal meetings at which matters of common concern, such as studies in progress, funding plans etc., are discussed. As was indicated earlier, it would seem a good idea to promote closer collaboration between the different parties concerned and to define their respective responsibilities more clearly than has hitherto been the case.

To achieve these aims in the Swedish context, it is necessary for *all the parties involved* -- including the relevant sectoral authorities -- *to declare in clearly worded policy statements or in some other way what responsibility they are prepared to assume for research in this area.* Overall responsibility for biodiversity research must be considered to lie with the Environmental Protection Agency. The Agency should -- for example through a specially appointed project group -- draw up tangible proposals for research commitments and compile annual reports on the work carried out in this field, i.e. in terms of function-, inventory-/classification- and action-oriented research. Responsibility for these three component areas could appropriately be assigned to the Natural Science Research Council, the Museum of Natural History, Stockholm, and the Swedish Biodiversity Centre, Uppsala, respectively. Other bodies or combinations of responsibilities are of course also possible. Work in this area should be coordinated with the `R&D for a Better Environment' project.

Timetable

The time-scale will of course depend to a large extent on the financial commitments which the bodies responsible are prepared to make.

In the *short term*, of one to a few years, it would seem important to clarify matters of organization/responsibility, at both the national and the international level. At the same time, work on developing *indicators of biodiversity* must be stepped up, to enable conservation efforts to be targeted on the most important sites. It is also important within this period to begin detailed planning of *marine biodiversity research* and to initiate research on *policy instruments* of express relevance to the conservation of biodiversity. To sum up, the focus over the next few years should be on a more general effort to plan in more detail the research that needs to be undertaken in relation to all the different levels of biodiversity.

In the *medium term* -- over the next five to ten years -- the most urgent requirements in terms of taxonomic expertise should be met and computer systems should be developed which function well enough, in relation to the needs of both Sweden and developing countries, to enable new knowledge to be continuously built into them, and also to evaluate the effects of action taken. In addition, over this period, our basic understanding of the nature of biodiversity and of the underlying processes in both terrestrial and aquatic ecosystems should be substantially enhanced, as a basis for the successful restoration of habitats and landscapes whose biological capital has been partly eroded by misuse or mismanagement.

In the *longer term*, looking more than ten years ahead, a more permanent structure should be established for dealing with international questions and how they tie in with biodiversity. Genetics will probably be of growing interest, primarily in relation to cultivated plants; secondarily, there will be an increasingly pronounced need to study the resistance of plant and animal populations to pollutants (nitrogen, phosphorus, metals, carbon dioxide etc.). Marine issues will also remain a focus of attention: among other things, there is likely to be a growing interest in monitoring littoral-zone organisms and in using them for various purposes, such as bioconcentration of pollutants or production of useful organic compounds.

Estimated cost

The largest funding bodies currently providing regular support for research on biodiversity in Sweden are the Natural Science Research Council (NFR), the Council for Forestry and Agricultural Research (SJFR), the Environmental Protection Agency, the World Wide Fund for Nature (WWF) and the Centre for Environmental Research (CMF), Umeå. Although there are certain difficulties in calculating the sums involved (see Environmental Protection Agency Report 4389), it has been estimated, on the basis of the 1992/93 financial year, that total funding from these bodies for biodiversity research amounts to around SEK 65 m. a year. Considerable proportions of this funding relate to the species and community levels (around SEK 25 m. and SEK 16 m. a year, respectively). The combined commitments of these key funding bodies to work concerning the different levels of biodiversity are shown in the diagram below:

[FIGURTEXT:]

SEK '000

Taxonomy
Genetic level
Species level
Habitat level
Landscape level

Fig. 6. Funding for research on the different levels of biodiversity, including taxonomic research (financial year 1992/93, Environmental Protection Agency, NFR, WWF, SJFR, CMF).

Other funding agencies, such as the Museum of Natural History, Stockholm, the Swedish Biodiversity Centre in Uppsala, the Royal Academy of Sciences, the Council for Planning and Coordination of Research, the Swedish Farmers' Foundation for Agricultural Research (SLF), the Forestry Research Institute of Sweden, the Foundation for Strategic Environmental Research (MISTRA), the Swedish International Development Authority (SIDA; formerly the Swedish Agency for Research Cooperation with Developing Countries, SAREC), the Swedish Hunters' Association and a wide range of charitable foundations etc., finance research of varying relevance to biodiversity. The EU's Fourth Framework Programme should also be mentioned in this connection.

In 1992, an estimated total of SEK 100 m. was committed to research in the field of biodiversity. Adjusted for annual inflation of 5 %, this corresponds to around SEK 117 m. in 1995. The majority (90 %) of this research addresses function- and action-related problems, while work on purely taxonomic issues is at present only supported by a few councils (chiefly the Natural Science Research Council) and certain foundations. A more detailed breakdown of research funding by taxon, environment/habitat and environmental threat, chiefly within the nature conservation sector, is presented in Environmental Protection Agency Report 4389.

As far as purely taxonomic research is concerned, it may be noted that Sweden has undertaken to identify, to monitor on a long-term basis and to manage the components of biodiversity occurring within its territory. There is thus a clear case for strengthening `natural resources-related taxonomy'. To do this, there needs to be a sustained effort to develop both taxonomic capabilities and databases in which to store all the relevant information, including monitoring data. Monitoring of the country's biodiversity is an ongoing activity. After roughly five years of capacity-building (SEK 5-15 m./year), there will probably be ten years of work in taxonomy/systematics (SEK 30 m./year, which will meet the cost of around ten researchers and some thirty staff at the technician level, including travel and associated expenditure). The total cost of project planning, database development, running of the organization as a whole over a ten-year period, and a transition to a more evenly spread monitoring phase over three years has been estimated at SEK 373 m. over an 18-year period, i.e. an average of just over SEK 20 m. per year (figure supplied by Edmar, Museum of Natural History, 1994).

Assuming that research funding needs remain at their 1992 level over the next few years, and that the calls for enhanced taxonomic expertise are heeded, *biodiversity research will require annual funding of the order of SEK 130-150 m. in the years to come.*

Funding

Although the main bulk of research funding currently comes from central government, and the development of policy instruments could give the public sector an increasingly powerful influence, a very substantial proportion of research on biodiversity will still be undertaken by a variety of non-governmental foundations and organizations. These bodies are funded either entirely from voluntary donations

(e.g. WWF, Swedish Society for the Conservation of Nature), or else by sectoral organizations which have decided to set aside funds for biodiversity research (e.g. Swedish Hunters' Association, Forestry Research Institute of Sweden, SLF).

It is important to draw up a *programme for each sector, to make it clear who is responsible for carrying out* -- and funding -- *research.* A programme on forest biodiversity, for instance, could consist of the following components:

Ecological planning	Environmental effects of production	Methods development	Management to conserve biodiversity	Research on terrestrial ecology	International activities
STORA	University of Agricultural Sciences	Environmental Protection Agency	Forestry Research Institute	Council for Forestry and Agricultural Research	European Union

It has not been possible within the framework of this action plan to draw up a comprehensive set of programmes covering the various sectors and areas of research involved. To ensure that this work is coordinated in the years ahead, it is recommended that *programmes be developed on a sectoral basis*, making clear who is responsible for what, in relation to the scale of biodiversity research in terms of time, space and funding. It would seem natural to group this research according to the structure described above: function-oriented, action-oriented and taxonomic research.

5.8 Policy instruments

What policy instruments are needed to achieve the objective of conserving our country's biological diversity? What types of instrument are most effective, and what combination of measures should be employed? Where are the biggest deficiencies at present? `Incentive measures' are dealt with, in very general terms, in Article 11 of the Convention. This section of the action plan is concerned with legal and economic instruments, and with information and education. Legislation and economic incentives geared to reducing pollution are considered briefly in section 5.4. Policy instruments relating to particular sectors are described in the action plans of the relevant sectoral agencies.

In general, disseminating information and encouraging and involving the people who use biological resources in one way or another are important ways of seeking to ensure that objectives are achieved. The groups of interest here include farmers, forest owners, fishermen and reindeer herders. However, proposals on policy instruments in these key sectors are mainly set out in the relevant sectoral action plans.

5.8.1 Legislation

The following proposals should be implemented in conjunction with the introduction of a new Environmental Code. Those requiring further examination should be considered by the Committee entrusted with drafting the Code. The Environmental Protection Agency therefore suggests that the proposals below should be

transmitted to that committee for consideration. In particular, the proposals concerning substantive requirements, impacts on the wider environment and new species protection arrangements need to be examined in more depth.

Proposals to extend the area in which land drainage is prohibited and to broaden and extend the protection of rivers and stretches of rivers covered by Ch. 3, Sect. 6, of the Natural Resources Act are dealt with in sections 5.2.3 and 5.2.5.

ACTION 47: **Introduce, in the Environmental Code, a *legal definition* of biological diversity.**
Proposed wording of provision: `Biological diversity' means the variability among living organisms from all sources including, *inter alia*, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems.

Background and reasons for proposal: Increasingly, environmental legislation has come to focus on the biological components of the environment. Biodiversity is now a key concept in environmental protection activities and implies a partly new approach. When permit applications etc. under environmental legislation are considered, impacts on both entire ecosystems (including their functions) and genetic variation need to be assessed. This new, broader approach should be clearly underlined in the legislation. Many of the statutory provisions concerned have the maintenance of biodiversity as their ultimate aim. It is necessary to make it clear -- not least to all those required to observe or apply these laws -- what biological diversity is. The concept should be defined in accordance with Article 2 of the Convention.

It is proposed that this definition should be included alongside the other definitions in the Environmental Code. Links with other provisions of the Code and with other laws -- not only those deriving from the Natural Resources Act -- should be made clear. There is some common ground between this proposal and a recommendation in the action plan presented by the National Board of Housing, Building and Planning (see section 4.5).

ACTION 48: **The *substantive requirements* set out in the legislation which is to be incorporated in or linked to the Environmental Code should, when the Code and associated legislation are drawn up, be reviewed and supplemented with a view to enhancing the conservation of biodiversity. In other legislation, too (e.g. the Property Registration Act), substantive requirements should be supplemented to include a link with biodiversity.**

Background and reasons for proposal: The substantive requirements laid down by environmental legislation have a direct bearing on whether, how and to what extent biodiversity is taken into account. In line with the articles of the Convention concerning sectoral integration, the aim should be to integrate substantive requirements relating to biodiversity in the various environmental and sectoral legislation concerned.

The substantive requirements of different enactments should be reviewed and developed, and the need for such requirements in other legislation should be analysed. The following are a few examples of areas in which rules requiring account to be taken of biodiversity should be introduced:
i) Decisions on certain operations affecting the natural environment, provided for in Sect. 20 of the Nature Conservation Act. If certain species are affected by the

operation, how will this affect other species and the ecosystem as a whole?
ii) Consideration of which species should be permitted to be hunted: Hunting of any given species should not be considered in isolation; account should also be taken of that species' function in the ecosystem and of how hunting could (indirectly) affect other species in the ecosystem.
iii) Setting of fishery catch quotas: Here, too, there should be provisions requiring an integrated, ecosystem-based approach; i.e. account must also be taken of how a given harvest of fish will affect other parts of the ecosystems in question.

ACTION 49: **Supplement and clarify statutory provisions, in order to ensure that *impacts on the wider environment* are also regulated; e.g. the provisions of the Natural Resources Act (Ch. 4), Nature Conservation Act, Planning and Building Act, Forestry Act, Chemical Products Act, Minerals Act etc.**

Background and reasons for proposal: A question of general importance in environmental legislation and its application is how a given activity should be assessed if it has a detrimental impact (far) beyond the area in which it is carried out. Legislation which is of significance for biodiversity, but whose provisions are ineffective or unclear as regards assessing such impacts, includes the Nature Conservation Act, the Natural Resources Act, the Planning and Building Act, the Water Act, the Roads Act, the Continental Shelf Act and the Shipping Lanes Act. One example of the kind of problem that can arise is a drainage scheme which has adverse impacts on lakes, rivers and sea areas a long way downstream. Another is a project which disrupts the natural water regime of a river and thus has a major influence on its lower reaches.

In addition, there is the special situation in which activities taking place outside a protected area or an area of particular value are detrimental to biodiversity inside that area. The aims of site safeguard and the value of areas of national conservation interest should not be undermined by activities outside the areas concerned.

A closer study needs to be made of how legislation should deal with such wider impacts.

ACTION 50: ***Define more precisely the responsibilities of municipal authorities* with regard to nature conservation and biodiversity in their areas. An important consideration here is the special responsibility of municipalities to ensure that features of conservation interest are preserved within and in the vicinity of urban areas, which they can do by collecting data (e.g. through surveys) and by protecting and managing areas of particular value, in parallel and integrated with physical planning.**

Background and reasons for proposal: Traditionally and historically, nature conservation has largely been, and been regarded as, a central government responsibility in Sweden. Despite the wording of the introductory provisions of the Nature Conservation Act (Sect. 2): `Nature conservation is the responsibility of both national and local authorities', in practice the role of the latter has been unclear. Only relatively recently (since 1988) have local authorities had the power to designate protected sites, subject to that power being delegated to them by the county administrative board.

One deficiency here is that the general responsibility of municipal authorities for nature conservation and biodiversity is not clearly defined in the Nature

Conservation Act. They have powers, but no independent responsibility. As a result, there has been less scope for local authorities to broaden and develop their nature conservation activities.

A Government Bill (1994/95:230) on `Municipal strategic planning in the Planning and Building Act etc.' proposes amendments to that Act which will make it clear that municipal authorities have a responsibility, when preparing structure (master) plans and in their other physical planning activities, to take particular account of the need for green spaces in urban areas and their immediate vicinity. The bill points out that the urban fringe is especially important, but that corridors extending into the surrounding landscape and agricultural, forest and other areas of countryside are also of great significance in this context. It emphasizes that parks and other green spaces are important from the viewpoint of health and the environment and that they are essential to conserving biodiversity in and adjacent to urban areas.

A provision in the Nature Conservation Act clarifying the general responsibility of municipalities would be a complement to the proposed amendments to the Planning and Building Act. It could also encourage broader participation in nature conservation and biodiversity activities and help to ensure that biodiversity issues are taken into account in the ongoing planning process. This proposal should not be taken to mean that the role of municipalities is *confined* to urban areas and the urban fringe, however. As has been pointed out before, municipal authorities have a key part to play in conserving biodiversity. The proposal is intended to *clarify the responsibilities resting on these authorities.* It is balanced by the explicit responsibility of central government for matters of concern to the country as a whole (e.g. areas of national interest).

ACTION 51: **Clarify the broader grounds for shore protection (consideration for plant and animal life), by including a supplementary provision in Sect. 16 of the Nature Conservation Act.**
Proposed wording of provision: Sect. 16, first paragraph, point 2: Nor may, in any other case, any installation or device be constructed in a protected shore area in such a way that land and areas of water are used as a building site or the public are in any other way prevented or deterred from entering an area in which they would otherwise have been entitled to move freely. *Nor may any installation be constructed or any measure undertaken in a protected shore area which could impair the living conditions of plant and animal life.*

Background and reasons for proposal: Sect. 15 of the Nature Conservation Act was recently amended to broaden the objective of shore protection to include the aim of maintaining good living conditions for plant and animal life on land and in water. This is a very important amendment as far as conserving biodiversity is concerned. The bill proposing the change (1993/94:223) made it clear that its purpose was to preserve the value of shore areas both for flora and fauna and as a resource for public recreation. The safeguarding of outdoor recreation and the protection of plant and animal life are intended to be two distinct assessment criteria, carrying equal weight.

The broader aim of shore protection is not followed up in Sect. 16 of the Act, however. The latter provision does not state that the construction of an installation or device may also be prohibited in order to protect plant and animal life. This raises uncertainty as to whether the protection of plant and animal life is in fact an independent criterion in the assessment of proposals for buildings etc.

There need to be powers to prevent a measure being undertaken in a protected shore

area solely with reference to the area's plant and animal life. If such powers are not available, the biological component of the shore protection rules will be of very limited significance. Sect. 16 of the Nature Conservation Act therefore needs to be clarified.

ACTION 52: **Examine the possibility of introducing a form of species protection (for certain species listed in advance) which also safeguards the habitats of the species concerned.**

Background and reasons for proposal: A fundamental weakness of existing legislation on protected species is that it affords no protection to the habitats of the species concerned. It is therefore a very blunt instrument indeed (species and populations cannot be conserved *in situ* if their habitats are not preserved). It is illegal to pick, break etc. specimens of a protected species, and yet in many cases there is virtually nothing to prevent people destroying its habitat (and hence, obviously, eliminating the species from the site). Nature conservation agencies have long discussed the need for an effective form of species protection, i.e. one which also provides the necessary safeguards for the species' habitats. Such protection should be viewed as a *complement* to existing legislation (on protected areas, habitat protection etc.).

A number of basic principles and obligations in this area are embodied in undertakings made by Sweden under international agreements: apart from the more general ones set out in the Convention on Biological Diversity, there are more specific requirements in Article 4 of the Bern Convention (which gives states a special responsibility to protect the habitats of species listed in appendices to the Convention). The EC's Birds and Habitats Directives also lay down a responsibility to protect the habitats of certain species (the extent of that protection depending on the species concerned).

This complex issue needs to be examined in more detail. One approach could be to link species protection of the kind described here to a list of species stipulated in advance. Such a list could be based on the Bern Convention and the EC directives and, we would suggest, include (certain) species in the Endangered and Vulnerable categories.

ACTION 53: **Amend the Nature Conservation Act and the Peat Act so that applications to extract peat for energy purposes are also examined under the provisions of the Nature Conservation Act. Proposed amendments are set out below.**

Background and reasons for proposal: Applications for permits to extract peat for energy purposes are examined under the Act on Certain Peat Deposits (the Peat Act). Consequently, the provisions of Sects. 18, 18 c and 18 d of the Nature Conservation Act concerning drainage do not apply in such cases.

The *travaux préparatoires* of the Peat Act, which was passed in 1985 to regulate the extraction of peat for energy purposes, made it clear that the new law was not intended to diminish the weight attached to nature conservation in the assessment of applications relating to such operations. However, when the Nature Conservation Act was amended to include Sects. 18 c and 18 d, which introduced a permit requirement for drainage operations and powers to prohibit such operations in certain areas, drainage works for the purposes of energy-related peat extraction were excluded from scrutiny under these provisions. The prohibition on drainage provided

for in Sect. 18 d thus does not apply when applications are examined under the Peat Act. Nor do the provisions concerned indicate that the environment and biodiversity are to be taken specifically into account when applications are assessed.

In 1993, under the powers given to it in Sect. 18 d of the Nature Conservation Act, the Government introduced provisions in the Nature Conservation Ordinance (Sect. 19 h) banning drainage in certain areas and stating that exemptions could be granted if there were `special reasons' for doing so. The areas in question are specified in Annex 3 to the Ordinance, and include the wetlands listed under the Ramsar Convention. Even these sites, however, are not expressly protected from development for energy purposes, an obvious inconsistency which needs to be rectified. Wetlands where drainage is prohibited under Sect. 18 d should enjoy the same protection, irrespective of which law is applicable. The Water Act, for example, offers a higher level of protection. Sweden's accession to the EU and the resultant obligations under various directives, together with other, earlier international undertakings, also make it necessary to improve the protection afforded to wetlands.

The Agency proposes the following amendments:

** Section 18 c, second paragraph, Nature Conservation Act: A permit under Sect. 18 c is not required for land drainage which is to be undertaken in conjunction with peat extraction for which a licence is required under the Act (1985:620) on Certain Peat Deposits etc.*

If this amendment is adopted, plans to extract peat in areas where drainage is prohibited will also have to be assessed under the Nature Conservation Act. The amendment should also apply to exploration licences if exploration could result in land being drained.

** Sect. 18 d, second paragraph, Nature Conservation Act: The Government or an authority stipulated by the Government may grant exemptions from the prohibition if there are extraordinary reasons for doing so.*

The power to grant exemptions in areas where drainage is prohibited should be laid down in the Nature Conservation Act. The proposed amendment is worded in such a way that the Government will be able to retain the right to consider applications relating to particularly valuable wetlands of international or EU interest.

** Sect. 7, third paragraph, Peat Act: A licence to work peat deposits in an area in which the Government has introduced a prohibition on land drainage under Sect. 18 d of the Nature Conservation Act may not be granted contrary to a decision under Sect. 18 d of the Nature Conservation Act.*

This amendment is a consequence of the other changes proposed.

ACTION 54:

- **Ensure that expertise on biodiversity is available when water rights cases are to be determined.**
- **Re-examine the rules concerning reviews of water-related operations and study how such reviews are carried out in practice.**

Background and reasons for proposal: Continuous attention needs to be paid to nature conservation, and in particular biodiversity, when water rights cases are determined and earlier water rights judgments are reviewed. Greater weight should be

attached to nature conservation in such cases. The procedures for determining these cases and the legislation governing them (the Water Act) are currently being examined by the Environmental Code Committee.

The Environmental Protection Agency possesses a broad range of expertise in nature conservation and environmental protection. County administrative boards often have a detailed knowledge which should be utilized in water rights cases.

Many older water rights judgments fail to provide adequate safeguards for biodiversity. Judgments should be regularly *reviewed* with a view to ensuring that such safeguards are improved. An application for a review of a water rights judgment going back more than 30 years can be submitted to the National Judicial Board for Public Lands and Funds, for example by the Environmental Protection Agency, the National Board of Fisheries, a county administrative board, a municipality or a fishery conservation area. Only the National Judicial Board for Public Lands and Funds, however, can formally turn to the Water Rights Court to request a review. A wider right to ask for a review should be considered.

The spawning and nursery sites of many fish species -- and also other organisms -- living in regulated rivers and in reservoirs associated with hydroelectric schemes are greatly affected by the disturbance of the hydrological regime which such schemes entail. It is therefore important to minimize the impact of regulation, above all by guaranteeing a minimum rate of flow, acceptable from the point of view of biodiversity. Flow rates vary according to the time of day and the time of year, and the models used to calculate minimum rates should therefore be based on *biological variables*. When a water rights judgment relating to a regulated river is reviewed, the river environment should be restored in order to safeguard biodiversity as far as possible. It should be feasible to set aside funds to restore watercourses that have been cleared for timber floating or other purposes, diverted through culverts or straightened, and to restore lakes whose surfaces have been lowered or which have been disturbed in other ways.

In southern and central Sweden, many large lakes (e.g. Lake Mälaren) are regulated for other purposes than electricity generation. Such schemes have often reduced the amplitude of water level fluctuations and thus depleted biodiversity, since important shore environments have been eliminated, invasion by reeds, willows and alders has accelerated, and so on. Reviews of judgments relating to projects of this kind should also be considered, above all with a view to *recreating* shore habitats. The benefits of a controlled water regime should be evaluated and weighed against the losses of biodiversity, lower level of nitrogen retention, invasion of rooted vegetation, and other phenomena which result from it.

Implementation: Ways of ensuring greater attention to the environment and nature conservation in the processing of applications under the Water Act should be studied by the Environmental Code Committee. The proposals above should be considered by that committee.

Reviews: The Environmental Protection Agency should continue to cooperate with the National Judicial Board for Public Lands and Funds and the National Board of Fisheries to secure a review of old water rights judgments and to develop methods of enhancing biodiversity in disturbed rivers. Reviews should be coordinated on a river-by-river basis. The knowledge of county administrative boards should be put to good use. A study should be made of whether it would be feasible to examine, with regard to an entire river, both the scope for improving conditions in developed stretches of the river and the possibility of extending and/or improving the efficiency

of existing installations. When new applications are considered, zero-flow schemes (leaving stretches of a river entirely dry) should not be permitted; and where existing judgments are reviewed, withdrawal of permission to reduce river flow to zero should be considered. Flow rates below the natural minimum flow of a river should not be permitted. When reviews are carried out, research findings (concerning modified regulation schemes for river-valley reservoirs, better geared to nature conservation) should be taken into account.

Timetable: Should be undertaken in conjunction with the Environmental Code Committee's inquiries, up to the entry into force of the Code. Reviews: In the course of 1995, proposals submitted to the National Judicial Board for Public Lands and Funds by county administrative boards should be collated and a number of typical cases selected and brought before the water rights courts.

Cost: Reviews: Selecting priority cases will require commitments of staff by the Environmental Protection Agency, the National Board of Fisheries, county administrative boards etc.

Funding: Reviews: Some of the cost of the studies that may be needed in cases that are reviewed can be defrayed by the National Judicial Board and be recovered as legal costs. It is not clear, however, whether the entire cost of these studies can be met in this way. Restoration costs should be met by the companies responsible for regulating the rivers etc. concerned.

* * *

Apart from the actions proposed above, biodiversity should be taken into account in the inquiries and development work in progress concerning *environmental impact assessment* and *environmental quality standards*. Environmental quality standards are a new concept in Swedish environmental legislation and will presumably be included in the Environmental Code. It is very important to include provision in the new Code for prescribing such standards in the area of biological diversity, too.

5.8.2 Economic instruments

The importance of using economic instruments and of *internalizing* the cost of damage to the environment in the activity which causes it has been underlined in several political decisions, including the *Strategy for Biological Diversity*. The latter points out that existing markets are deficient in the sense that they fail to `place a value on the costs resulting from losses of species and ecosystems, or on the potential benefits which genes, species and ecosystems may have for third parties or future generations'.

When a detrimental impact involves no monetary cost, there is a tendency to ignore it, and indeed a clear risk that resources will be misused. This is also true of biological diversity and biological resources. It is important to recognize that *a loss of biodiversity is to be regarded as an environmental problem* -- or as environmental degradation, if we prefer that expression.

Up to now, economic instruments have mostly been employed in other areas than those with a close link with biodiversity: e.g. environmental taxes on specific substances or pollutants with the aim of reducing their use or levels of emissions. The development of economic instruments to internalize the environmental costs associated with loss of or damage to biodiversity is as yet in its infancy. The

polluter-pays principle, for example -- long accepted at both the national and the international level in the sphere of pollution control -- has yet to be applied to any other form of environmental degradation than emissions from more or less stationary installations. No corresponding principle applies to a person or company responsible for a loss of biodiversity, for instance; such losses still involve basically no cost for those who cause them. This can only be put right by a combination of legal and economic instruments.

Several basic difficulties need to be overcome in order to develop economic instruments to conserve and ensure the sustainable use of biological diversity: (i) It is difficult to put a price on biodiversity. Presumably only certain components and aspects of diversity can be valued (e.g. the area covered by a certain type of habitat). Some methods already exist, however, and intense efforts are being made to develop others. (ii) It is often difficult to design instruments which work in practice *and* achieve their objective. (iii) A third difficulty is the growing significance of international trade and economic integration. Certain instruments can only be introduced in parallel with competitor nations, or need to be pursued by Sweden in the EU (e.g. a carbon dioxide tax).

Actions proposed

To make it possible to introduce economic instruments to promote the conservation and sustainable use of biodiversity, there is a need both for further basic research and for additional practically oriented studies. Research is dealt with elsewhere (see 5.7). It is important to explore the *underlying, societal causes of biodiversity losses* and to develop *methods to assess the monetary value of biodiversity*. The proposals below are chiefly concerned with further studies with a more practical slant, and are intended to draw attention to important areas for such studies.

ACTION 55: **Analyse how the decision in principle to eliminate environmentally harmful subsidies has been implemented (here, in relation to biodiversity). It needs to be made clear that financial support must not be given to activities which involve a risk of damage to or loss of biodiversity. The need for amendments or additions to the Government Agencies and Institutes Ordinance and other regulations should be examined.**

Background and reasons for proposal: This principle, which originates in the Brundtland Report, has been endorsed by Parliament and the Government in several different contexts (including Govt. Bill 1991/92:150, Annex I:12).

Implementation: The principle of sectoral integration should apply, i.e. the sector or agency administering a particular form of support should be responsible for carrying out the necessary analysis. The Government should clarify the basic policy and commission an overall assessment of how the decision in principle has been implemented. Subsidies that are judged to have a detrimental impact on biodiversity (or the basic conditions for biodiversity) should be abolished as soon as this assessment has been completed.

Timetable: Should be implemented as soon as possible.

ACTION 56: **Examine how different methods of monetary valuation of biodiversity can be *applied in different situations in order to internalize environmental costs* (in the**

form of expected damage to/loss of biodiversity).

Background and reasons for proposal: Methods and procedures for assessing the monetary value of biodiversity make it easier to internalize the costs entailed by damage to or losses of diversity. A number of different valuation methods are described in the country study (Environmental Protection Agency, *Monitor 14*). Researchers have tested a variety of methods in specific contexts.

Monetary valuation is an extremely difficult business. It should be attempted in the light of both the practical experience gained in other countries and the research and the limited applications reported in Sweden. A number of valuations have been carried out, in the form of studies of willingness to pay for different species or natural areas, estimates of the cost of restoring the ecological functions of wetlands, for example, and various types of cost-benefit analysis of alternative uses of areas.

Implementation and timetable: The Government should issue specific terms of reference for a study of this question.

5.8.3 Education and information

General background

Education and information are two important instruments in promoting the maintenance of biological diversity. Articles 12 and 13 of the Convention deal specifically with these areas. Ultimately, the aim is to create a greater understanding (the Convention talks about `awareness') of the importance of maintaining biodiversity. Greater knowledge will, it is hoped, change attitudes and values, in turn resulting in changes in behaviour (on the part of both individuals and groups of individuals). To achieve this aim, substantial efforts need to be made in the areas of information, training and education, drawing on the combined specialist knowledge represented by the various environmental and sectoral authorities (and also by other bodies and individuals).

To create an awareness of the importance of biodiversity, information and education activities need to extend over a period of many years. A long-term (10-year) strategy should be drawn up without delay, but at the same time work needs to begin on shorter-term measures. Given the magnitude of the task, moreover, every sectoral authority must shoulder its share of responsibility for the process from start to finish.

Environmental Protection Agency's strategy

The primary role of the Agency in the area of information and education should be to give a lead and to act as a catalyst, encouraging other bodies to become involved and to include biodiversity among their activities. The Agency also has an important part to play in providing (where possible) material which, in various ways, can support and inspire those whose jobs involve disseminating information and providing training. Key players and potential partners are:

- non-governmental organizations concerned with nature and the environment,
- adult education associations, especially those with an emphasis on nature/the environment,
- certain foundations working in the area of nature and the environment;

and also, taking a longer-term view:

- non-governmental organizations with an interest in how resources are used,

and

- farmers, forest owners, fishermen and reindeer herders.

These groups are, in addition, *primary target groups* for information. As far as the agricultural and forest landscapes are concerned, farmers and landowners -- and their organizations and adult education bodies -- are naturally key partners. With regard to fauna- and flora-related crime and certain other areas, the police and customs authorities are important partners, e.g. in relation to information and basic and in-service training at all levels.

Action proposed

The proposal below briefly summarizes a number of different measures. Some of them can be implemented immediately, while for others the scope for cooperation with other bodies needs to be clarified first.

ACTION 57: **Undertake information activities relating to biological diversity, e.g.:**

- **Produce information material (leaflets, study guides, material for schools etc.).**
- **Take part in joint projects with other bodies, e.g. non-governmental organizations.**

Total cost: Estimated as being of the order of SEK 4 m., roughly SEK 3 m. of which should be in the form of grants to non-governmental organizations.

5.9 Action at the local level

This action plan has been drawn up on a national basis, and primarily from a national point of view. Much of the day-to-day work of maintaining biodiversity, however, has to be done at the local level. Local efforts -- and a local perspective -- are, moreover, one of the cornerstones of *Agenda 21*. As the opening chapters of the present plan have made clear, objectives need to be developed and action taken at the regional and local as well as the national level.

The action plan drawn up by the National Board of Housing, Building and Planning -- which deals in particular with the built environment, physical planning etc. in relation to biodiversity -- includes quite a number of proposals for action at the local level, e.g. relating to urban green spaces and the natural environment of the urban fringe.

This section illustrates what can be done locally to promote biodiversity by citing *examples* from three municipalities. These examples should be seen as just that: every local authority must of course tackle biodiversity issues in the light of its own conditions and priorities. The aim in presenting these reports is to give an indication of the important work being done on a municipal basis and, by making these good examples more widely known, to inspire further activity at the local level. The country's municipal authorities, taken together, undoubtedly have the potential to play a very significant role in nature conservation in the years to come.

It should be emphasized that, in addition to municipal authorities themselves, there are a number of other important actors at the local level. In particular, these include local farmers and forest owners, reindeer herders and their communities, fishermen

and so on. These people work in areas administered by the sectoral agencies that have been involved in preparing action plans on biodiversity. Other important local partners may include village and neighbourhood associations, other voluntary organizations, schools, workplaces etc., which are touched on briefly in the section on education and information. Local action must, of necessity, evolve at the local level. We have chosen to focus in this section on the official side, i.e. the work of municipal authorities.

Many municipalities are currently involved in an exciting and important process of developing local Agenda 21s. Chapter 15 of *Agenda 21* is specifically devoted to biological diversity, and in the municipality of *Norrtälje*, a local Agenda 21 initiative has in fact formed the basis for action in support of biodiversity. In the case of *Kungsör*, efforts in this area are centred on a municipal biodiversity action plan, while in *Karlstad* the focal point is a nature conservation programme currently being drawn up by the local authority. The reports below are based on information supplied by the authorities in question. Other good examples (from five other municipalities) are described in detail in `Good examples 10 -- Nature conservation in municipal strategic planning' (in Swedish), published jointly by the Board of Housing, Building and Planning and the Environmental Protection Agency.

Example 1: Municipality of Karlstad

In Karlstad, the municipal authority decided several years ago, in 1990, to draw up a nature conservation programme for its area. It chose to apply the following basic principles and approaches:

The process was to be guided by an *integrated approach to nature conservation*. It was considered important to create a common platform for nature conservation activities in the municipality, with a shared view of key threats, valuable habitats etc., common priorities, and a clear division of responsibilities between different bodies and individuals (local authority, county administrative board, county forestry board, landowners). Of necessity, this meant involving different departments and areas of the municipality -- a cross-sectoral approach.

Another important guiding principle was a *focus on landscape ecology*. Many nature conservation programmes -- at both county and local levels -- have focused on areas/sites of particular value, while failing to take account of important issues of landscape ecology (the biological characteristics of the wider countryside, outside the areas designated as being of particular value).

The programme was also to be *action-oriented*. Action was the key concern, it was to be clearly defined and devoted a great deal of attention. Moreover, in addition to traditional nature conservation, the programme was to encompass outdoor recreation, parks and green spaces, and to a certain extent sustainable use of natural resources. The programme places particular emphasis on the greenspace structure of the municipality's built-up areas.

It was decided, furthermore, that nature conservation was to be *guided by objectives*. The aim has been to *proceed from the environmental objectives laid down by Parliament and to translate these into objectives for the municipality of Karlstad* and into the action needed to meet the national objectives within the municipality. The authority decided that Karlstad should seek to achieve the goals set by Parliament no later than the year 2020. When the national objectives were translated into municipal goals, they were divided into seven groups, one of which was

concerned with the conservation of biodiversity. The tangible goals arrived at are intended to be clearly traceable to objectives already adopted; they should in addition be *relevant, clear (in terms of areas, percentages, numbers etc.), measurable and realistic, and have defined timetables.* The actions set out in the programme should in turn be traceable to these tangible goals.

Another important basic principle was that the programme should be *both a product and a process*: stress was laid on the need to develop it further, gain wider support for it, establish working groups and produce follow-up products. The main product will consist of several reports: a general section (basic principles, prior conditions, background facts), a programme section (objectives, strategies and action), a biological inventory and a list of threatened species. In addition, several follow-up products will be compiled: a booklet aimed at households, a course syllabus for adult education groups, and guidance notes for school teachers. However, the nature conservation programme is not intended merely to result in a number of reports and other publications; equally important at least is follow-up in the shape of seminars, courses, working groups etc., with the aim of disseminating information and gaining wider support for the programme. An important contribution to this process will be made by a consultative group consisting of representatives of the local authority, the Federation of Swedish Farmers, forest owners' organizations, the forestry company STORA Skog, the county forestry board and the county administrative board, whose task will be to follow up the objectives and measures proposed.

The programme adopts a strategy based on *habitat types* and their distribution in the landscape. The following assumption has been made: *if the natural distribution of habitat types in the landscape and the quality of individual habitats are maintained and consolidated, there should be a good basis for conserving biodiversity.* The authority has decided to focus in the programme on seven habitat types of particular importance in the municipality:

- The Lake Vänern archipelago
- Deciduous forests and ravine forests
- Lake-shore meadows
- Bogs
- Forests on hyperite (olivine norite) substrates -- natural forests
- Farmland -- pastures
- Aquatic environments

These habitat types are both representative of the municipality and of particular importance at a national and county level. The municipal authority -- together with other bodies -- has a special responsibility for conserving them and for maintaining their biological components (including threatened species) and functions.

Active measures to conserve biodiversity will centre on these habitat types. The approach that has been adopted involves a focus on habitats and in certain cases groups of species, such as cryptogams requiring long forest continuity, vascular plants favoured by continuous use of land for grazing, or amphibians and reptiles dependent on shallow, warm pools with no fish fauna. In the case of habitat types and species groups for which landscape-ecological planning is known to be relevant, a generalized strategy along those lines has been chosen. Put simply, such a strategy involves an active endeavour to conserve and recreate the larger-scale natural structures of the landscape in order to create conditions for biodiversity. Key concepts here are *core areas, transition zones* and *corridors*.

For each habitat type, the programme includes a definition, a general description of its range and component features, and an account of existing problems. In addition, it sets out objectives for each type, along with a strategy for maintaining its biological

and conservation interest. The programme section ends with a number of clearly defined measures, representing the local authority's contribution to the overall nature conservation effort. These actions are costed and grouped according to the financial year in which they are to be implemented.

A few examples of specific objectives and measures included in Karlstad's nature conservation programme are given elsewhere in this action plan.

Example 2: Municipality of Kungsör

Biodiversity conservation has been an active concern in Kungsör, at the western end of Lake Mälaren, for many years. Thanks to a series of pasture management and restoration projects spanning more than two decades, a total of 65 pastures have now been restored and are appropriately managed. This work has also been of far broader significance, however: it has, for example, enhanced the amenity value of the local environment, helped to conserve ancient monuments, and improved the municipality's standing as a tourist destination.

In 1994, work began on a major survey, the results of which are to form the basis for a municipal action plan on biological diversity. This is intended to be a cross-sectoral process, to ensure that the results feed back into the agricultural and forestry sectors. An additional aim is to create a greater awareness of biodiversity among planners and the general public. Study programmes are to be developed at a special resource centre, aimed at primary and secondary schools, higher education establishments, local authority planners, forest owners and farmers, voluntary organizations and the public at large.

With a wide variety of interested parties, the process needs to be properly coordinated. Kungsör has decided to employ a project manager to act as a coordinator between, for example, livestock farmers, landowners, voluntary conservation organizations and the county administrative board.

A major effort began back in the 1970s to restore pasture-land in the municipality that was becoming overgrown. The aim was to halt the negative trend resulting from the declining need for grazing land and from the planting of spruce on redundant pastures. Projects were launched with a focus on Iron Age settlement areas, wooded pastures with a predominance of warmth-demanding deciduous trees, the large 16th-century estates, and also forest areas used for grazing. Large parts of these areas are classed as being of national interest in terms of nature conservation.

Activities in Kungsör have not been confined to the restoration projects themselves, however. The local authority has embarked on a broad-based programme, encouraging the involvement of many different sectors and parts of the municipality. This includes an *educational* initiative in the form of a `nature school', aimed at groups both within the municipality (schools, teachers, local government officials etc.) and outside groups (other local authorities, higher education establishments, planners, tourist organizations etc.). A wide-ranging nature study programme has been drawn up for all preschool units in the municipality, whose children visit a specific site at different times of year to study its plant and animal life. A day nursery with an ecological emphasis, which grows its own crops and has a hay meadow, was opened four years ago.

The municipality's pasture-land sites have also generated a large volume of *tourism* focusing on the natural and cultural landscape. With proper planning, the local

authority expects to be able to make use in the years ahead of the tourist asset which the area's restored cultural landscape represents. It is reckoning on a good return on the investments that have been made in restoring and managing pastures.

Exhibitions, lectures and nature trails are some of the *information activities* being organized as part of the municipality's overall commitment to biodiversity. Others include free coach trips to key sites, with talks by the project manager about the natural and human-influenced environment, and the publication of booklets and other material.

Another interesting initiative is the *resource centre* set up by the authority as a base for outward-oriented activities, in the shape of courses in which Kungsör intends to share its 20 years or more of practical nature conservation experience. The project manager also provides *advice* to farmers, forest owners and the general public.

Other projects with a direct or indirect bearing on the conservation of biodiversity include plans for an ecological upper secondary school in the municipality -- the `Growing Power' project -- which will, among other things, focus on avoiding artificial fertilizers and reducing pesticide use.

Example 3: Municipality of Norrtälje

Biodiversity as part of a local Agenda 21

In Norrtälje, biodiversity is one of the areas covered by the local Agenda 21 project. A document setting out the results of this project will be presented at the end of 1995, and it will include a chapter on biodiversity, describing visions, objectives, actions etc. The project team publish a *monthly newsletter* reporting on nature conservation activities etc. in the municipality. In the spring of 1995, as a component part of the Agenda 21 process, public meetings on special themes were arranged to coincide with the publication of a series of reports entitled `Nature Conservation in Norrtälje'. Landowners, organizations and the general public were invited to take part in discussions on ways of conserving and reinforcing biological diversity. During the year, there are also plans for *round-table talks* between representatives of landowners, forestry companies, voluntary organizations and the authorities on biodiversity conservation in the light of *Agenda 21*.

Biodiversity in day nurseries and schools -- an important start

Children and young people are a natural starting-point for activities in support of biodiversity. In Norrtälje, day nurseries and schools (34 in all) are encouraged to *adopt a natural area* in their vicinity. A list of suggestions has been drawn up, but the final choice depends on the individual establishment's capacity, interest, priorities and resources. The land surrounding many nurseries and schools is owned by the local authority, but in certain cases privately owned land is also involved (this has not caused any problems, however). Sites adopted include overgrown pastures, lake- or sea-shore forest areas, and lakes. They are used for nature study and environmental projects, including survey work, putting up nest boxes and clearing pastures, and for camps.

Municipal nature conservation plan based on surveys

Since 1989, the municipal authority has carried out annual *biological surveys*, the results of which are published in the `Nature Conservation in Norrtälje' report series. The areas covered have been selected in the light of existing threats and present gaps in knowledge, and have included mixed landscapes of farmland and lakes, and mire-rich areas of natural forest. During 1995, what will probably be the last of these surveys are being carried out. The reports describe the plant and animal life of the areas concerned and suggest how they could be managed and developed. The individual reports are intended to have a uniform and appealing design and to be accessible to ordinary readers with an interest in nature. The knowledge produced by the surveys will naturally also form a basis for the *municipal nature conservation plan* which is currently being prepared, and which will be presented in 1996. The data are, in addition, recorded continuously in a *GIS-based natural environment database*.

Norrtälje's natural environment database -- storing nature conservation information

The municipality's GIS-based natural environment database has been developed using the GSD (Geographical Data on Sweden) versions of the red series (1:250 000) and topographical (1:50 000) maps, together with MapInfo software. It is used to store data from the `Nature Conservation in Norrtälje' and other surveys, field visits, specialist literature etc. At present, the information collected is being transferred from the red series to the topographical map. The database is used to check all notifications of timber felling in the municipality. It is also used on an ongoing basis in conjunction with dredging permits, building permits, local plans and more in-depth structure plans, and siting studies.

Norrtälje Nature Conservation Fund -- a tangible tool for conservation projects

This is a non-profit foundation, set up by the municipal council in 1989. Its aim is to disseminate information about the natural history of Roslagen (the coastal region in which Norrtälje is situated), make use of the public's interest in conservation, preserve sites and features of particular conservation value, and manage nature reserves and nature conservation areas. Its board includes representatives of voluntary conservation organizations in the municipality. The Fund's *financial resources* derive from interest on its capital and contributions from members of the public, organizations and authorities. The Fund has launched the following projects: `Worth seeing in the Roslagen countryside', involving the publication of 10 000 copies of a book with the same title; a project to put up uniformly designed signs to mark sites of conservation interest; a scheme in which consumers `adopt' a calf, which is then placed for just over a year with a farmer or other landowner with valuable pasture-land that needs to be kept grazed; `Save Uppland's otters', including surveys, information to landowners, and restoration and protection of habitats; `Conserve the three-toed woodpecker', involving survey work and action to conserve habitats; annual nature conservation conferences on special topics; action to protect natural forests, wet forests and rich fens; and management schemes for the Linkudden and Marum nature reserves. Most of these projects are being run jointly with other interested parties. Planned activities include projects to conserve the hair-grass *Koeleria pyramidata* var. *polonica* and the clouded apollo butterfly (*Parnassius mnemosyne*), rehabilitation of injured birds, and nature conservation in schools.

Action proposed

What action is appropriate will depend on the specific conditions and priorities of the individual municipality.

A general principle that should guide work in support of biodiversity at the local level -- as at the regional and national levels -- is that it should be *cross-sectoral in approach*. In other words, relevant sectors within the municipality (both different departments of the local authority and bodies outside local government) should be involved in the process in suitable ways. The *key role played by strategic planning* in relation to land and water use -- and hence biodiversity -- should also be stressed. In addition, it is important for every municipal authority to acquire sufficient expertise in the area of biodiversity and nature conservation. A significant capacity-building effort is called for (see proposals in the action plan presented by the National Board of Housing, Building and Planning). Ultimately, it is up to each municipal authority to decide what action to take. Apart from the proposal below, the section on policy instruments includes a proposal calling for municipal responsibilities with regard to nature conservation and biodiversity to be more clearly defined in nature conservation legislation.

GENERAL PROPOSAL (58): **Municipal authorities should address biodiversity issues and propose objectives and measures relating to them as part of their local government responsibilities. Appropriate frameworks for this include local Agenda 21 initiatives, municipal nature conservation programmes, action programmes or the equivalent. Biodiversity should also be addressed in strategic planning, as follows:**

- **produce the necessary basic data (in urban areas, data on their structure of green spaces),**
- **make a declaration of intent in support of the conservation of biodiversity, and**
- **define ways of safeguarding areas/factors of particular significance for the municipality's biodiversity.**

Municipal authorities should also redouble their efforts to establish new nature reserves and nature conservation areas.

5.10 Action at the international level

International cooperation is an important factor in the conservation of Sweden's biological diversity. This section describes proposals relating to such cooperation in the years ahead, with a particular emphasis on the *additional measures* that are required in various international forums. Projects already in progress are not described (although it is obviously important that they continue and are completed as planned). Initiatives within HELCOM, OSPARCOM, the IMO and similar forums are dealt with in the section on the marine environment.

General priorities

Sweden's overall policy in relation to international environmental cooperation is presented, for example, in `The environment -- Our common responsibility' (Government paper to Parliament 1994/95:20). The Government views the conservation of biodiversity as *one of four priority areas in Sweden's policy towards the EU in the environmental sphere* (Government paper 1994/95:167: `Swedish environment policy within the European Union -- Emphases and

implementation'). One of the points made in the latter document is that several policy areas of importance to biodiversity, including agriculture and fisheries, are regulated by the EU. It also emphasizes that Sweden should make biodiversity a high priority in discussions on forestry.

The task of maintaining biodiversity in Sweden has a clear international dimension to it. On the basis of an overall assessment, the Environmental Protection Agency has decided that its international efforts should focus on the areas of *acidification, eutrophication, climate and ozone issues* and *metal emissions*. These priorities tally by and large with the Agency's analysis of the impact of different pollutants on biodiversity (see section 5.4).

Numerous international forums are or could be of significance for Sweden's biodiversity. They range from nature conservation conventions dealing with species and habitats to agreements on pollutant emissions, from the work of various United Nations bodies and the European Union to bilateral cooperation, and so on. In the area of biodiversity, the Environmental Protection Agency gives general priority to the work being done within the EU and under certain conventions.

[BOX:]

Priority conventions from the viewpoint of action on biodiversity:

- Convention on Biological Diversity
- Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention)
- Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)
- Convention on the Conservation of European Wildlife and Natural Habitats (Bern Convention)
- Convention on Wetlands of International Importance especially as Waterfowl Habitat (Ramsar Convention)
- Convention on the Protection of the Marine Environment of the Baltic Sea Area (Helsinki Convention/HELCOM)
- Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPARCOM)
- Convention on Long-Range Transboundary Air Pollution (LRTAP, Geneva Convention).

[END OF BOX]

In identifying relevant action at the international level, we have been guided by the following basic question: What problems relating to biodiversity in Sweden cannot be solved by national action (alone), but need to be tackled primarily in international forums? The following are a few examples of such problems:

- Pollutants, especially long-range air- and water-borne pollutants, which primarily affect Sweden's aquatic environments.
- Problems affecting the Baltic Sea (including fisheries, pollution, shipping, land-based activities etc.).
- Problems which have to be solved on an international basis because of economic integration and free trade.
- Problems relating to habitats outside Sweden in which `Swedish species' (e.g. migratory birds) spend some part of the year.

Actions proposed

GENERAL PROPOSAL (59): **In various international forums relevant to the conservation of biodiversity, Sweden should seek to ensure that greater emphasis is placed on an approach based on sectoral integration and responsibility. This is particularly relevant within the European Union.**

Background and reasons for proposal: Sectoral responsibility has been a cornerstone of our national environmental policy for many years. Sweden therefore has a particularly large fund of experience when it comes to tackling environmental issues on the basis of sectoral responsibility and integration. Sectoral integration should be achieved in all relevant contexts -- especially the EU and the Convention on Biological Diversity (this is emphasized in Article 6(b) of the Convention), but also forums such as HELCOM, OSPARCOM and LRTAP.

EU cooperation

ACTION 60: **Within the European Union, pursue issues with a major bearing on biodiversity in Sweden, such as**

- **acidification,**
- **climate,**
- **a second NO_x/VOC protocol,**
- **a programme for an environmentally sound transport system in Europe,**
- **early reform of the Common Agricultural Policy (CAP),**
- **the Baltic Sea environment,**
- **scope to control introductions of alien species and genetic material on a national basis in certain cases.**

Background and reasons for proposal: By and large, the problems of pollution can only be solved by further action under international agreements. A decisive factor in reducing atmospheric deposition of nitrogen and concentrations of oxidants, and hence the threat they pose to biodiversity, is a cut in emissions across Europe. The EU is currently working on a strategy on acidification.

To achieve success in this area, it is necessary to secure concerted EU action in the transport sector and a second NO_x/VOC protocol, based on critical loads. Sweden should play an active part here, making sure that it gets across its ideas on environmental quality/health objectives, sectoral integration and environmentally more sustainable transport in Europe. An environmentally sound transport system of some kind needs to be achieved across Europe. On the climate issue, too, Sweden should be giving a lead within the EU.

Sweden's agricultural policy now forms an integral part of the Common Agricultural Policy (CAP) of the European Union. Any changes we wish to see in this area will have to be pursued largely through the EU. The CAP should be reformed in such a way as to minimize any detrimental effects on biodiversity and create a good basis for maintaining biodiversity. Advice on the direction of these reforms should be drawn up by the Swedish Board of Agriculture, in line with its sectoral responsibility (to pursue `sustainable agriculture in the years to come'). Sweden should, for example, seek a transfer of resources from production-related agricultural support to the EU's conservation-oriented funds (e.g. the LIFE instrument).

The Baltic -- the world's largest brackish-water sea -- is an almost unique ecosystem, even at the global level. The states in its drainage basin have a common

responsibility for the environment of this sea area. In addition to the work in progress within HELCOM, Sweden should promote greater efforts relating to the Baltic environment within the EU. Key problem areas from the angle of biodiversity include inputs of nitrogen compounds, toxic organic pollutants, oil and chemicals, the situation of the porpoise and of wild salmon populations, and littoral habitats.

The problems associated with introductions of alien species and genetic material are discussed in section 5.3.

ACTION 61: **Fulfil the undertakings under the Birds and Habitats Directives which Sweden entered into on joining the European Union.**

Background and reasons for proposal: The EC has adopted two Council Directives in the area of nature conservation: on the conservation of wild birds (the Birds Directive) and on the conservation of natural habitats and of wild flora and fauna (the Habitats Directive). These directives involve an obligation to protect both species and habitats, in a certain manner and according to a given timetable. They are binding on member states, and Sweden has to amend its national legislation to meet their requirements. The two directives offer considerable scope for nature conservation work in Sweden in the years ahead.

The Government paper on Swedish environment policy in the EU stresses that Sweden should be actively involved in shaping the Union's nature conservation policy, e.g. with regard to the creation of a European network of special areas of conservation and special protection areas -- Natura 2000. Sweden should seek to ensure that the directives are `fully complied with by the member states. It is therefore important that they are implemented in full by Sweden, too.'

Implementation: The Environmental Protection Agency (information and coordination), in collaboration with all county administrative boards. Proposals to protect specific areas have to be approved by the Government.

Timetable: Implementation began in June 1995 and the first phase is expected to be completed in 1996 or 1997, depending on when agreements are reached with the EU. In the second phase (1998-2004), county administrative boards will introduce protection for the areas identified.

Estimated cost: Introducing the necessary protection for the areas concerned: to implement the Habitats and Birds Directives, the resources allocated to site safeguard (Environmental Protection Agency's investments allocation) will need to be increased. However, the basic data needed to estimate the costs involved are not available at present. The Agency will return to this question when more is known about how many and which areas need to be protected as a result of the directives.

Funding: The Environmental Protection Agency's investments allocation. In view of the high priority of this work, and the limited time-scale, there is a case for making special funds available.

Other international cooperation

ACTION 62: **Under the Convention on Long-Range Transboundary Air Pollution (LRTAP), Sweden should above all seek to reduce emissions of nitrogen oxides (through a new international agreement). We should also pursue further reductions**

of sulphur and VOC emissions and work for the adoption of international agreements regulating emissions of ammonia, certain hydrocarbons (persistent organic pollutants), and the heavy metals mercury, cadmium and lead.

Background and reasons for proposal: Of all the different air pollutants, nitrogen oxides have the most significant detrimental impact on Sweden's biodiversity. 85-90 % of total nitrogen oxide deposition in Sweden originates in other countries. Existing international agreements on nitrogen oxides have only achieved a marginal reduction of emissions across Europe. European emissions of volatile organic compounds (VOCs), sulphur, certain hydrocarbons (POPs) and the heavy metals mercury, cadmium and lead have all decreased more than those of nitrogen oxides, and also more than emissions of ammonia. Emissions of these pollutants in other countries cause a good deal of damage to Sweden's biodiversity. From a Swedish vantage point, it is particularly important to reduce air pollutant emissions in Poland, Germany, the Netherlands, the United Kingdom and Denmark.

Implementation: The main bodies responsible for activities relating to the Convention on Long-Range Transboundary Air Pollution are the Ministry of the Environment and the Environmental Protection Agency.

Timetable: Sweden should seek to ensure that a new, effective international agreement on nitrogen oxides comes into force by the year 2000. To achieve this aim, negotiations on the agreement must be concluded by 1998.

Estimated cost and funding: The cost is expected to be met out of annual allocations for activities relating to international air pollution.

ACTION 63: **Continue to pursue biodiversity issues (and promote an approach entailing greater sectoral integration) within HELCOM, OSPARCOM, MARPOL and other forums.**

Background and reasons for proposal: Within HELCOM, nature conservation issues are the responsibility of the Working Group on Nature Conservation and Biodiversity (EC NATURE), which has existed for several years. Important projects currently in progress include Red Lists of habitats (coastal and marine); Red Lists of threatened species (coastal and marine); protected areas; and the wild salmon stocks of the Baltic. As far as marine reserves are concerned, a great deal of work has been done over a period of several years. A number of areas have already been designated as reserves, of which Sweden has contributed 13. A recommendation has also been adopted calling on governments to identify stretches of their coasts which are of particular conservation interest. Guidelines have been drawn up on the selection of marine and coastal areas. EC NATURE is currently compiling a list of open sea/offshore marine areas. One aim of this work on reserves is to secure the designation of the Baltic Sea as a Special Area under the MARPOL Convention and thus give it special protected status. Efforts to this end should continue and be intensified.

Corresponding nature conservation activities will begin within OSPARCOM in the autumn of 1995, through its Working Group on Impacts on the Marine Environment (IMPACT). A preliminary assessment suggests that the group's main areas of concern should be fisheries and their environmental effects; the health of marine ecosystems; and impacts on habitats. This work, too, should continue, with Sweden giving a lead.

* * *

International regional cooperation also has an important part to play, cooperation in the Barents Euro-Arctic region being a case in point.

Nordic cooperation

A range of projects of varying degrees of relevance to the conservation of biodiversity are in progress under the auspices of the Nordic Council of Ministers. Below, we outline just one project directly linked to the implementation of the Convention. Obviously, other relevant projects should also be completed.

ACTION 64: **In the framework of Nordic environmental cooperation, continue and complete the project `Nordic implementation of the Convention on Biological Diversity'.**

Background and reasons for proposal: A continuous exchange of experience and knowledge between the Nordic countries in conjunction with their implementation of the Convention is of very great importance to all the countries. This is particularly true with regard to their efforts to develop sectoral integration and responsibility, especially in primary sectors and in the area of housing and infrastructure. By international standards, the Nordic countries have made considerable progress towards sectoral integration, and their combined experience will be of value to other countries. This project can be described primarily as a network between key individuals in the Nordic region.

Implementation: The project, which is headed by Finland, involves all the Nordic countries, together with Estonia. Sweden is participating through the Environmental Protection Agency and, to a certain extent, the relevant sectoral authorities (Boards of Forestry, Agriculture, and Housing, Building and Planning).

Timetable: The project is initially intended to run until 1996, when a report will be published. At that stage, the results will be evaluated and a decision taken as to whether to continue.

Estimated cost: A budget of SEK 200 000 has been agreed.

Funding: This project, like other environmental projects relevant to the Convention on Biological Diversity, is being funded in the framework of environmental cooperation under the Nordic Council of Ministers and hence through the budget of the Committee of Senior Officials for Environmental Affairs.

5.11 Costs and funding

When a loss of biological diversity does not entail a financial cost, there is a tendency not to take it into account, and a danger that components of biodiversity will be misused. It is therefore important to recognize that such losses are an environmental problem and that the costs involved should as far as possible be internalized in the activities which cause them. Existing economic systems have not managed to attach meaningful values to the potential benefits of genes, species and ecosystems for present or future generations.

Internalizing the costs associated with conserving biodiversity is often quite a different matter from internalizing costs in the area of pollution control, for example. In the case of industrial emissions or remediation of contaminated land, for instance, there are often more or less clear links with specific sectors and industries. Losses of biodiversity are commonly caused by the *combined impact* of a wide range of activities, often taking place in a variety of sectors. As a rule it is difficult to distinguish the respective roles -- and where relevant the financial responsibilities -- of individual sectors or industries.

The principal costs involved in achieving a society which maintains biodiversity in the long term will arise in those sectors in which changes and adjustments to methods and practices are required. That is to say, in primary sectors (farming, forestry etc.), as well as in sectors such as transport, energy and manufacturing. In keeping with the principle of sectoral responsibility and integration, the majority of these costs should be borne by the sectors concerned. This is true, for example, of the cost of introducing environmentally more sensitive practices in the different primary sectors.

Within the scope of this action plan, it has not been possible to estimate the costs built into specific sectors in this way. They are part of the price that has to be paid for sustainable development. To a large extent, such costs are already being incurred as a result of rules requiring care of the environment in connection with various operations in farming, forestry etc. It has not been possible, either, to carry out a comprehensive analysis of how the action needed to maintain biodiversity should be paid for. Below, however, we discuss in general terms the fundamental principles that should apply and the funding options that may be available.

How should the necessary action be paid for?

A basic point of departure when it comes to financing the measures that are needed to maintain biodiversity is that -- as far as possible -- they should be paid for by whoever has caused the damage, in line with the polluter-pays principle (PPP).

This principle was first formulated by the OECD in 1972, as one of its `Guiding Principles Concerning the International Economic Aspects of Environmental Policies'. In 1975 the Council of the European Communities adopted a recommendation on PPP, based essentially on the OECD's Guiding Principles. When the Single European Act was adopted in 1993, it was confirmed in Article 130r of the Treaty of Rome that the principle that `the polluter should pay' was to apply within the Community.

Both the EU and the OECD, however, considered it reasonable to make exceptions from this principle in the following areas:

- protection of habitats,
- reclamation of land where it can no longer be established who caused it to be contaminated,
- expenditure that can be regarded as complementary to PPP, e.g. support for the development of public transport,
- initiatives at the international level to provide grants that may be justified by common interests and reasons of efficiency and solidarity.

In view of this, it seems reasonable not to transfer the polluter-pays principle directly to the area of biodiversity. A report entitled `Nature conservation and the primary sectors' (in Swedish; Ds 1991:87) also concludes that the principle that the polluter or the user should pay cannot be directly applied to types of environmental impact

primarily associated with such uses of land or natural resources as may conflict with nature conservation interests, unless pollution of air, soil or water is involved.

A report from the Environmental Advisory Council, `Biological diversity in Sweden -- how do we discharge our responsibility?' (in Swedish; 1992:3), includes a discussion of sectoral responsibility, in particular the principles governing who should pay for nature conservation in primary sectors and how those principles should be applied in practice. Sectoral responsibility is essentially a matter of a sector's responsibility to do what it can to make its activities ecologically more sustainable, with a view to achieving the environmental objectives that have been set.

There are several advantages in seeking to place the financial burden *collectively* on the sectors considered to have caused a given loss of biodiversity. One is that it is then not as important in unclear cases to seek a judicial determination of liability in the specific case concerned. It is possible to place less emphasis on the polluter-pays principle, while not abandoning it as a fundamental principle, and to introduce a sort of `collective/vicarious PPP'. In addition, if individuals are not singled out as solely responsible for a loss of biodiversity, there may be a greater willingness on the part of the sectors concerned to pay for action on a joint basis.

Funding action in the agricultural and forest landscapes

There are various possible ways of paying for action to maintain biodiversity. It has not been possible in the process of preparing this action plan to elaborate and put forward detailed and comprehensive funding proposals. Below, we merely draw attention to a number of questions which should be considered as a basis for future proposals on finance. Our discussion centres on the types of detrimental impact that are chiefly associated with land use in the agricultural and forestry sectors.

Agricultural sector

Since 1994, Sweden's agriculture policy has formed an integral part of the Common Agricultural Policy (CAP) of the European Union. Any changes in this policy will therefore have to be pursued largely through the EU. To bring about a process of change, attention needs to be drawn to several issues. For one thing, a study should be made of how the EU's production-related agricultural support arrangements affect biodiversity, whether they result in a depletion of biodiversity and, if so, how they could be changed. Another question to be examined is to what extent EU agricultural support could be developed so as more actively to promote and finance practices better geared to biodiversity. In this context, Sweden should seek to ensure a gradual transfer of resources to the EU's conservation-oriented instruments.

Other issues that need to be highlighted are whether the revenue from different taxes/levies aimed at the farming sector (e.g. levies on chemical fertilizers) should be used to a greater extent than at present to pay for measures to maintain the biodiversity of the agricultural landscape.

Forestry sector

In forestry -- as in agriculture and other sectors -- nature conservation should primarily be promoted by ensuring that those working in the sector pay due attention to the natural environment on a day-to-day basis. In addition, however, the forestry

sector should contribute to the funding of any further action needed to conserve biodiversity.

In this context, it is important for a policy decision to be made on priorities and aims in this area, a decision which must in turn take account of both the value of protection of biodiversity and the costs which it entails.

There are various ways of financing measures in support of biodiversity within the forest sector. The Government has announced that it intends to ask the Environmental Advisory Council to look into a possible nature conservation levy on forestry.

* * *

The ideas discussed above should be seen purely as suggestions regarding possible ways of paying for the conservation of biodiversity. It is important to make a closer study of this question, as a basis for recommendations on funding arrangements.

Estimated costs

As far as more general action under central government auspices is concerned, such as research, survey work and environmental monitoring, our basic approach here is that the costs should for the time being be met out of tax revenue. Some of the costs involved are expected to be able to be met from existing allocations, but in certain cases present funding levels will need to be increased. The preliminary estimates given below relate solely to the proposals included in the present action plan.

[BOX:]

	SEK m.
Inventory of lakes and watercourses	26
Extended programme of environmental monitoring	27 + 16/year (excl. CORINE Land Cover)
Extended programme of research etc.	30
Information and education	4
Other actions proposed (as in summary)	20
Total	107 + 16/year

[END OF BOX]

The proposed expansion of environmental monitoring will require a certain increase in resources. The possibility of finding some of the necessary funding by reordering priorities should be considered (see section 5.6.1). An extended programme of research on biodiversity can only be achieved if the funding agencies concerned generally give higher priority to biodiversity-related research than they have done up to now. MISTRA and the EU are also relevant here as possible sources of additional funding. The cost of implementing the Habitats Directive, including Sweden's contribution to Natura 2000, is not included in the figures presented above; it will only be possible to estimate it when further data are available (see proposal in section 5.10).

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Annex 1

Glossary

This glossary explains and defines a number of key terms and concepts relating to biodiversity. Several of the definitions are based entirely on those set out in the Convention on Biological Diversity (Article 2), while others reflect the terminology used by the Swedish Environmental Protection Agency. The glossary also explains a number of abbreviations used in the action plan.

Action objective Expresses the result (e.g. a given protected area, a particular state of management of a pasture, a certain reduction in sulphur emissions) which a set of measures are intended to achieve within a given period of time. Action objectives relating to the Environmental Protection Agency's sphere of responsibility are proposed by the Agency and adopted either at the political level or by the relevant authorities. As with other goals, it should be possible to assess progress towards meeting action objectives, which means that they should be formulated in unambiguous and measurable terms. They should always contribute to the attainment of environmental quality objectives.

Agenda 21 Global action programme for environmental protection and development in the 21st century, adopted at the United Nations Conference on Environment and Development (UNCED) in Rio de Janeiro in 1992. The programme is framed in terms of recommendations and is not legally binding on the countries concerned. One of its fundamental ideas is that further action needs to be taken at the local level in every country.

Animal community A grouping of animal species found living together.

Anthropogenic Affected, created or caused by human beings.

Avermectins Active ingredients of deworming agents. Have been found to have toxic effects on many insect species that live in livestock manure.

BAT Best Available Technology.

Biological diversity (biodiversity) The variability among living organisms from all sources including, *inter alia*, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems *(as defined in the Convention on Biological Diversity)*. Species diversity or species richness (see below) is just one aspect of biodiversity.

Biological resources Includes genetic resources, organisms or parts thereof, populations, or any other biotic component of ecosystems with actual or potential use or value for humanity *(as defined in the Convention on Biological Diversity)*.

Boreal The phytogeographical region encompassing the tundra and cold temperate areas of the northern hemisphere.

CAP Common Agricultural Policy of the European Union.

Care-demanding species See `Red-listed species'.

CORINE Community-wide Coordination of Information on the Environment in Europe (EU/EEA).

Database A collection of data meeting certain requirements in terms of accessibility, an organized structure, security etc. (Swedish Government Official Reports (SOU) 1990:71).

Data flow Sequence of steps in the transfer of data from source to user.

DBN `Databas Natur' (Natural Environment Database) (see 5.6.2).

Ecosystem A dynamic complex of plant, animal and micro-organism communities and their non-living environment interacting as a functional unit *(as defined in the Convention on Biological Diversity)*.

EIA Environmental impact assessment. In Sweden, provisions on EIA are set out in the Natural Resources Act and Ordinance, for example.

Endangered species See `Red-listed species'.

Endemic species A species that is restricted to a particular geographical area, e.g. a country or island.

Environmental quality objective Expresses the environmental quality to be achieved by a given point in time. The expression `environmental quality' means a state of the environment described in terms of, for example, levels of pollutants (chemical and/or physical conditions) or the existence of viable populations of species. Environmental quality objectives often express desirable *basic conditions* for biological diversity. These objectives must be formulated in such a way that it is possible to assess progress towards achieving them. Environmental quality objectives need to be translated into action objectives, which will in turn guide environmental protection efforts.

Eutrophication Over-enrichment of an aquatic ecosystem caused by increased inputs or availability of plant nutrients, especially nitrogen and phosphorus.

Ex situ conservation The conservation of components of biological diversity outside their natural habitats *(as defined in the Convention on Biological Diversity)*.

Genetic variation The genetic variation of a species is the sum of the combinations of genes which occur in that species. This variation is reflected *inter alia* in the natural occurrence of subspecies, races and varieties and in physiological adaptation within a species to varying geographical or ecological conditions.

GIS Geographical information system(s).

GMO Genetically modified organism.

Habitat Strictly, the place or type of site where an organism or population naturally occurs *(as defined in the Convention on Biological Diversity)*. In other words, the living place of a plant or animal species, or more precisely its living place during part of its life cycle. `The environment as perceived by the individual species.' The term is

often used in a wider sense, however, to refer to major assemblages of plants and animals found together, and the environment in which they occur. This sense is very close to that of ecosystem (see above).

HELCOM The Helsinki Commission. Executive body for the Helsinki Convention (the Convention on the Protection of the Marine Environment of the Baltic Sea Area). Made up of representatives of the Baltic Sea states.

IMO International Maritime Organization. UN specialized agency responsible for maritime safety and marine environment issues. Highest decision-making body in relation to MARPOL (see below).

Indicator Something which we measure, and which we hope or know represents the thing we wish to measure (when what we actually want to measure cannot be measured directly, or would be too expensive or difficult to measure directly). A variable may be an indicator, but it need not be; it may instead be a precise measurement. *Indicator species* are thus species which act as indicators.

In situ conservation The conservation of ecosystems and natural habitats and the maintenance and recovery of viable populations of species in their natural surroundings and, in the case of domesticated or cultivated species, in the surroundings where they have developed their distinctive properties *(as defined in the Convention on Biological Diversity)*.

Invertebrate An animal without a backbone or spinal column.

IUCN World Conservation Union (formerly the International Union for Conservation of Nature and Natural Resources).

Load objective Expresses the maximum input of a pollutant or the maximum physical disturbance that can be accepted if overall environmental objectives and quality objectives are to be achieved. Quantitative critical loads or levels of disturbance are calculated by researchers, and related objectives are proposed by the Environmental Protection Agency or by the Government/Parliament. Values may be stated in terms of the total load or the load per unit of time. Load objectives relevant to biodiversity often relate to pollutants. For example: Atmospheric deposition of sulphur and nitrogen in southern Sweden should not exceed 300 kg S/km^2 yr and 500 kg N/km^2 yr.

LRTAP UN ECE Convention on Long-Range Transboundary Air Pollution. Signed by most countries of Europe, together with the United States and Canada.

Management-dependent habitat types Plant and animal communities and habitat types which are dependent on appropriate long-term management.

MARPOL International Convention for the Prevention of Pollution from Ships. Global convention drawn up by the IMO (see above). There is a link between MARPOL and the Helsinki Convention (see HELCOM).

MISTRA Swedish Foundation for Strategic Environmental Research.

NOLA Nature Conservation Measures in the Agricultural Landscape. An earlier scheme for the purchase of environmental services. Is to be phased into the EU Agri-Environment Programme.

NUTEK Swedish National Board for Industrial and Technical Development.

Oligotrophic Poor in nutrients (nitrogen, phosphorus).

OSPARCOM Oslo-Paris Commission. Executive body for the Convention for the Protection of the Marine Environment of the North-East Atlantic, which deals with marine pollution, particularly from land-based sources, dumping and offshore activities.

Plant community A grouping of plant species found living together.

POPs Persistent organic pollutants. Includes toxic hydrocarbons which degrade very slowly in the environment, e.g. PCBs and DDT.

Population Total number of individuals of a species occupying a defined geographical area.

PPP The polluter-pays principle.

Productive forest land Forest land which on average yields at least 1 cubic metre of timber per hectare per year when managed using normal forestry methods (Swedish definition).

Rare species See `Red-listed species'.

Red-listed species Sweden's Red Lists (Red Data Books) use the following classification system:

Category	Definition
0 Extinct	Species (taxon) that has disappeared from the country or is regarded as having disappeared as a reproducing population since 1850.
1 Endangered	Species (taxon) in danger of disappearing from the country as a reproducing population in the near future if the threats to it are not eliminated without delay.
2 Vulnerable	Species (taxon) whose survival in the country is not assured in the long term. Includes, among others, species exhibiting a serious decline in numbers or geographical range and which could possibly soon move into the Endangered category.
3 Rare	Species (taxon) which is not at present classed as endangered or vulnerable, but which is nevertheless at risk because its total population in the country is small or has a range which is either geographically very restricted or thinly scattered.
4 Care-demanding	Species (taxon) not belonging to categories 1-3, but nevertheless requiring attention to its specific needs.

Species density Degree of concentration of the species in a community. A practical index of how densely or sparsely the species occur in a community. Species density is determined on the basis of a species/area analysis.

Species richness The number of species (taxa) in a given area (1 m^2, a parish, a continent etc.). Species richness is a measure of diversity in the sense of the number of species (taxa) per unit area.

STRAM Regional environmental strategy, drawn up at the county level. Key elements in the process: environmental analysis, environmental problems, environmental objectives, action programmes.

Sustainable use The use of components of biological diversity in a way and at a rate that does not lead to the long-term decline of biological diversity, thereby maintaining its potential to meet the needs and aspirations of present and future generations *(as defined in the Convention on Biological Diversity)*. Sustainable use involves other dimensions besides the maintenance of biodiversity.

Taxon (plural taxa) Group of organisms of any rank, e.g. subspecies, species, genus, family, phylum etc.

Taxonomy Area of systematics that is concerned with principles and procedures for classifying and naming species.

Threatened species A species whose long-term survival in viable populations is not assured. Threatened species thus consist of species assigned to the Endangered and Vulnerable categories. Species in the Extinct category are usually also included among threatened species. See `Red-listed species'.

UN ECE The United Nations Economic Commission for Europe. Its responsibilities include environmental issues.

Unproductive forest land Forest land which on average yields less than 1 cubic metre of timber per hectare per year when managed using normal forestry methods (Swedish definition).

Variables A general term for the phenomena which we intend to measure/determine the value of. Refers both to the phenomena that are intended to be measured and the objects used to measure them (as defined in the Environmental Protection Agency's `Handbook on environmental monitoring'). See also `Indicators'.

Viable population A viable population of a species exists when the total number of individuals, or the number of individual populations/localities, is sufficiently large to avoid the genetic variation/development of the species being eliminated because genetic exchange between individuals and populations is no longer possible.

VOCs Volatile organic compounds.

Vulnerable species See `Red-listed species'.

Wetland A wetland is an area of land where, for a large part of the year, there is water just below, at or just above the ground surface, or an area of water covered by vegetation. A practical definition can be based on the type of vegetation present: a wetland has over 50 % water-demanding vegetation (definition used for the Environmental Protection Agency's Wetlands Inventory).

WWF World Wide Fund for Nature.

Annex 2

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Bengt Cedrenius: Information and education

Ulf Gärdenfors *et al.* (Threatened Species Unit): Draft system to identify priority species conservation measures (commissioned in another context)

Thomas Hallingbäck *et al.* (Threatened Species Unit): Analysis of measures needed to conserve red-listed species

Pekka Hedin: Biodiversity action in Kungsör

Gabriel Michanek (Uppsala University): Legal instruments

Roland von Bothmer (Swedish University of Agricultural Sciences): Introduction of alien plant species and genetic material

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Ingegerd Michel	Pollution
Manuela Notter	Environmental indices
Stig Ohlsson	Forest landscape
Gösta Stenbeck	Research
Torbjörn Svenson	Liming
Lars Thorell	Assessment of Board of Fisheries' action plan
Inger Vilborg	Sub-editing
Per Wallsten	Mountain landscape
Lars Westermark	Action to reduce pollution
Anders Wetterin	Hunting
Elisabeth Wickström	Costs and funding
Gunnar Zettersten	Tourism and recreation

In addition to the above, many individuals within and outside the Environmental Protection Agency made valuable comments and suggestions as work on this action plan progressed. Their contributions are gratefully acknowledged.

[BAKSIDESTEXT:]

REPORT ????

Action Plan on Biological Diversity

Sweden has signed the UN Convention on Biological Diversity. What steps does it now need to take to honour the undertakings which that entails?

This action plan proposes a wide range of objectives and measures to promote the conservation of biodiversity. It takes a broad approach and covers many different fields, including the protection and management of areas of particular value, action to reduce pollution, measures at the species and population levels, research, environmental monitoring, and legislative, economic and other policy instruments.

The plan -- which has been prepared at the request of the Swedish Government -- also gives a brief background to the Convention, outlines the Government's *Strategy for Biological Diversity* and summarizes the main threats to biodiversity in Sweden. It also looks at some basic assumptions and principles: Why conserve biodiversity? What has Sweden undertaken to do? What principles should guide the conservation and sustainable use of biodiversity?

It is important that sectors which use biological resources in various ways are involved in seeking to achieve the objectives of the Convention. At the Government's request, therefore, sectoral action plans have also been drawn up by the National Board of Housing, Building and Planning (physical planning, the built environment and infrastructure), the National Board of Fisheries (fisheries and aquaculture), the Swedish Board of Agriculture (agriculture, horticulture and reindeer herding) and the National Board of Forestry (forestry). These plans have been submitted to the Government separately. The five plans are complementary and should be read in parallel.

The current state of biodiversity in Sweden, and the factors influencing it, were described in detail in *Biological Diversity in Sweden -- A Country Study* (Swedish Environmental Protection Agency, *Monitor* 14, 1994). The action plans now being published can be regarded as the second stage in the process of implementing the Convention in Sweden.

ISBN 91-620-4567-9
ISSN 0282-7298

Preface to the English edition

The Swedish Environmental Protection Agency presented its action plan on biodiversity to the Government of Sweden in December 1995. As part of its assignment, the Agency was also asked to produce and publish an English version of the plan.

The action plan is being published in English primarily with a view to making Sweden's efforts to implement the Convention on Biological Diversity better known outside the country's borders. Along with the four sectoral action plans (see main preface), it can be seen as an illustration of what can be done in this area and, perhaps, provide ideas and inspiration for others. An extract from the Government's *Strategy for Biological Diversity* and the country study *Biological Diversity in Sweden* have already been published in English. The *Strategy*, proposed by the Government and approved by Parliament, sets out Sweden's national policy on biodiversity. Read together, these documents give a good overall picture of the national implementation process in Sweden.

Apart from a few minor adjustments and corrections, this English edition is a straightforward translation of the Swedish action plan and has not been reworked with the foreign reader in mind. A summary of the measures proposed will be found at the beginning of chapter 5.

Sectoral responsibility and sectoral integration are key elements of Sweden's environment policy. This means that important sectors, as well as institutions and other bodies and individuals, must of necessity be involved in the task of safeguarding biodiversity. The objectives and measures proposed in the present action plan are obviously geared specifically to the situation in Sweden. The Environmental Protection Agency would, though, like to draw particular attention to two of the aims that have guided its work on the plan: to develop measurable objectives, against which progress can be monitored, and to propose action which is tangible and practicable.

Swedish Environmental Protection Agency

Stockholm, March 1996