MINISTRY OF THE ENVIRONMENT AND SPATIAL PLANNING
ENVIRONMENTAL AGENCY OF THE REPUBLIC OF SLOVENIA

Biological and Landscape Diversity in Slovenia

An overview

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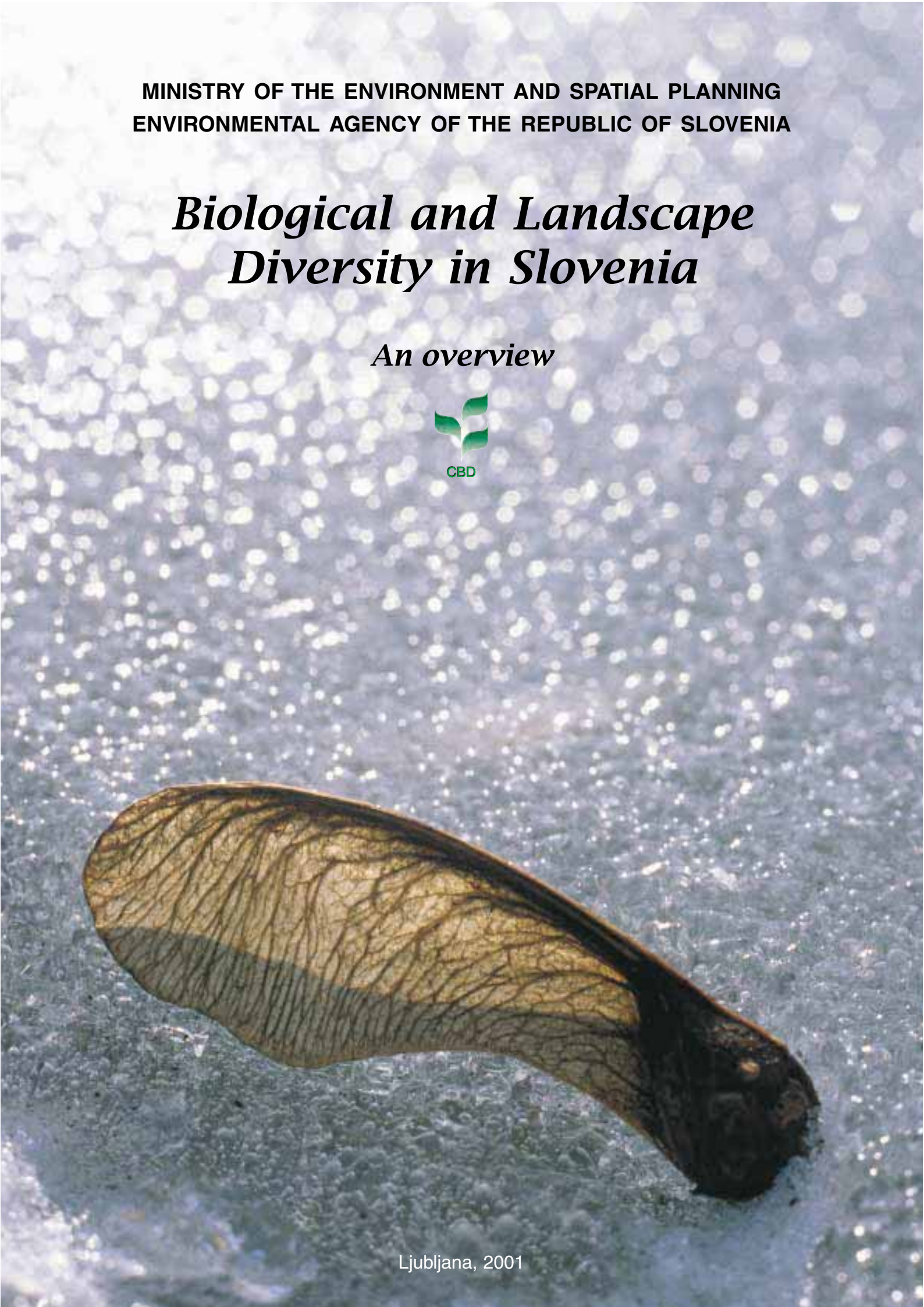

Ljubljana, 2001

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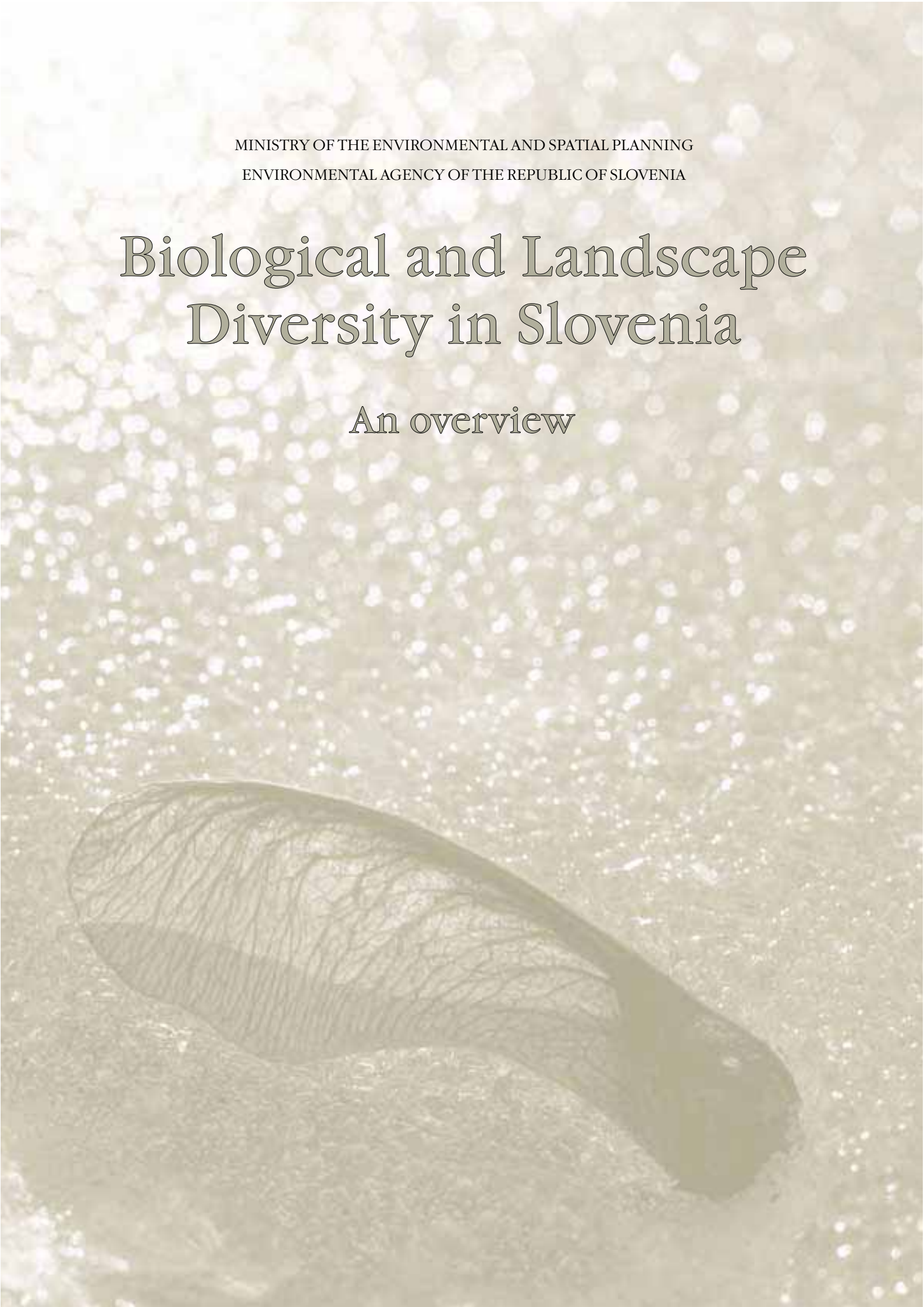

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Reviewers of the draft text:
Kazimir Tarman Ph.D., Andrej Martinčič Ph.D., Fedor Černe Ph.D.

English translation:
Andreja Naraks
Gordana Beltram Ph.D. *(chapter on Invasive Species, ..., comments on the figures),*
Andrej Golob *(chapter on Communication, Education and Public Awareness)*

Revision of the English text:
Alan McConnell-Duff
Ian Mitchell *(chapter on Communication, Education and Public Awareness)*
Gordana Beltram Ph.D.

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FOREWORD

The wilderness has created man
but man cannot create the wilderness.
He can only be part of it.

after David Brower

The overview of *Biological and Landscape Diversity in Slovenia*, the result of the two years' work of many experts, is now before you. It represents a basis for the preparation of other strategic documents, programmes and policies at the Governmental and local levels.

The collected data show the immense pressure on natural resources, ecosystems and species that is threatening biodiversity as a whole. Under the prevailing circumstances, the unchanged practices could lead to the situation currently being faced by Europe.

The assessment of the status of biological and landscape diversity in Slovenia has shown that the problems are much worse than imagined. Consequently, the responsibility of this generation to future generations is great.

In view of the ever-faster pace of life, when human relations are severed and success is measured only by material wealth, nature is our only sanctuary of peace and relaxation. Its conservation has become a social need of modern humankind, rather than a utopian idea of the determined nature conservationists.

Without decisive and firm action for the conservation of nature and healthy environment our children too will suffer from the diseases of the present. We are only as healthy as is the living environment of the species that share the Earth with us.

The key to success is to invest into nature conservation and its integration into all the training programmes. The conserved natural phenomena that are easily identifiable provide a **unique opportunity for Slovenia in the united Europe**, which has lost its valuable natural features long ago and is now trying to restore them with substantial financial incentives.

The concepts of environmental protection, through which large polluters and activities affecting nature are controlled, have already been accepted. **The conservation of finely dispersed natural wealth** of overgrown streams, living rivers and green lakes, together with minute and unique species and their habitats, is the priority objective of Slovenia. Once they are lost their restoration to the original status is extremely costly and physically almost impossible.

Are we truly aware that forests and many still undocumented, tiny features of nature cover 70 % of the territory of Slovenia?

Andreja Čerček -Hočevar Ph.D.
Directress
Environmental Agency of the Republic
of Slovenia

ACKNOWLEDGMENT

I would like to thank all those involved in the preparation of this important document, in particular Mr Stane Peterlin who started this demanding project and Mr Frits Hesselink from whom we learnt to how discern between the important and the trivial, and the GEF that provided funds implemented by the World Bank.

Andreja Čerček - Hočevar Ph.D.

SUMMARY

Pursuant to the obligations of Article 6 of the Convention on Biological Diversity (Rio de Janeiro, 1992) ratified in 1996, the Ministry for the Environment and Spatial Planning has headed and coordinated the preparation of the *Biodiversity Conservation Strategy of Slovenia*. The two main conditions for preparing such a document are the review of the status of biodiversity and related issues and the assessment of the trends in and causes of biodiversity loss, together with the principal deficiencies in the implementation of the existing mechanisms for the conservation and sustainable use of biodiversity. The overview of *Biological and Landscape Diversity in Slovenia* is divided into three main headings. In the introductory part biodiversity is presented, including its time and spatial framework, as well as the grounds established for its evaluation. The review of the status of habitats, species, genetic diversity and landscape diversity follows in the second part. Finally, the methods for the conservation of biodiversity are discussed, in particular with regard to the legislation, economy, organisation, education and research. The importance of communication and education is particularly emphasised.

The Convention on Biological Diversity provides basis for a new understanding of the importance of biodiversity and the responsibility for its conservation: each and every individual depends on biodiversity and is responsible for the conservation of all living organisms on Earth. In order to implement the Rio principles, the boundaries of particular ministries must be surpassed and all governmental organisations, companies, scientific institutions, NGOs and individuals have to be encouraged to consider the environmental issues and act accordingly. That has been the objective of the present publication. The extent and complexity of the issues have called for the active participation of numerous institutions and individuals, and for a demanding revision. The result is not only this document but also the established linkages between sectors and the raising awareness about the common endeavours for the conservation of biodiversity.

The Convention's definition of biodiversity is rather broad: from molecules, through genetic and species levels, to ecosystems. The data show that the rate of biodiversity loss at the global level is considerably high. The reasons for such a trend are human activities, in particular the intensified economic development of a small proportion of the world population. The loss of biodiversity is closely linked to the reduced cultural diversity. In addition to plant and animal species, numerous tribes and peoples are disappearing, and with them their languages, cultural heritage and the wisdom of use of plants and animals, as well as the sustainable way of life. Diversity means stability, an ability to adapt to changes, a basis for a long-term survival.

The trends and status of biological and landscape diversity in Slovenia have been presented with regard to the European and global data. Slovenia is characterised by rich diversity in a rather small territory situated between the Alps, the Dinaric Mountains, the Pannonian plain and the Mediterranean. This variety is demonstrated in the geology of the area, its varied relief, climatic conditions, biodiversity, as well as landscape and cultural diversity. In the past most of the territory was modified by human activities, which, more or less, gave consideration to the variety of natural attributes. Consequently, the cultural landscape is as equally diverse as nature.

The review of habitats shows that all the basic categories are extremely rich: coastal and marine types, inland waters, scrub and grasslands, forests, bogs, fens and marshes, barren land (rocky habitats, screes, dunes, caves) as well as agricultural and urbanised landscapes. The principal characteristic of the landscapes is the intertwining of small units and its mosaic structure. Large areas of one habitat type are rare. Such composition is the result of the diversity of natural factors (i.e. the Mediterranean, Alpine or continental influence) and human activities (i.e. mowing, grazing). Specific habitat types that cover relatively small areas ('*mrazišča*', dunes), and habitat types that are rare in Slovenia (the sea and marine habitats), are extremely important

since they significantly contribute to the diversity in the area. Forests, which cover 56 % of the territory, are the prevailing habitat type. A substantial share is taken up by caves (7,400 registered caves), which is the result of the predominating carbonate bedrock that determines the appearance of the landscape and defines the composition of biodiversity. At the national level only the data on the distribution of main habitat types (Corine Landcover) are available. A more detailed mapping of habitat types in Slovenia, helpful for the implementation of the nature conservation legislation, still needs to be carried out.

Due to the transitional character of the country encompassing four biogeographic regions, the specific habitat types are important as elements of the Pan-European Ecological Network (PEEN) since they facilitate the establishment of connections between populations inhabiting these areas. The connections between Gorski Kotar and the Alps, as well as the Mediterranean and continental Europe, are particularly important. Its geographical position also determines Slovenia's status as a transport corridor. The construction of a highway system is believed to seriously accelerate the fragmentation of habitats and obstruct the regular communication routes between populations, and increase the negative impacts of air pollution. Changes of water regimes, intensification of agricultural production or abandonment of farming land, and expanding urbanisation are some more important causes threatening habitats. The most endangered habitat types are wetlands and dry grasslands.

From the landscape perspective, cultural landscape is an important and characteristic spatial element in Europe. Moreover, many plant and animal species are closely linked to its existence and affected by its changing. Therefore, the *Pan-European Biological and Landscape Diversity Strategy* (Sofia, 1995), a European framework for the implementation of the Convention on Biological Diversity, also emphasises the importance of the conservation of cultural landscape. With regard to the landscape classification, Slovenia is divided into five basic regions (Alpine, Pre-Alpine, Sub-Pannonian, Karst and Coastal), which are further subdivided into 233 sub-units and 357 landscape patterns. It demonstrates that Biodiversity is closely linked to the rich landscape diversity, in particular when landscape is a result of less intensive agriculture practices which maintain many small structures (hedges, stone walls). Landscape is determined by social and economic conditions. The expected economic (liberalisation of the market, accession to the EU) and political changes (changed ownership relations, liberalisation of spatial policy) lead to simplified and uniform landscape patterns. The inconsistent spatial planning policy and the inefficient implementation of the spatial legislation may lead to the loss of the identity of particular areas in Slovenia and, together with the economic factors, cause the decline of habitat types and species (forests intended for litter utilisation in Bela Krajina, 'bumpy' meadows, less intensively managed meadows and pastures with '*kozolec*', a hay drying frame).

According to the available data, there are 22,000 registered plant and animal species in Slovenia. However, it is estimated that the actual number is between 50,000 and 120,000. The degree of endemism is considerably high in comparison to the smallness of the area. Particularly evident are the diversity and endemic character of subterranean animals. In Slovenia the conditions are still favourable for the vital populations of brown bear, lynx and wolf. Data about specific invertebrate groups is not sufficient. Moreover, the national scientific institutions lack structures for the taxonomic research on algae, fungi and mosses. The available funds are decreasing, and so is the number of researchers engaged in the taxonomy and distribution of flora and fauna. The Ljubljana University Herbarium and Botanical Garden have not been granted the status of a national collection and therefore lack funds. Slovenia needs a well-managed scientific database (national biodiversity reference centre) where all the data on the taxonomic classification and distribution of plants and animals would be kept. The available data are now dispersed in different institutions and societies, this preventing easy access. The common weakness of these data is that the sites, where specific species have been found, are not spatially defined.

According to the Red Data List, the most endangered groups are amphibians and reptiles, but the assessment of their status has not been carried out for all taxonomic groups. The existing Red Data Lists are not always comparable and should be revised according to the 1994 changes of IUCN categories. The most important causes endangering plant and animal species are the changes in habitats, including pollution. The causes are similar to those mentioned for habitat types. The impact of non-indigenous invasive species, which is extremely difficult to prevent, should be emphasised (changes in the riparian vegetation, introduction of non-indigenous fish species into watercourses or their translocation from one river basin to another). In view of their extent, the direct threats (picking of commercially exploitable plants, fishing, hunting, collecting, trading in endangered species) are less important but should nevertheless be controlled by special measures.

Genetic diversity is also discussed within the framework of biodiversity. This issue has neither

been sufficiently taken into account in the conservation of wild plants and animals, nor has its importance been evaluated with regard to the stability of populations and their ability to adapt to changes in the environment. Genetic diversity has only been considered when dealing with genetic resources of forest woody plants. More attention has been devoted to indigenous cultivars of agricultural plants and breeds of domestic animals. The data show that the diversity is rather rich. The genetic diversity of agricultural plants and breeds of domestic animals is threatened by the changes in agricultural practices, the globalisation of the market and the inconsistent legislation in this field.

The third part of the document deals with the sustainable use of biological and landscape diversity. The chapters on the regulative and organisational issues include the legislative framework of the conservation and sustainable use of biological and landscape diversity, and the implementation of the *in situ* and *ex situ* nature protection mechanisms. A characteristic feature of the Slovenian legal system concerning nature conservation is the adoption of legislation that is subsequently not implemented. Particular areas have not been given the protection status that would be in line with the ascertained valuable natural features. Only approximately 8 % of the national territory has been protected. However, areas with valuable natural features and ecologically important areas cover more than one third of Slovenia. One of the yet unsolved key issues related to protected areas is the issue of an adequate management system. The integration of the sustainability principles into sectoral policies has only just begun. The leading role has been taken on by the forestry sector, where sustainable management has been incorporated into the forestry legislation, expertise and practice. Agriculture has also taken some positive steps in this direction and with the preparation of the biodiversity strategy new links have been established between different sectors (defence, tourism, water management).

For the first time, the nature conservation sector is faced with the issues of economic development and integration of sustainability principles into the work of other sectors. So far, economic aspects have been analysed from the viewpoint of environmental protection and the environmental factors have been taken into account in the economic development. However, biodiversity as one of the basis of economic and regional development has not been thoroughly analysed until now. It is evident that not enough analyses of biodiversity and nature as potentials for regional development have been carried out, even though the conserved nature is considered a comparative advantage of Slovenia in relation to the rest of Europe. It has been declared a potential capital for the economic and regional development of Slovenia.

The conditions for the implementation of various mechanisms are the adequately trained staff and the available funds, and in particular, the transparency of the organisational structure and role of specific institutions. In Slovenia these conditions have not yet been fulfilled. The main reason is the continuing reorganisation of institutions that, regrettably, have not yet been stabilised because of the unconcluded period of a country in political and economic transition.

An important support system for the elimination of the critical biodiversity issues and nature conservation in general, and for the achievement of the adequate education level and active participation of the population in the solving of environmental issues, are communication, awareness raising, as well as education and training in the field of biodiversity. Such a support system has not been developed in Slovenia. All the relevant activities occur mainly spontaneously, which is undoubtedly extremely important but, unfortunately, not enough. In order to achieve the desired efficiency the strategic communication, i.e. communication in every phase of the political cycle, from the identification of the problem to its effective elimination, is indispensable. This chapter, therefore, deals with different communication forms - direct, through media, the raising of awareness, formal and informal education and training, and various forms of partnership and public participation. In addition, some of the major deficiencies in the mentioned fields are discussed. Even though communication can be effective by itself, the support mechanism is needed because it usually functions best in combination with other mechanisms used for biodiversity conservation (legal, economic, finance, etc.) since it motivates people to change their attitude and behavioural patterns towards biodiversity conservation. Namely, people generally weigh their priorities and benefits in view of their health, economic situation, importance in society, etc.

INTRODUCTION

With the adoption of the Act ratifying the Convention on Biological Diversity (Uradni list, Mednarodne objave, 7/1996) the Republic of Slovenia assumed the obligation to conserve biodiversity in Slovenia.

The main objective of the Convention is to conserve biodiversity, in particular through sustainable development. It emphasises:

- biodiversity conservation at the national and local levels and the sustainable use of its components, in particular the fair and equitable sharing of benefits deriving from the use of genetic resources;
- integration of nature conservation principles in all activities at the national or local levels;
- public participation in the conservation of biological and landscape diversity.

In compliance with Article 6 of the Convention, each contracting party has to develop national strategies, plans or programmes for the conservation and sustainable use of biodiversity or adapt for this purpose the existing strategies, plans or programmes. The mentioned article stipulates that contracting parties should integrate, as far as possible and as appropriate, the conservation and sustainable use of biodiversity into the relevant sectoral or cross-sectoral plans, programmes and policies. In this way, the Convention binds all sectors to conserve biological and landscape diversity. By the Act ratifying the Convention on Biological Diversity the responsibility to co-ordinate its implementation is given to the Ministry of the Environment and Spatial Planning.

ORGANISATION AND DATA COMPILATION

In 1998, the contract was signed between the Ministry of the Environment and Spatial Planning and the World Bank on the allocation of the financial resources of the Global Environmental Fund (GEF) for the preparation of the National Biodiversity Strategy. The work on the strategy was organised by the Environmental Agency - Office for the Environment, Nature Conservation Division, and the Ministry of the Environment and Spatial Planning - Nature Conservation Office.

The Environmental Agency started the work with the preparation of the *Biological and Landscape Diversity in Slovenia*. Data have been collected and processed by the selected leading experts of the working groups responsible for the strategy preparation, focal points of the international biodiversity related agreements, national research organisations, representatives of various ministries, the non-governmental organisations and many other experts.

Working groups

In order to increase the efficiency of the work and due to the complexity of the subject, 17 thematic working groups were designated to prepare the material covering different fields. Their work was coordinated jointly by the leading experts, employed outside the public administration, and coordinators - experts from the public administration (Table 1).

Additional expertise

The working groups compiled available data on the state of a specific area of biological or landscape diversity. In some areas additional data were required and prepared by the contracted experts (Table 2).

National expertise was used as a basis for the assessment of the state of biodiversity and preparation of the National Biodiversity Strategy. The original contributions are available at the homepage of the Ministry of the Environment and Spatial Planning http://www.sigov.si/mop/ under the Information on biodiversity (CHM - Clearing House Mechanism of the Convention on Biological Diversity).

	Working Group	Leading Expert	Co-ordinator
1.	Habitat mapping and establishment of ecological Network	Andrej Seliškar, M. Sc.	Peter Skoberne, Ph.D.
2.	Conservation of plant species and botanical gardens	Prof. Tone Wraber, Ph. D.	Peter Skoberne, Ph.D.
3.	Conservation of animal species and *ex situ* conservation in zoos	Boris Kryštufek, Ph. D. Slavko Polak	Jana Vidic, M. Sc., Tanja Košar
4.	Education and communication	Prof. Boštjan Anko, Ph. D.	Branka Hlad
5.	Biotechnology and biosafety	Prof. Radovan Komel, Ph. D. Alenka Gaberščik, Ph. D.	Ph. D. Biserka Strel
6.	Forest ecosystems	Živan Veselič, M. Sc.	Baldomir Svetličič
7.	Mountain ecosystems	Igor Maher	Martin Šolar
8.	Marine and coastal habitats	Lovrenc Lipej, doc. Ph. D.	Robert Turk, M. Sc. Gordana Beltram, Ph. D.
9.	Inland waters and wetlands	Anton Brancelj, Ph. D. Andrej Sovinc	Gordana Beltram, Ph. D.
10.	Grasslands and agricultural ecosystems	Mitja Kaligarič, Ph. D.	Mirjam Gorkič, Matjaž Jež, M. Sc.
11.	Subterranean - Hypogean - ecosystems	Prof. Boris Sket, Ph. D. Andrej Mihevc, Ph. D.	Andrej Hudoklin, Marko Simić
12.	Landscapes	Prof. Dušan Ogrin	Jelka Habjan
13.	Microorganisms and microbiological gene banks	Nina Gunde-Cimerman, Ph. D.	Julijana Lebez-Lozej, M. Sc.
14.	Gene banks in agriculture - crops	Vladimir Meglič, Ph. D.	Darja Jeglič
15.	Gene banks in agriculture - livestock	Dragomir Kompan, M. Sc.	Darja Jeglič
16.	Gene banks in forestry	Hojka Kraigher, Ph. D.	Baldomir Svetličič
17.	Protected areas - *in situ* conservation	Ana Barbič, Ph. D.	Alma Vičar

Table 1: *Working Groups for the preparation of the national Biodiversity Conservation Strategy.*

The compilation and production of the document before us, which is based on the expertise and other sources, was made by a group of editors Branka Hlad, Peter Skoberne, Andrej Arih, Urška Mavri, Mateja Blažič, Jelka Habjan, Jana Kristanc and Tanja Košar at the Environmental Agency. Their aim was, as far as possible, to achieve a logical and balanced text. In June 2001, the working draft of the document was sent to the authors and leading experts for review. At the same time, representatives of the ministries involved, who were appointed to participate in the preparation of the strategy, were asked to complement the relevant data. In August 2001, after the modifications and corrections had been inserted in the text the material was re-directed to the authors, the representatives of the ministries and the nature conservation non-governmental organisations. Most of the relevant remarks and suggestions were taken into account.

The authors are solely responsible for the content of the expertise. The content of the document on Biological and Landscape Diversity in Slovenia is the responsibility of the editors.

Additional modifications and comments were contributed by (alphabetically): Boštjan Anko, Ana Barbič, Blanka Bartol, Matjaž Bedjanič, Gordana Beltram, Andrej Bibič, Anton Brancelj, Doroteja Čarni, Andreja Čerček-Hočevar, Andrej Gogala, Stanislav Gomboc, Mirjam Gorkič, Jasna Grbovič, Katarina Groznik-Zeiler, Uroš Herlec, Milena Janežič, Darja Jeglič, Matjaž Jež, Dušan Jurc, Aleksander Golob, Gordana Kerekeš, Vesna Kolar-Planinšič, Stanka Koren, Klemen Koselj, Hojka Kraigher, Konstantin Krebs, Matjaž Kuntner, Julijana Lebez-Lozej, Ivana Leskovar, Milena Marega, Andrej Martinčič, Matjaž Mastnak, Tone Novak, Stojan Pečlin, Andrej Piltaver, Alja Pirnat, Aleš Podbrežnik, Meta Povž, Marko Simić, Silvo Smonkar, Slavko Šolar, Jaka Šubic, Tina Trampuš, Peter Trontelj, Robert Turk, Florjana Ulaga, Rudi Verovnik, Živan Veselič, Alma Vičar, Minka Vičar, Jana Vidic, Vera Vogrinčič, Franc Žepič, Bojan Žnidaršič.

The chapter on the economic development of Slovenia and the issues related to the conservation of biodiversity are summarised from the Strategy of Economic Development until 2006 (Chapter 3; UMAR, 2001) and the experts' groundwork for the preparation of the chapter on the Environment in this Strategy (Radej et al, 2000). The text summarises the work of the Institute of Macroeconomic Analysis and Development, including Dr Pavle Gmeiner - innovations, technological development and competitiveness; Ivanka Zakotnik - processing industry; Matjaž

Table 2:
Review of contributions by experts specialised in certain areas.

Expert	Area covered
	Flora
Nina Gunde - Cimerman, Ph. D.	Micro-organisms
Dušan Jurc, M. Sc.	Lower fungi
Hojka Kraigher, Ph. D.	Mycorrhizal fungi
Mihej Urbančič, Primož Simončič, Ph. D.	Forest soil ecosystems
Professor Danijel Vrhovšek, Ph. D.	Freshwater algae
Nataša Smolar - Žvanut, Ph. D.	Freshwater algae
Gorazd Kosi, Ph. D.	Freshwater algae
Andrej Piltaver	Eumycota
Professor Franc Batič, Ph. D.	Lichenes
Professor Andrej Martinčič, Ph. D.	Bryophyta
Professor Tone Wraber, Ph. D.	Pteridophyta and Spermatophyta
	Fauna
Professor Boris Sket, Ph. D.	Fauna of Slovenia, Hirudinea, Hydrozoa and Malacostraca, Subterranean - Hypogean - fauna
Slavko Polak	Subterranean- Hypogean Araneae and Coleoptera
France Velkavrh	Mollusca
Matjaž Kuntner	Araneae
Tone Novak, Ph. D.	Opiliones
Anton Brancelj, Ph. D.	Freshwater Entomostraca
Daša Zabric, M. Sc.	Ephemeroptera
Matjaž Bedjanič	Odonata
Ignac Sivec, Ph. D.	Plecoptera
Ivan Kos, Ph. D.	Chilopoda
Božidar Drovenik, Ph. D.	Coleoptera
Dušan Devetak, Ph. D.	Mecoptera, Neuropteroidea
Ciril Krušnik, Ph. D.	Trichoptera
Mojmir Lasan	Lepidoptera
Jan Carnelutti, Ph. D.	Lepidoptera
Rudi Verovnik, M. Sc.	Lepidoptera
Andrej Gogala, Ph. D.	Heteroptera and Hymenoptera
Stanislav Gomboc	Saltatoria, Isoptera, Dermaptera, Mantodea, Phasmoptera, Blattaria, Lepidoptera
Peter Trontelj, Ph. D.	Saltatoria
Meta Povž, Ph. D.	Freshwater Pisces and Cyclostomata
Lovrenc Lipej, Ph. D.	Marine fauna
Katja Pobolšaj	Amphibia
Staša Tome, M. Sc.	Reptilia
Janez Gregori	Aves (Caprimulgi, Apodiformes)
Tomaž Jančar	Aves (Charadriiformes, Columbiformes, Anseriformes, Falconiformes)
Milan Vogrin, private researcher	Aves (Podicipedidae, Cressores)
Borut Štumberger, M.D.	Aves (Galliformes, Gruiformes)
Al Vrezec	Aves (Passeriformes)
Boris Kryštufek, Ph. D.	Mammalia
	***Ex situ* conservation of animal species**
Irena Furlan	ex situ conservation of animal species
	Economic aspects
Aleksander Kešeljevič, M. Sc.	Economic aspects of conservation of biodiversity
Bojan Radej, M. Sc.	Economic development in Slovenia with reference to the biodiversity issues
	Legal aspects
Jelka Kremesec-Jevšenak Gaja Štovičej	nature conservation and related legislation

Hanžek - human development; Jure Povšnar - energy; Mateja Kovač - agriculture; Dr Janko Seljak (School of Public Administration) - measuring sustainable development; Dr Fedor Černe (Government Office for European Affairs) - the National Environmental Action Programme and sustainable development; and Bojan Radej - sustainable development (editor). This report was published as the UMAR Working paper, No. 7/ 2000.

AIMS AND OBJECTIVES OF THE DOCUMENT

Aims and objectives of the document are grouped under three main headings:

1. the content, time and spatial framework of biological and landscape diversity in Slovenia and its evaluation (economic, cultural, social, intrinsic);

2. presentation of the known and available data on biological and landscape diversity:
   - to check and supplement the existing data on the status of biological and landscape diversity and to evaluate the deficiencies;
   - to assess the threats to the biodiversity, and the direct and indirect causes of these threats, including the destruction and degradation of habitats, the trends concerning the decline in abundance of species and the unsustainable use of natural resources (methods and trends);
   - to collect material to identify:
     - criteria for determining the most endangered habitats and the directions towards the implementation of priority measures;
     - criteria for the selection of the most important areas in the context of the conservation of biological and landscape diversity;
     - the most important areas and species for which it is essential to implement the priority measures for the conservation of biological and landscape diversity;

3. presentation of the compiled data and the overview of existing mechanisms for the conservation and sustainable use of biological and landscape diversity as well as their efficiency:
   - legal mechanisms and the implementation of nature conservation:
     - legislation on conservation of biological and landscape diversity;
     - legislation on sustainable use of biodiversity components;
     - implementation of the *in-situ* and *ex-situ* protection as well as the deficiencies and key problems;
   - economic development (biodiversity issues are often not included in the economic and social development, therefore their overview provides an opportunity to fill in the gaps in the future):
     - Slovenia's development pattern and trends in the priority sectors of the economic and environmental integration;
     - overview of other sectors with substantial impact on the status of biological and landscape diversity;
     - implementation of the sustainability principles through structural economic reforms;
   - organisational structure of the services for the conservation of biological and landscape diversity, and for the deficiencies of the institutional framework:
     - implementation of administrative, expert and management tasks;
     - control;
     - non-governmental organisations;
   - financial resources;
   - communication, raising of public awareness and education (along with the economic aspects, this is one of the most neglected issues within nature conservation, and therefore the overview provides an important opportunity to fill in the future gaps). The following issues are considered:
     - direct communication and communication via the media;
     - raising of public awareness;
     - education and training;
     - other forms of co-operation and public participation;
   - research on biological and landscape diversity: a review of projects and programmes is included;
   - monitoring and use of different methods.

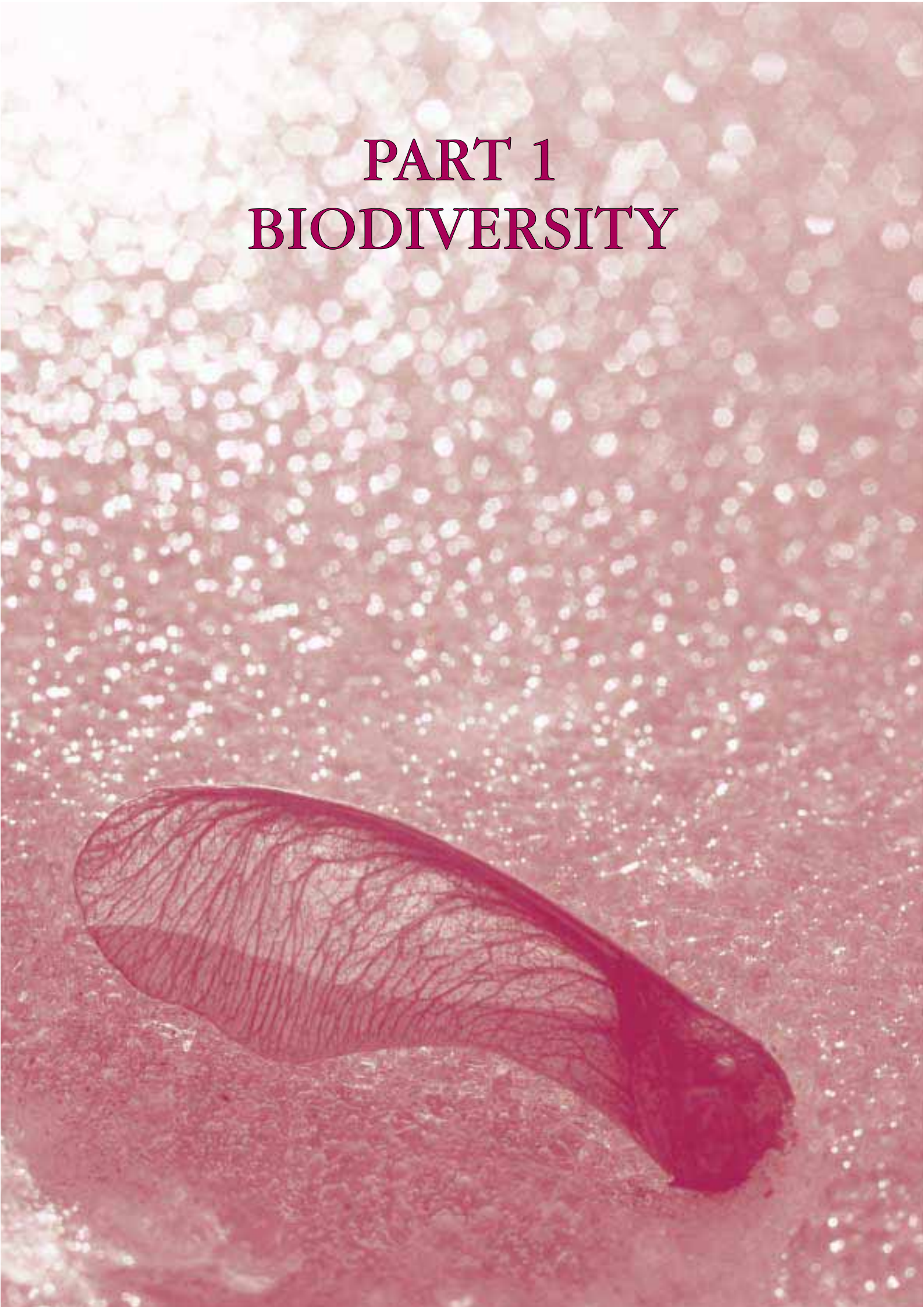
The document objectives form the basis of the national biological and landscape diversity strategy and the establishment of the relevant systemic measures for biodiversity conservation within the strategy framework, including its action plans.

PROBLEMS, CONSTRAINTS AND LIMITATIONS IN PREPARATION OF THE DOCUMENT

The main constraints faced by the editors of the document on the status of *Biological and Landscape Diversity in Slovenia* were in particular:

- limited organisational possibilities and the lack of staff and time for the preparation of this overview;
- lack of data; lack of experts for specific areas, additionally, some scientific areas are not organised within research institutions (for example, mycology);
- limited access to certain data (dispersed in various institutions, private collections, unpublished) which are therefore rarely included in analyses and assessments;
- unequal quality of the data with regard to the taxonomic reliability; data are often not spatially defined;
- basic data on biodiversity (taxonomic research and number of species) and the relevant scientific conclusions are not based on the analysis of the causes and consequences of the decline in biodiversity; the assessment of threats to biodiversity is based more on the estimates than on accurate data;
- insufficient conversion of data (as a result of different measuring and monitoring methods) into interpreted information (application of data in a specific context) needed for further action, decision-making and promotion of activities;
- systematic monitoring of the status has not been implemented; the environmental monitoring is adapted to the sectoral aspects and needs. Various institutions and non-governmental organisations monitor environmental elements using different methods, and the biological component is often not adequately considered. Currently, the monitoring is only carried out in some geographical areas, therefore, it is not possible to do a comprehensive overview of the status of biodiversity since its long-term and spatial aspects have not been considered;
- no appropriate institutional framework and links between institutions have been established which could facilitate the comprehensive collection of data and the preparation of information on changes in the field of biodiversity;
- insufficient awareness of the complexity of the problem concerning biodiversity loss at all stages, from the identification of the problem, its causes and consequences, to the consideration of the potential solutions.

PART 1
BIODIVERSITY



BIODIVERSITY

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" (Article 2 of the Convention on Biological Diversity).

LEVELS OF BIODIVERSITY

The term *biodiversity* comprises the richness of the entire biosphere (all living forms). The biosphere expresses and maintains the variability of the living organisms at several levels: genetic diversity of organisms, diversity of living beings and diversity of systems composed of organisms. From the perspective of human existence, biodiversity is the most important and the least valued asset. Only a few economists are interested in dealing with the economic aspects of biodiversity.

According to some estimates the economic value of the biosphere is US$ 33 x 1012, which is almost twice the annual World GDP (US$ 18 x 1012) (Kryštufek, 1999:12).

Genetic diversity

Every living organism carries in its genetic material (genotype) information for every protein that builds its body, every individual morphological structure - even the tiniest - every colour pattern, physiological process and behavioural response. Information is stored as a nucleotide sequence of the DNA chain. The gene is a DNA unit which determines a particular property of an organism. Genetic diversity guarantees the relevant information for life at all higher organisational levels, from a cell and an individual organism to ecosystems and the entire biosphere (Kryštufek, 1999: 17).

Species diversity

Intuitively, it is easiest to identify biodiversity at the species level. Since 1753, when a system of binominal nomenclature of plant and animal species was introduced, approximately 1.75 million species have been identified. However, it is becoming clear that only a minor part of all living organisms is included in the number. It has been estimated that there are between 10 and 100 million species living on Earth (Kryštufek, 1999: 13). These estimates are very subjective and are based on the experiences of individual scientists. In a few centuries of the species identification the scientists have managed to name the major part of higher plants and vertebrates, but the species diversity of viruses, bacteria and protists is relatively unknown. The same applies to fungi, soil roundworms and specific invertebrates. Species diversity is not evenly distributed in the world. Only few areas have a high species concentration, many of them are endemic. The highest species diversity is in tropical areas.

Ecosystem diversity

The ecosystem is a community of organisms interacting with one another and their non-living environment. Living organisms cannot survive outside ecosystems. They are most successful in ecosystems to which they had adapted through the evolution. Destruction of an ecosystem means the disappearance of species living in it, and vice versa. Different species play different roles in an ecosystem. If one of the key species, which is essential for the existence of others, is lost, this could trigger the extinction of other species and thus degrade the entire ecosystem. Ecosystem delineation is often subjective, making it difficult to express ecosystem diversity in figures. Between two ecosystems there is usually a transitional zone (ecotone) with special ecological conditions (Kryštufek, 1999).

(Photo: Marko Simić)

Figure 1. *Biological diversity in the Earth history can be well presented in palaeontological collections. This is the collection of Dr Bogdan Jurkovšek and Dr Tea Kolar-Jurkovšek.*

The relation between the diversity of an ecosystem (number of species) and its inner stability is of key importance for biodiversity conservation. Ecosystems are exceptionally complex units with numerous interactions. They are open systems influenced by numerous external factors, which makes their research so demanding. At the same time it is quite difficult to anticipate their further development.

Landscape diversity

In the Nature Conservation Act, *landscape diversity* is defined as a spatial composition of natural and human-made landscape elements. The term landscape diversity includes both: the inter-landscape and intra-landscape diversity. The inter-landscape diversity denotes the spatial structure of landscape elements (ecosystems as landscape components), and the intra-landscape diversity means the diversity of various landscapes.

BIODIVERSITY THROUGH TIME

Knowledge of the history of diversity through geological time is based on analysis of the fossil record. Fossils, as the preserved parts or casts or imprints of dead organisms, provide the only direct evidence of the 3,500 million year history of life on Earth. Referring to the UNEP-WCMC data (2000: 36) the fossils discovered and described by palaeontologists represent more than 250,000 species, virtually all of them now extinct, but these are believed to make up only a very small fraction of all the species that have ever existed.

Living species presumably represent only between two and four percent of all species that have ever lived. Numerous estimates have been made of the lifespan of species in the fossil record; these range from 0.5 to 13 million for groups as varied as mammals and microscopic protoctists. Analysis of 17,500 genera of extinct marine micro-organisms, invertebrates and vertebrates suggest an average lifespan of 4 million years in these groups. At a very gross estimate,

Map 1: *Position of Slovenia in Europe. (Source: ZRC SAZU Geografski inštitut Antona Melika, 2001).*

the mean extinction rate would be 2.5 species per year if there were around 10 million species in total. Even if background extinction rates were ten times higher than this, extinction amongst the 4,000 or so living mammals would be expected to occur at a rate of around one every 100 years, and amongst birds at a rate of one every 50 years (UNEP-WCMC, 2000: 41).

In palaeontology much attention has been devoted to mass extinction periods, during which some 75-95% of species then living became extinct during geologically very short periods of time, in some cases possibly as little as a few hundred thousand years or even less. Five such phases, based chiefly on the extinction of marine species, are recognised in the Ordovician, Devonian, Permian, Triassic and Cretaceous periods (Table 3).

The late Ordovician event appears to be correlated with global glaciation, i.e. with three separate episodes of extinction spread over only 500,000 years. It is widely accepted that the late Permian mass extinction was a long-term event, lasting for 5-8 million years. It appears to have been associated with geologically-rapid global physical changes (including the formation of the supercontinent Pangea), climate change, and extensive, tectonically-induced marine transgression and increased volcanic activity. The late Cretaceous extinction is probably the best known, but in terms of overall loss of diversity is also the least important. There is strong evidence that this event was associated with climate change following an extra-terrestrial impact, although this remains somewhat controversial.

The precise causes and timespans of each of the mass extinctions have been the subject of much debate and study. In all cases, however, the ability to determine accurately the timing and periodicity of extinction is heavily dependent on

Table 3: *The principal mass extinctions in fossil record (Source: UNEP-WCMC, 2000: 45)*

Period	Date (Mya)	Species loss (%)	Biotic change	Possible causes
End Cretaceous	66	75 %	Radical change in plankton foraminifers; 85 % of calcareous nanoplankton lost, also all ammonites, belemnites and many bivalves; losses in echinoids and corals. Many marine reptiles extinct (ichtyosaurs, plesiosaurs, mosasaurs); significant losses in freshwater and terrestrial vertebrates, including last dinosaurs (high turnover dinosaur history, end Cretaceous unusual in that no replacements emerged). Mass extinction in plants, highest (possibly 60 % species loss) in angiosperms, lowest in ferns.	Impact of large meteor Volcanism Cooling Marine regression
End Triassic	205	80 %	Mass extinction in marine invertebrates, especially brachiopods, cephalopods and molluscs, also mass disappearance of scleractinian corals and sponges. Several seed fern families lost; some land vertebrates lost, but evidence for mass extinction questionable.	Marine regression
End Permian	250	95 %	The most severe extinction crisis, metazoan life came within a few percent of total extinction. Tabulate and rugose corals terminated, complex reefs disappear (return after 8 My gap); echinoderms almost wiped out; worst crisis in history of foraminifera; severe extinction in ammonites, brachiopods, bryozoa, molluscs. Some losses in early ray-fin fishes. Major loss of terrestrial vertebrates (75 % of families) and insects (8 of 27 insect orders extinct). Mass extinction in plants, large plants including peat-forming trees lost (spread of small conifers, lycopods and quillworts), sudden unprecedented abundance of fungal spores at end of period.	Volcanism Warming Marine transgression & anoxia
Late Devonian	365	80 %	Mass extinction came at the end of prolonged period of diversity reduction. Rugose corals lost > 95 % of shallow water species, stromatoporoid corals reduced by half and reefs disappeared, brachiopods lost 33 families, ammonoids and trilobites severely affected. Fishes suffer only major mass extinction; all early jawed fishes (placoderms) disappear and most agnatha. First major crisis in plants; diversity greatly reduced, but spread of first tree, the gymnosperm *Archaeopteris*.	Marine transgression & anoxia
Late Ordovician	440	85 %	The last but largest of several extinction events during the Ordovician. More than 25 % of marine invertebrate families lost. Entire class Graptolithina reduces to a few species; acritarchs, brachiopods, conodonts, corals, echinoderms, trilobites, all much reduced.	Cooling; Warming Marine regression Marine transgression & anoxia

the completeness of the fossil record and the reliability and precision of stratigraphic analysis.

A mass extinction period is typically followed by a five to ten million year phase of very low diversity, with a handful of species dominant in fossil faunas and floras.

According to some estimates humans, are responsible for the extinction of mammoth, mastodon and other ice-age animals. Yet it is much more reasonable to believe that these animals became extinct due to climate change, since they were not able to adapt to the changing environment.

The present biological diversity is a result of the evolution of species and other living forms over geological time. Species extinction is a natural phenomenon, and can be expected. It is estimated, however, that recent and current extinction rates are considerably higher than expected by natural evolution. According to the IUCN data (2000), 11,000 species threatened with extinction is just an indicator of a much larger global phenomenon of biodiversity loss. Data show that 816 taxa have become extinct in the last decades. There are different estimates about the extinction rate. The fact is that, while the natural average is approximately 2-3 species per year, the present extinction rate is much higher. And the main cause of the sixth mass extinction may be attributed to human activities. Fast demographic increase of human population requires an accelerating use of natural resources, and in turn causes the retrogression of other species, as well as unbalanced and excessive use of natural resources and energy. The consequences of global impacts on the biosphere include considerable degradation or complete destruction of ecosystems.

(Photo: Marko Simić)

Figure 2. *In an old-growth forest nature is taking its way. The fallen trees are slowly degrading and providing a habitat for numerous animal species, fungi and micro-organisms.*

The exact number of species on Earth is unknown. So far, biologists have documented some 1.75 million species. This number represents a relatively small proportion of all species estimated to exist on Earth. According to some estimates the number is less than 10-15% of the total number of species, while others believe that the total number of species is about 100 million, although the known proportion is only 1-3%. However, the total number is increasingly believed to be 14 million species living on Earth.

GLOBAL AND EUROPEAN FRAMEWORK

In recent decades, human activities have been altering the flow of material and energy through geological, biological, oceanic and atmospheric processes causing significant changes on the global scale. Human-induced consumption and transformation of net primary productivity is estimated to be about 40 percent of that carried out by the Earth's terrestrial ecosystems. Humans release almost as much nitrogen and sulphur into the environment as does nature. We are also altering the carbon cycle by releasing large quantities to the atmosphere from burning fossil fuels. Human emissions of trace metals such as lead exceed natural flows by a factor of 17. The human contribution of other metals such as cadmium, zinc, mercury, nickel, arsenic and vanadium is twice or more than that of natural sources (EEA, 1995: 9).

The scale of planetary changes induced by human activities is also evident in the modification of the physical landscape. Since the eighteenth century, the planet has lost 6 million km^2 of forests - an area larger than Europe. The extent of vegetated soil degradation has reached 17 % of the Earth's land area in the last 45 years, due to overgrazing, deforestation, overexploitation, and improper agricultural and industrial practices. In Europe, the proportion of degraded vegetated land reached about 23 % of the total over the same period (EEA, 1995: 9).

VALUES OF BIODIVERSITY

Successful evolution of humans and their expansion over the planet was possible due to social and technological development enabled by crop-based agriculture and livestock breeding. Available evidence suggests that this happened around the end of Pleistocene. The first tangible evidence of cultivated plants concerns grains of rye *Secale orientale*, found in Syria dating from around 13,000 years BC. The earliest definite indi-

cators of domestication of the dog (*Canis*) are from around, 14,000 years ago in Oberkassel in Germany (UNEP-WCMC, 2000: 54).

Information on early human population numbers is based heavily on inference from circumstantial evidence, and remains on an uncertain footing. There are some indications that the global late Pleistocene human population may have been between five and ten million. According to some estimations the first cycle of primary population increase in Europe, Asia and the Mediterranean was brought about by the spread and further development of Neolithic agriculture, which appears to have allowed a great increase in population density. At the start of the Iron Age in Europe and the Near East, some 3,000 years ago, the world population was believed to be doubling every 500 years and the total probably reached 100 million around this time or soon after. After the Dark Ages in Europe, a second growth cycle began around 10th century in Europe and Asia, with numbers rising to a peak of around 360 million during 13th century. Crucially, the rate of global population growth peaked during the late 1960s; it was then at just over 2% per year, but is now about 1.7%. The medium variant of the current UN long-range forecast suggests that the total in 2050 may be 8,900 million (UNEP-WCMC, 2000: 56).

Importance of biodiversity for human use

As living beings, humans are part of the Earth's biological systems, and their subsistence totally depends on the functioning of ecosystems, in particular, the composition of the atmosphere (proportion between oxygen and carbon dioxide), the ozone layer in the stratosphere (absorption of UV radiation), the primary production (transformation of energy, solar into chemical - food), climate change, etc. Although these factors form the basis of life on Earth, we are still not fully aware of their complexity and the importance of their functioning.

Direct-use values of biodiversity

The direct-use values of biodiversity resources include food (plants and animals), wood/timber, drugs, building materials, clothes and animals for labour. The biodiversity potential for research and exploration of new substances (e.g. medicines, industrial materials etc.) as well as mechanisms of operating systems (e.g. movements of robots, aerodynamic properties) can, when patented, have direct-use values.

Food plants exemplify the most fundamental values of biodiversity. The variety of species used is no doubt limited much more by cultural factors, such as tradition and palatability, than by nutrient content. Estimates suggest that some 7,000 of the 270,000 described plant species have been collected or cultivated for consumption (UNEP-WCMC, 2000: 62). Perhaps more remarkable is the fact that very few, some 200 or so, have been domesticated, and a mere handful are crops of major economic importance at global level. A dozen crop plants together provide about 75% of the world's calorie intake. These comprise: bananas/plantains, beans, cassava, maize, millet, potatoes, rice, sorghum, soybean, sugar cane, sweet potatoes and wheat. These crops are becoming more and more sensitive to diseases. Additionally, due to a constant population growth (250,000 births per day) the demand for food is constantly increasing. Biodiversity has been recognised as an important natural resource in the production of new crop varieties. As an example, *Zea diploperennis*, a maize species unexpectedly resistant to intensive agricultural practices, has become an important source of genetic information on crop resistance to numerous diseases affecting current maize cultivars.

There are far fewer animal than plant species contributing to the human diet, and although most consumption of wild species will go unreported, this must be insignificant at global level in comparison to products from just three domestic forms: pigs, cattle and poultry.

Wood is one of the few commodities used and traded world-wide that is mainly harvested from wild resources; it is also one of the economically most important commodities in international trade. The annual value of wood exports world-wide totals several billion US dollars, and such exports form a significant part of the earnings of many tropical developing countries. Most timber in world trade consists of softwood (conifers) from north temperate zones, and a significant proportion is from plantation forests. Hardwoods, including highly valued timbers such as mahogany and teak, are produced from natural forest in the tropics.

Fishes and other fishery products make up the second class of commodities which are derived mainly from wild sources by direct harvest, and are of great economic importance in world trade. These resources are also of crucial importance to global food security. Capture fisheries have stagnated since the start of the 1990s, the total harvest now exceeds 100 million tonnes with the deficit being filled by aquaculture production. This can have production benefits, but in many parts of the world the coastal environment has been severely degraded by conversion to mariculture operations (UNEP-WCMC, 2000: 69).

(Photo: Ciril Mlinar)

Figure 3. *Scorpaena scrofa. In 1983, the catch of marine fish in Slovenia was 8076 tonnes, since 1993 the average annual catch is 2000 tonnes.*

Medicines. Before the advent of modern medicine, all biologically active compounds were derived from natural sources. The vast majority of botanical material for medicinal use is still collected from the wild. Only a few medicinal species are cultivated, and many wild populations are now at risk from over exploitation. Of the estimated 10,000 to 20,000 plant species used medicinally, the pharmaceutical properties of some 5000 have been laboratory tested (UNEP-WCMC, 2000: 68). They are used either as a direct source of beneficial compounds, as a blueprint for their manufacture, or as a means for their study. Amongst the top 150 most prescribed drugs in USA, 56% contain compounds which are attributable at some point in manufacture or design to animals (23%), plants (18%), bacteria (4%) and fungi (11%). This contribution may be translated into an economic value of at least 80 billion US dollars in USA alone.

(Photo: Peter Skoberne)

Figure 4. *Gentiana lutea, is threatened by natural encroachment of vegetation on the karst grasslands and by people recklessly gathering its roots for its various medical values.*

Pleasure and recreational value. Recreation in the preserved natural ecosystems and the enjoyment of nature, animals and plants relaxes people and gives them new strength. A healthy environment improves people's health, working ability and motivation. Sometimes one even relaxes while watching TV-programmes and reading magazines about life in nature. However, such programmes and photo material can only be filmed where biodiversity is conserved. The enjoyment and recreational value of biodiversity are marketed by the 'green', 'eco' or alternative tourism, and depends on preserved biodiversity and nature.

In the Orkney Islands in Great Britain (area of preserved nature) tourism annually contributes to the local budget £ 1.7 million (Scottish Natural Heritage, 1998).
Tourism in the Bayerischer Wald in Germany annually generates approximately DEM 300-350 million and employs 3,500 staff.

Indirect-use or ecological values

The Earth is a global system of atmosphere, lithosphere, hydrosphere and biosphere (which are) linked closely together. In addition to direct-use values, biodiversity provides numerous less tangible benefits resulting from the functioning of natural ecosystems and their components.

For continuous functioning of the ecosystem, the rapid matter flow between trophic levels, production of biomass and its decomposition, is of primary importance. Residue, the remaining matter which may be regarded as useless at one trophic level, can be considered a resource (nutrient) at another trophic level, causing constant matter cycling. Humans are part of this cycle using the resource (for example, food - cereals, meat, milk) and returning the waste into the ecosystem (sewage, refuse). The importance is in the continuous cycling, with different organisms and groups of organisms playing a key role. The biomass producers (plants as primary and domestic animals as secondary producers) are as important as the decomposers that change the inorganic matter into mineral components, or as 'predators and diseases' that regulate population growth of other organisms. Due to constant flow, organic and inorganic matter is not accumulated

as 'dead capital' hindering development of other trophic levels in an ecosystem. Sudden environmental disturbances exert a lesser impact on biologically rich ecosystems which, in turn, succeed in retaining a good ecosystem status.

Ecosystem functioning supports ecological processes that are fundamental to human social and economic needs. These processes prevent soil erosion, mitigate climate change (CO_2 sinks), purify water, provide suitable habitats for plants and animals. By recognising and promptly incorporating the ecosystem functioning into the socio-economic development, less resources are needed for reconstruction of ecosystems and mitigation of human induced impacts, hence less use of public money. Experience shows that restoration of degraded ecosystems is costly, requiring a considerable amount of public money, thus indicating that the precautionary approach is the cheapest alternative for the State budget. Data available from some EU countries emphasise savings resulting from the change to less intensive agriculture practices and to more efficient energy consumption.

(Photo: Peter Skoberne)

Aesthetic, intrinsic and cultural values

It is important to be aware that there still remain areas of preserved nature and high biodiversity, and that they are the legacy of future generations. People are willing to invest money and volunteer work for the conservation of such areas. Humans need to maintain a vital link with the preserved nature to sustain their physical and mental balance and the quality of life, for present and future generations.

Figure 5. *Cerkniško jezero (Cerknica lake) is one of the best known natural wonders in Slovenia, which has for centuries been attracting naturalists. Due to is numerous values - intrinsic, aesthetic, cultural and recreational - it is increasingly attracting 'recreation lovers'.*

Biotska raznovrstnost

Kaj je biotska raznovrstnost?

Biotska raznovrstnost je raznolikost vseh oblik življenja, od mikroorganizmov do rastlin in živali ter njihovih življenjskih prostorov (gozdovi, morja, puščave ...)

Biotska raznovrstnost v času in prostoru

Današnja biotska raznovrstnost je odsev več milijonov let trajajoče evolucije vrst na Zemlji. Ko ljudje širimo svoj življenjski prostor in izkoriščamo naravo brez omejitev, se krčijo življenjski prostori rastlinskih in živalskih vrst, mnogokrat do skrajnosti - njihovega izumrtja. Pri zadovoljevanju svojih potreb pogosto pozabljamo na preostali svet okoli nas, povzročamo podnebne spremembe, čezmerno zmanjšujemo življenjski prostor drugih vrst, s katerimi si delimo planet. Tako so se na primer od 18. stol. površine pod gozdovi na Zemlji zmanjšale za 6 milijonov km² - tj. za ozemlje, večje od Evrope.

Dodatne informacije o biotski raznovrstnosti dajo:

Agencija RS za okolje, Sektor za ohranjanje narave
Vojkova ulica 1b, Ljubljana
telefon +386 (0)1 478 40 00

Biotska raznovrstnost Slovenije

Med glavne posebnosti Slovenije sodita ohranjena narava in izjemna biotska raznovrstnost, ki se kaže v velikem številu rastlinskih in živalskih vrst, bogastvu različnih ekosistemov in krajinski pestrosti. Slednja so ustvarile raznolike naravne danosti in človekove dejavnosti. Pri nas je opisanih okoli 22.000 rastlinskih in živalskih vrst, a strokovnjaki menijo, da jih je od 50.000 do 120.000. Čeprav mnogih niti še ne poznamo, raziskave kažejo precejšnje upadanje števila znanih vrst. Delimo od 3200 praprotnic jih je 330 na rdečem seznamu ogroženih vrst, od 447 znanih vretenčarjev je ogroženih 273, največ dvoživk (91%).

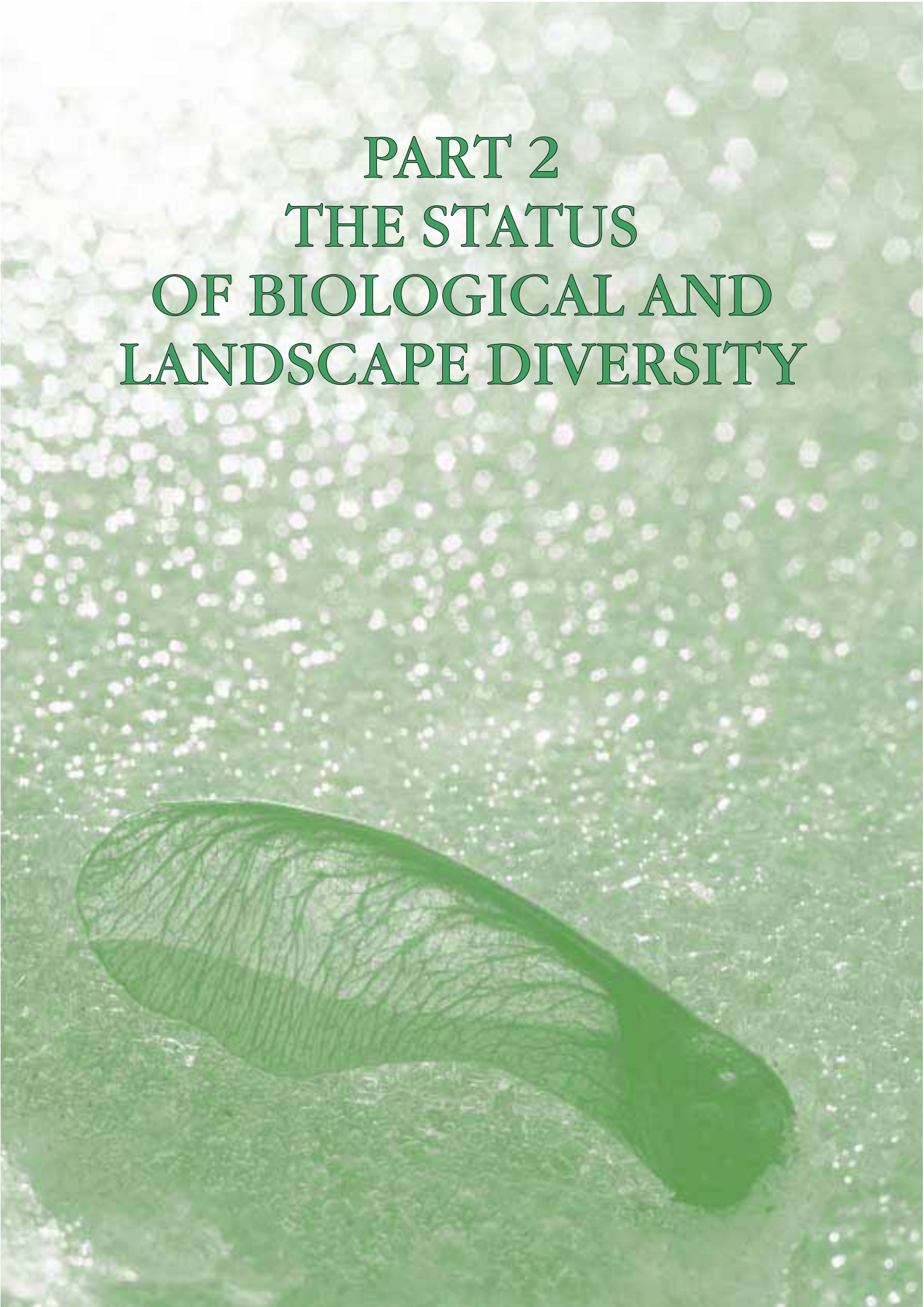
Uspešno varovanje vrst pa ni mogoče brez ohranjanja njihovega življenjskega prostora. Najbolj ogrožena so makrišča, kraške vode, suha travišča ter obalni, morski, rečni in gorski ekosistemi.

Konvencija o biološki raznovrstnosti

Na konferenci Združenih narodov o okolju in razvoju v Riu de Janeiru so številne države - danes 180 - podpisale Konvencijo o biološki raznovrstnosti in se s tem zavezale k ohranjanju biotske raznovrstnosti in trajnostni rabi naravnih virov. Še nikoli prej svetovna skupnost ni bila tako enotna, k temu je prispevala tudi Slovenija, ki je konvencijo podpisala in leta 1996 ratificirala. Za dan biotske raznovrstnosti je bil razglašen 22. maj, ko je bilo sprejeto usklajeno besedilo Konvencije.

Za njeno izvajanje v Sloveniji skrbi Ministrstvo za okolje in prostor, za njeno uresničitev pa smo odgovorni vsi, ki s svojim delom in življenjskim slogom vplivamo na biotsko raznovrstnost in smo od nje odvisni.

PART 2
THE STATUS OF BIOLOGICAL AND LANDSCAPE DIVERSITY

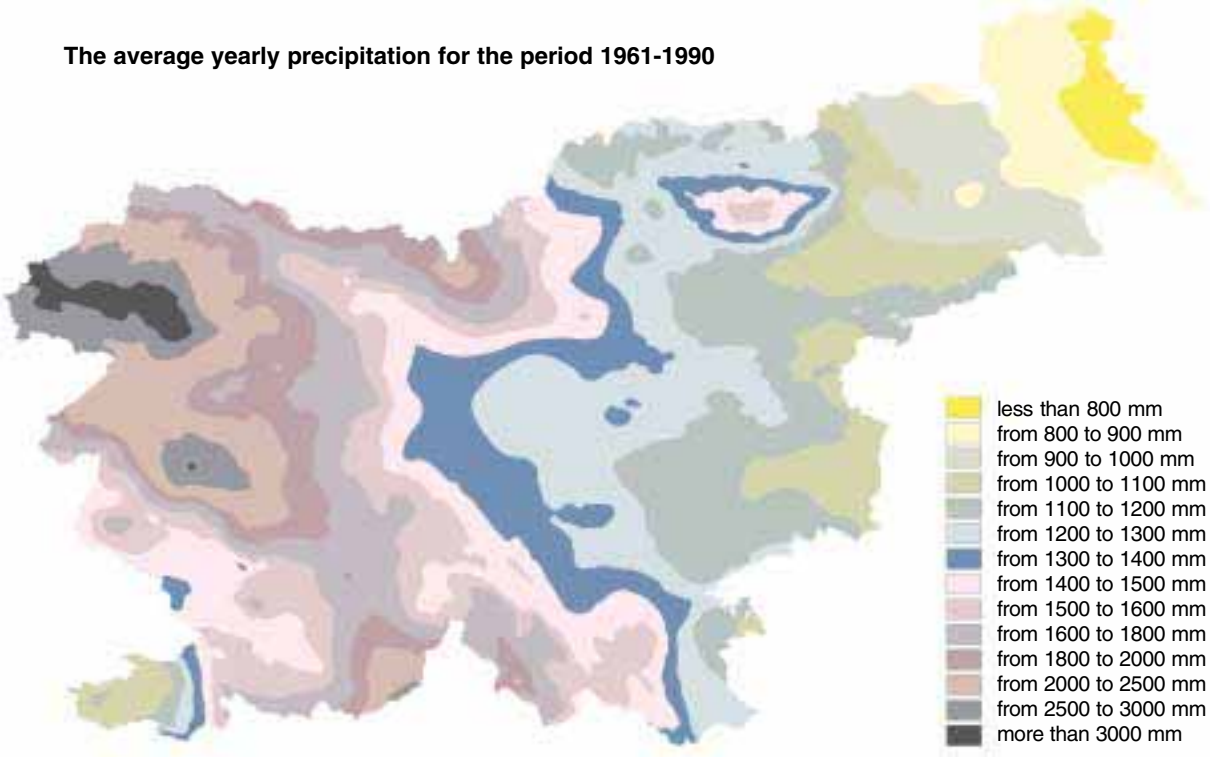


BIODIVERSITY IN SLOVENIA

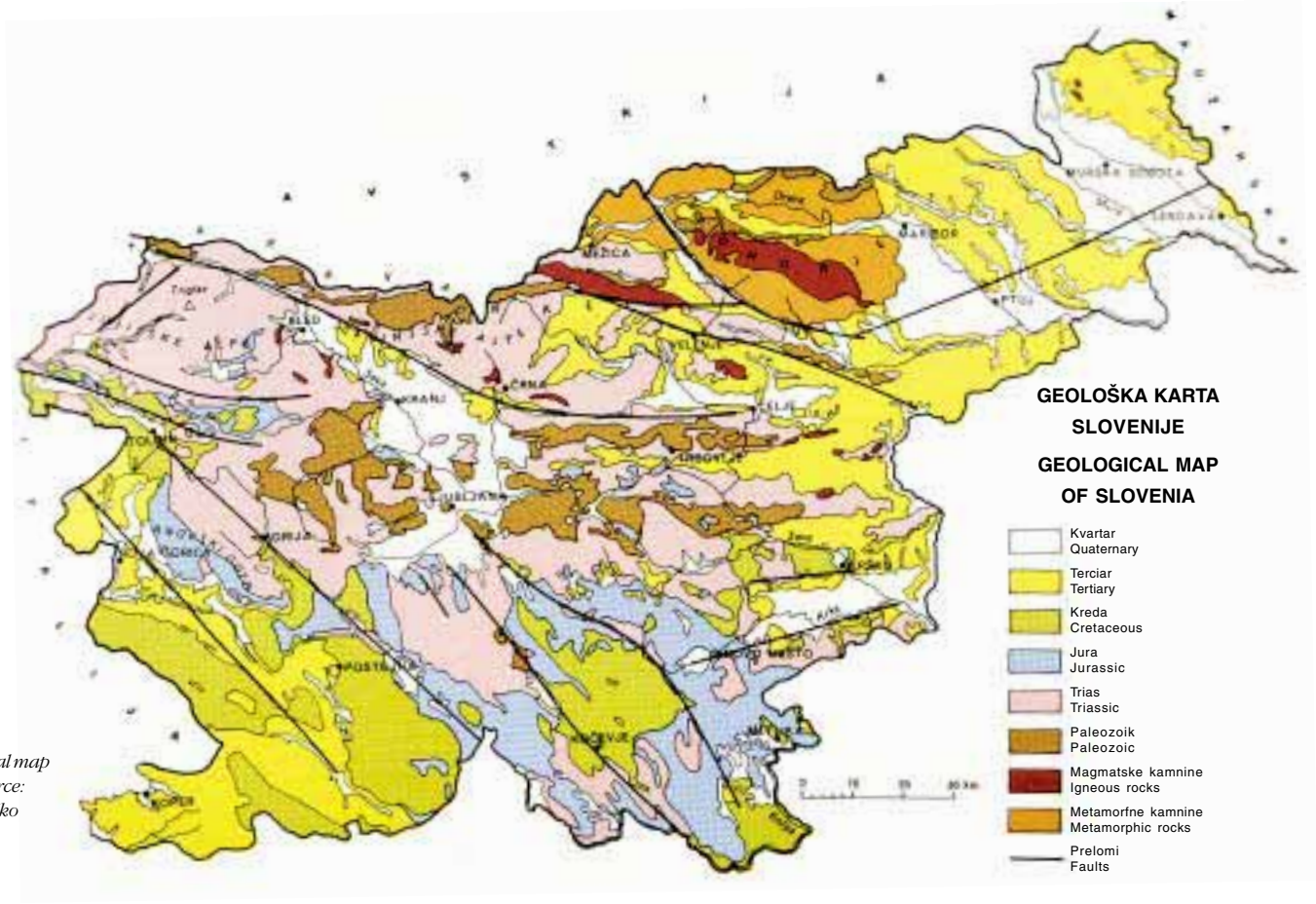
SOME MAIN CHARACTERISTICS OF SLOVENIA

Surface area: 20,273 km²
Inhabitants: 1,988,230 (31st March 2000)
Population density per km²: 98
Biggest permanent lake: Bohinjsko jezero (318 ha)
Biggest intermittent lake: Cerkniško jezero (2,400 ha)
Total length of the rivers: 26,989 km (TK 1:25)
Longest rivers: the Sava, Drava, Mura, Soča rivers
Length of the coast: 46.6 km
Highest peak: Triglav (2,864 m)
Number of local community administration units: 58
Number of municipalities: 192
Number of settlements: 5,997
(Source: SURS, *http://www.sigov.si/zrs/slfig00/index.htm*, 17.7.2000)

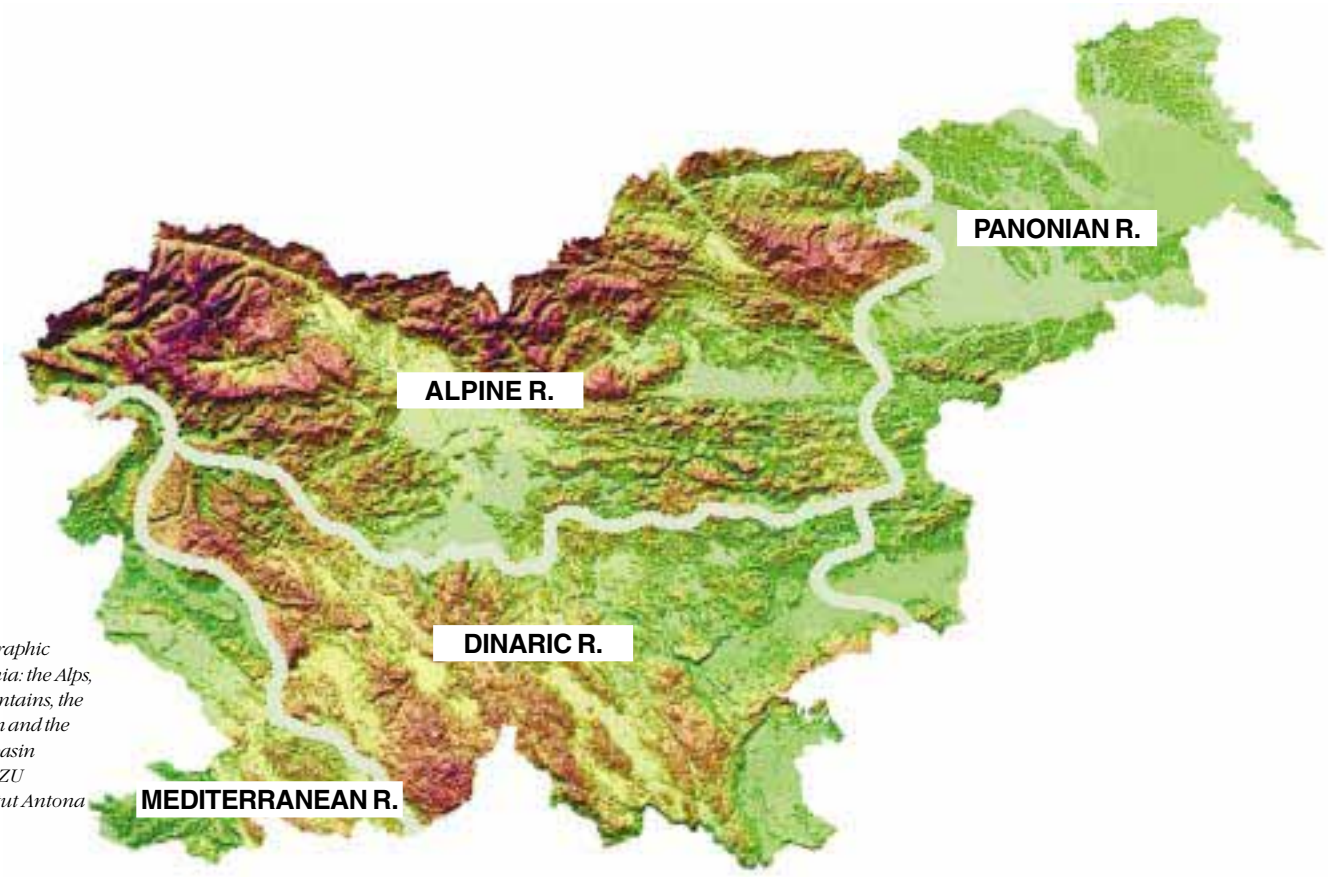
The average yearly precipitation for the period 1961-1990



Map 2: *Precipitation map of Slovenia (Source: MOP-ARSO, Urad za meteorologijo, 2001)*



Map 3: *Geological map of Slovenia (Source: Slovensko geološko društvo)*



Map 4: *Bio-geographic regions of Slovenia: the Alps, the Dinaric Mountains, the Pannonian plain and the Mediterranean basin (Source: ZRC SAZU Geografski inštitut Antona Melika, 2001)*

R. = region

CHARACTERISTICS OF BIOLOGICAL AND LANDSCAPE DIVERSITY IN SLOVENIA

The small territory of Slovenia is characterised by a rich diversity of plant and animal species, ecosystems and landscapes. This rich diversity results from Slovenia's transitional position at the contact area of tectonic units and biogeographical regions (the Mediterranean, Pannonian, Alpine and Dinaric), changing relief (from the sea bottom to the altitude of 2,864 m) and its diverse geological, pedological, climatic and hydrological conditions. The involvement of the Slav, German and Roman cultures influencing human activities has also contributed to the rich cultural and landscape diversity of the present Slovenian territory. Well preserved forests, mountain areas and freshwater underground ecosystems with the high diversity of plants and animals, including many endemic species, and the diverse ecosystems are of particular importance. (Table 4).

(Photo: Peter Skoberne)

Figure 6. *A view of the highest Slovenian mountain Triglav, and the Triglav glacier viewed from the Mt. Begunje.*

	Main characteristics
Geology	juncture of four geotectonic units: Eastern Alps, Dinarids, Pannonian Basin, Adriatic-Apulian foothills (Placer, 2000), diverse rock structures
Biogeographic regions	the Alps (30 %), the Dinaric Mountains (30 %), the Mediterranean Basin (10 %), and the Pannonian Plain (30 %), covering a total area of 20,273 km^2, give the country an ecotone character
Relief	varied relief, altitude above sea-level 0 to 2,864 metres 1/6 of the territory is of Quaternary sediments, some 44 % carbonate bed-rock, mainly karstified areas (over 7,000 caves registered)
Hydrological characteristics	two drainage systems: 2/3 to the Black Sea, 1/3 to the Mediterranean Sea five catchment areas: the Soča, Sava, Drava in Mura rivers, and the Slovenian Littoral relatively large karst area with no surface streams
Vegetation cover	56 % of the territory covered by forests 36 % of the territory is agricultural land
Flora	about 3,200 vascular plants 60 endemic taxa, including 22 narrow endemics with predominant distribution in Slovenia
Fauna	about 13,000 - 15,000 species (expected 50,000 up to 100,000) about 4,000 endemic taxa (above all cave animals)

Table 4: *Main natural features of Slovenia*

(Photo: Marko Simić)

Figure 7. *Sinking and spring dolines - estavels at Zadnji kraj on Cerkniško polje in the dry period expose the limestone bed-rock underlying the alluvial sedimentation.*

The natural features and the limited impact of the economic factors in the past are the reason for the relatively high biodiversity in Slovenia. However, the data show that it has declined in the last decades. The development of industry and agriculture, the construction of transport infrastructure and the urbanisation have contributed significantly to the pollution of surface and underground waters, soil and air and to the degradation of specific areas. The result is the biodiversity loss at the ecosystem, species and genetic levels and loss of landscape diver-

Figure 9 (right). *Risanica - landfill at the ponors of the Temenica stream. Water pollution is one of the major problems in Slovenia. In the karst area the water sources are even more vulnerable to pollution due to the water's low self-purification capacity.*

(Photo: Andrej Hudoklin)

Figure 8. *The inflow canal to the hydroelectric power plant Formin is intruding into the agricultural landscape and altering the habitat of a number of species. Loss of biodiversity is the result of intensive agricultural practices and monocultural production.*

(Photo: Marko Simić)

sity. The available data show that in the last few centuries 58 plant and animal species have become extinct in the territory of Slovenia. In total 2,700 taxa are included in the Red Data List of threatened species (mainly at the species level). Biodiversity is threatened mainly due to the following causes:

- insufficient awareness of the importance of biodiversity;
- changes in agriculture (technology, intensification of production, abandonment of arable land, use of new cultivars and hybrids, acceleration of monoculture production, market and social changes);
- introduction of agriculture in areas of preserved nature (forested areas in the Kočevje region);
- development of infrastructure (motorways, hydroelectric power plants);
- canalisation of watercourses (flood protection, increase in the surface area of arable land, artificial banks);
- drainage of wetlands (land use changes for the economic and agricultural development);
- uncontrolled urbanisation, in particular dispersed settlements;
- introduction of non-indigenous and invasive plant and animal species (to the country and between regions within Slovenia);
- excessive removal of plants and animals from nature (hunting, fishing, picking, etc.);
- air, water and soil pollution, and climate change;
- lack of implementation of legal provisions and deficient control measures;
- weak coordination between different stakeholders in the biodiversity conservation;
- lack of organised education, training and raising of public awareness.

The most critical are the consequences at the ecosystem, species and genetic levels. They include in particular:

- fragmentation of ecosystems and habitats;
- degradation, destruction and loss of habitats of plant and animal species and the extinction of species in their natural environment;
- disturbance of plant and animal species in their natural environment;
- genetic pollution and extinction of species;
- genetic erosion;
- abandonment and loss of specific species, cultivars and breeds important for agriculture.

HABITATS - BIO-DIVERSITY AT THE ECOSYSTEM LEVEL

GENERAL CHARACTERISTICS

Almost the entire territory of Slovenia would have been covered by forests if there had been no human impact. However, people changed the primary landscape, in particular through the thinning of forests, land use for agricultural production, drainage of wetlands, modifications to the coast and canalisation of watercourses, mining, construction of roads, urbanisation, etc. As a consequence, on the one hand, the plant and animal species had been forced to find refuge in rather small areas. Many habitats, like lowland forests and wetlands (bogs, fens and reed beds) have locally disappeared and with them the populations of species characteristic of such habitats. On the other hand, new landscapes, such as pastures, grasslands, fields, have been created which often interchange with the remains of forests, hedges and watercourses. Large mammals, like the brown bear, wolf and European lynx, withdrew to the remote parts of their primary habitats, some species became extinct and others adapted to the new agricultural landscapes. The natural habitats are getting smaller, their fragmentation is continuous and their ability to support life is reduced. One of the key features is the isolation of small populations which are no longer capable of maintaining the biologically important links to larger gene pools of the primary ecosystems. The number of threatened species is continuously increasing.

One of the main obstacles to assessing the situation is the insufficient availability and quality of data on ecological parameters for specific habitats and the needs of the species which populate these habitats. In spite of its incompleteness, the overview of the habitats shows the richness of Slovenia in the main habitat categories: marine and coastal habitats, inland waters and wetlands, scrub and grasslands, forests, barren land as well as agricultural and urbanised landscapes.

(Photo: Marko Simić)

Figure 10. *A view of the botanically rich karst grasslands at the edge of mount Nanos. In the background are the Julian Alps.*

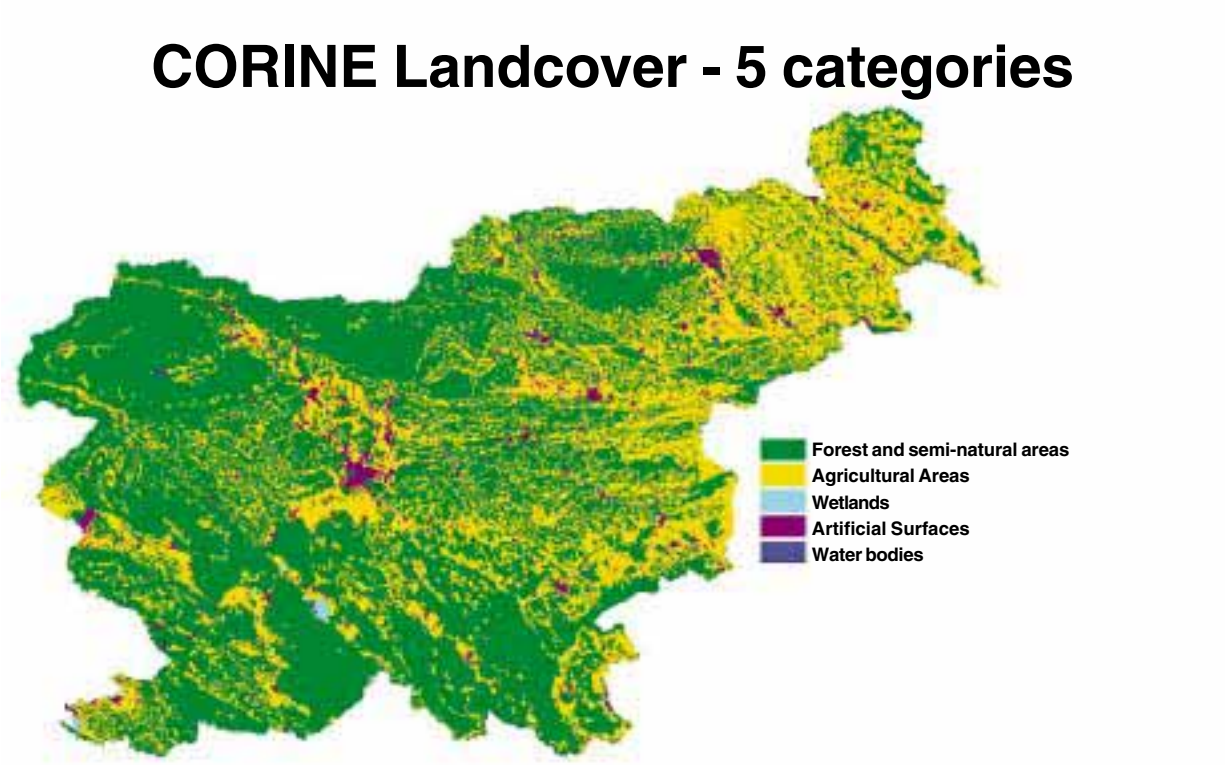
A *habitat type* is a spatially explicit ecosystem unit distinguished by biotope or biotic characteristics (Article 31 of the Nature Conservation Act).

A *habitat* is a natural home of a specimen, population, taxa or group. A habitat is an area where a species lives and which is characterised by specific living and non-living factors or a geographically defined area where the specimen or population of a species live (Article 11 of the Nature Conservation Act).

An *ecosystem* is a functional unit of a non-living environment (biotope) and biotic community (biocenosis) whose components are in a dynamic equilibrium (Article 11 of the Nature Conservation Act).

HABITAT TYPOLOGY

The typology of habitats *Habitat Types of Slovenia* was prepared in 2001 (URSVN, 2001). It is based on the PHYSIS system for habitat coding and is organised hierarchically (Table 6). There



Map 5: *Distribution of main habitat categories according to CORINE Landcover classification (1998).*

Table 5: *Presence of habitats in Slovenia in % (Source: CORINE Landcover).*

CATEGORY CORINE LANDCOVER 5	CATEGORY CORINE LANDCOVER 15	%
Forest and semi-natural areas		63.08
	Forest	57.121
	Shrub and/or herbaceous vegetation	4.406
	Open spaces with little or no vegetation	1.549
Agricultural Areas		33.67
	Heterogeneous Agricultural Areas	21.087
	Arable Land	5.643
	Pastures	5.975
	Permanent Crops	0.970
Wetlands		0.15
	Inland Wetlands	0.120
	Coastal Wetlands	0.30
Artificial Surfaces		2.68
	Industrial, commercial and transport	0.421
	Artificial non-agricultural vegetation	0.149
	Urban fabric	2.004
Water bodies		0.42
	Inland waters	0.421
	Marine waters	0.003
All together		**100**

Additionally, wetlands are discussed also following the classification and requirements of the Ramsar Convention on Wetlands.

are 7 types at the first level, followed by 35 subtypes at the second level. Further classification of habitats is possible, however it should be justified by defining conservation measures. So far, 514 habitats have been described in Slovenia. Since they have not been mapped according to the mentioned classification in the entire territory, the CORINE Landcover has been used to show the proportion of specific habitats (Table 5).

HABITATS AND THREATENED PLANT AND ANIMAL SPECIES

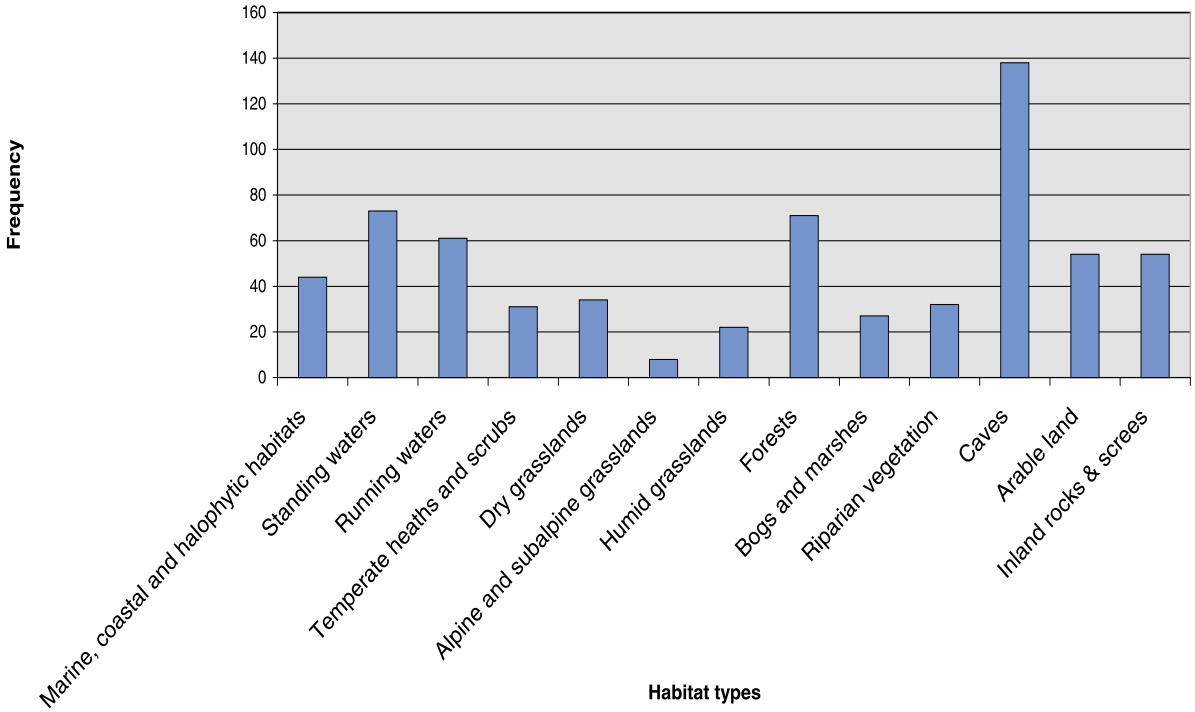
It is easiest to conserve biodiversity in nature if the natural equilibrium is maintained - the balance of relations between organisms themselves and between organisms and their habitats. The natural balance is destroyed when an activity destroys the quantitative or qualitative structure

First level	Second level
1. **Marine, coastal and halophytic habitats**	
	11. Ocean and seas, marine communities
	13. Estuaries and tidal rivers
	15. Saltmarshes, salt steppes, salt scrubs, salt forests
	18. Sea-cliffs and rocky shores
2. **Non-marine waters**	
	22. Standing freshwater
	24. Running water
3. **Scrub and grassland**	
	31. Temperate heath and scrub
	37. Humid grassland and tall herb communities
	38. Mesophile grasslands
4. **Forests**	
	41. Broad-leaved deciduous forests
	42. Temperate coniferous forests
	43. Temperate mixed forest
	44. Temperate riverine and swamp forests and brush
	45. Temperate broad-leaved evergreen forests
5. **Bogs and marshes**	
	51. Raised bogs
	53. Water-fringe vegetation
	54. Fens, transition mires and springs
6. **Inland rocks, screes and sands**	
	61. Screes
	62 Inland cliffs and exposed rocks
	63. Eternal snow and ice
	65. Caves
	66. Volcanic features
8. **Agricultural land and artificial landscapes**	
	81. Improved grasslands
	83. Orchards, groves and tree plantations
	84. Tree lines, hedges, rural mosaics
	85. Urban parks and large gardens
	86. Towns, villages, industrial sites
	87. Fallow land, waste places
	88. Mines and underground passages
	89. Industrial lagoons and reservoirs, canals

Table 6: *Habitats in Slovenia (Source: MOP - ARSO, 2001)*

of a plant or animal community; degrades or destroys their habitats; destroys or disrupts the ability of an ecosystem to function; cuts off interconnections between individual ecosystems; or causes a significant isolation of individual populations. The changes result in the modified structure and size of populations or species' distribution. The species whose population or distribution area is declining is threatened, and can thus be included in the Red Data List of threatened species. In Slovenia, more than 2,000 species were identified as endangered in 2001. Some of them are included in the lists of species for which conservation measures are required in accordance with the international regulations (Directive 79/409/EEC on the Conservation of Wild Birds, Directive 92/43/EEC on the Conservation of Natural Habitats and of Wild Fauna and Flora, Convention on the Conservation of Migratory Species of Wild Animals - Bonn, 1979, and Convention on the Conservation of European Wildlife and Natural Habitats - Bern, 1979). More than 300 such species are found in Slovenia.

The reasons for the decline in the populations of species are the direct destruction of specimens or the loss of their habitats. Most of the species on the Slovenian Red Data List are species which are threatened because of the loss of their habitats. Some habitats are more threatened than others because of their specific traits (rare bedrock formations, '*mrazišča*') and in general declining (wetlands). Among them, there are the habitats



Graph 1: *Habitats in Slovenia (Source: MOP-ARSO, 2001).*

of endemic, as well as locally and globally threatened species.

In order to illustrate the situation, an overview has been prepared of the habitats of the most endangered species (IUCN categories E and V) of birds, dragonflies, mammals, beetles, stoneflies, fish, flowering plants and ferns. The results are shown in Graph 1.

Among the habitats, caves stand out as a habitat of many endangered endemic taxa. With regard to the number of threatened species, the coastal habitats, standing and running water, and grasslands are important.

The number of threatened species is just one of the assessment criteria because certain taxa are closely associated with a specific habitat. The destruction of the habitat type thus results in the loss of the species.

Figure 11. *Pinna nobilis, marine fauna is mainly threatened by pollution, tourism developments and fishing with benthic trawl.*

(Photo: Ciril Mlinar)

CRITERIA FOR THE ASSESSMENT OF HABITATS

An assessment of habitats is needed to define the priority conservation measures, assess the environmental impact of activities and to plan and make decisions.

In the assessment of a habitat type, representativeness at the national and international levels is considered (EU Habitats Directive, Bern Convention), as well as whether an ecosystem is endangered due to reduction of areas or habitat degradation, and regional characteristics, and also with regard to its importance for the conservation of threatened plant and animal species.

THREATS

Habitats are threatened mainly due to human activities. The impacts of these activities are difficult to assess because information on habitats is not available. Habitats and their interconnections are one of the main areas for conservation of biological and landscape diversity. They are often extremely vulnerable. With regard to the past and current economic development, the overview of the status of natural and semi-natural habitats has shown that the most endangered habitats in Slovenia are:

- marine, coastal and halophytic habitats;
- running water and wetlands;
- dry grasslands;
- subterranean habitats (emphasis is placed on subterranean animals).

DEGREE OF RESEARCH

Reliable substantive and spatially determined data on habitat types are of key importance for the efficient biodiversity conservation, in particular at the ecosystem level but also at the species and genetic levels. The applicability of data largely depends on their substantive details and spatial accuracy.

Area covered. The available information on habitats (vegetation maps, plant communities, flora, fauna, ecology) found in the Slovenian territory is general and modest. That is particularly evident when the detailed information, which is essential for defining nature conservation measures, is needed. Quite a few areas in Slovenia have not been studied in detail (Kozjansko, part of Zasavje, etc.), in particular data on animals are missing. Additionally, data are not collected and maintained systematically. Within the framework of the CORINE Landcover PHARE project, a map was drawn in 1998 on the basis of the satellite images (LandsatTM 1995-96). The map can be used for general analyses but it is not sufficient for detailed nature conservation requirements. With the financial support of the Small Grants Fund of the Ramsar Convention the first inventory of the Slovenian wetlands has been made. The inventory provides a basis for the evaluation and systematic monitoring of wetlands in Slovenia.

Systematic research. Under the auspices of the Environmental Agency the 1:5000 scale mapping of non-forest habitats has been organised. With the development of the methods for the planning of forest management these data will be applied in the overview of forest habitats.

Thematic maps. Some of them cover the entire territory (the map of forest vegetation) and others only specific areas (habitats of Ljubljansko barje, the river Mura area, etc.).

Individual mapping. Maps are thematically and spatially delineated (e.g. Important Bird Areas, EIA).

HABITAT TYPES

The prevailing primary (natural) ecosystems in Slovenia are forests. Of the non-forest ecosystems, the areas above the timber line and under it form the most important ecosystems. They include the following: rock walls, sea and the sea coast, watercourses and standing waters, marshes and bogs, and subterranean ecosystems. As a result of human activity, the primary ecosystems have changed and thus their diversity has increased. Many secondary ecosystems have evolved, such as agricultural land (fields, meadows, orchards), urbanised areas (settlements), artificial water ecosystems (reservoirs, fish ponds), etc. The anthropogenic factors are extremely important for the conservation of biological and landscape diversity, as long as they do not lead to the total destruction of primary ecosystems. Nowadays, many habitats and communities are endangered because of the abandonment of the traditional activities and the natural encroachment of vegetation on arable land.

(Photo: Marko Simić)

Figure 12. *Ljubljansko barje (Ljubljana marshland) close to the Slovenian capital is mainly threatened by the continuous spreading of the urban areas.*

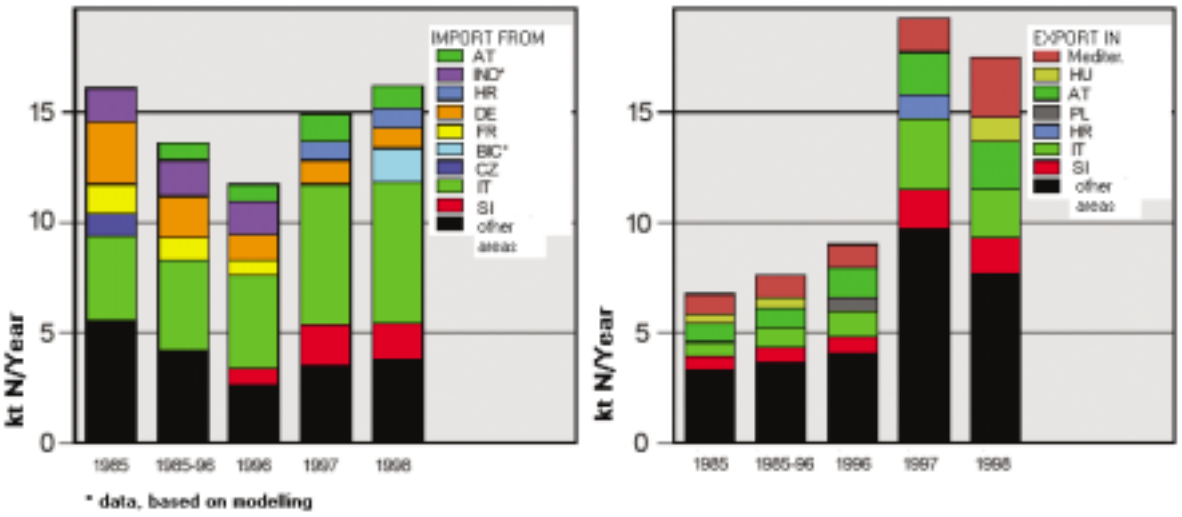
Ecosystems are threatened by:

- direct physical destruction and degradation of ecosystems;
- various forms of pollution;
- abandonment of the traditional farming and natural encroachment of vegetation on arable land;
- over-exploitation of all natural resources (inorganic and organic), including the exploitation of biodiversity components (hunting, fishing, agriculture).

Some of the negative impacts have transboundary implications and the relevant problems can

(Photo: Marko Simić)

Figure 13. *The Gračnica brook. Canalisation has caused drastic changes to the stream's ecosystem which has become unsuitable for most plant and animal species.*



Graph 2: *Depositions of oxidised nitrogen from 1985 to 1989 in kt N/year. Picture (r.): import into Slovenia; Picture (l.): export from Slovenia (Source: Lešnjak et al, 2000, Meteorological Synthesising Centre-West of EMEP).*

only be minimized and solved by bilateral or multilateral cooperation. For example, all forms of pollution, in particular air pollution (acid rain, nitrates) and transboundary rivers flowing into Slovenia. The emissions from Italy contribute to the major part of depositions of oxidised nitrogen in Slovenia (Graph 2; Source: Lešnjak *et al.*, 2000). The exploitation of watercourses for the generation of electricity is causing problems because it destroys ecosystems and substantially changes water regimes and reduces flood safety (the Čabranka and Mura rivers).

Marine and coastal habitats

General characteristics. The Slovenian sea forms part of the Bay of Trieste in the north-east of the Adriatic. It is a semi-closed and shallow sea, characterised by heavy pollution caused by human activities (maritime transport, intensive fishing, mass tourism in summer). Human activities have substantially modified the Slovenian coast, except its cliffs. The important wetlands of the area are the salinas and the mouths of the rivers Dragonja, Badaševica and Rižana. The north of the Adriatic Sea and the flysch formations determine the sub-Mediterranean vegetation. Halophytes grow in saltmarshes and on sandy sea shores. A special feature is the sea meadow of the neptunegrass (*Posidonia oceanica*).

Figure 14. *Mowing and grazing being abandoned, vegetation took over in the steep alpine pastures on Begunjščica.*

(Photo: Peter Skoberne)

Threats to marine and coastal habitats. It is generally believed that the Slovenian coastal wetlands are not as endangered as they were in the past. All the remaining wetlands are protected even though the protection regimes have not yet been implemented. The sand banks at Valdoltra (Sv. Nikolaj) and the seashells banks near Ankaran are threatened and have not been given a legal status. The same applies to some other sections of the coastal sea and sea shore (Fiesa, Pacug), including the neptunegrass site. Marine animals are mainly threatened by pollution, use of trawl nets in fisheries and construction in the tidal zone.

The watercourses flowing into the Bay of Trieste contribute to the pollution of the Slovenian coastal waters. As a result, the chemical and biological processes in the coastal sea change. The main cause of the transboundary pollution is the river Po, flowing into the sea from the Italian side. On the basis of the monitoring of the bathing waters, it has been established that they are suitable for their purpose. However, in 1999 the stipulated limit levels were exceeded in Škocjanski zatok, and the pollution killed many birds and other animals.

Threats caused by natural factors

- hypoxic and anoxic conditions - lack of oxygen (hypoxia, rarely anoxia), plankton bloom and slime ('mare sporco') and mass occurrences of specific species (mauve stinger *Pelagia noctiluca*, straight-needle pteropod *Creseis acicula*, toxic and non-toxic tides of dinoflagellates).
- natural introduction of non-indigenous species.

Anthropogenic factors

- pollution:
  - with chemical effluents; direct discharges of urban waste waters into the sea drastically change the structure of the benthic invertebrate communities;
  - pollution of the lower reaches of the rivers Rižana and Badaševica and insufficient waste water treatment;
  - maritime transport;
  - agricultural application of pesticides and fertilizes (in particular in the lower reaches of the Dragonja and Rižana rivers);
- fishing, in particular with a trawl net (removal of living organisms on the bottom);
- crushing of rocks for the harvesting of sea dates (*Lithophaga lithophaga*); indirectly the loss of endolithic invertebrates and fish;
- tourism and growing urbanisation (construction in the tidal zone and upper infralittoral);
- anchoring of vessels in the area of the sea meadows and also in other areas;
- introduction of non-indigenous organisms (via ballast water, as overgrowth, as a result of mariculture, etc.) and their successful colonisation in the new environment, in Škocjanski zatok, for example, nutria (*Myocastor coypu*) threatens other mammals, red-eared slider (*Trachemys scripta elegans*) reptiles and among the plants an invasive species Japanese honeysuckle (*Lonicera japonica*).
- saltpans in Sečoveljske soline are threatened by:
  - changes in the water regime (water intrusion or destruction of dikes because of lack of maintenance) which are the main cause for the loss of nesting populations of the saline birds;
  - 'air-shows' whose negative impacts on the nesting of the Common Tern (*Sterna hirundo*) and Black-winged Stilt (*Himantopus himantopus*) have been determined by observations; low flying of aircraft and helicopters and frequent flying in the summer disturb birds in the salina;
  - increased tourism and recreation in the salina threaten the flora and bird fauna; the data on specific species, for example Kentish Plover (*Charadrius alexandrinus*) show that the species is in decline because of the high number of visitors during the nesting period.

The extent and intensity of these activities have not been topographically evaluated for spe-

(Photo: Marko Simić)

Figure 15. *Coastal cliffs in Mesečev zaliv (Moon Bay). These scenic cliffs were formed in Flisch, a dominating bedrock of the Slovenian coastline.*

(Photo: Gordana Beltram)

Figure 16. *In Slovenia, halophytes are found only in the coastal ecosystems.*

(Photo: Gordana Beltram)

Figure 17. *Sečoveljske soline (Sečovlje Salinas). Inappropriate dumping of building material used for constructing the access road.*

(Photo: Milan Orožen Adamič)

Figure 18. *Octopus vulgaris, out of the two octopus species present in the Slovenian part of the Adriatic Sea, Octopus vulgaris is less abundant than Ozaena moschata.*

cific habitats. The changes of the habitat found in the shellfish- and fish-rearing waters are expected to be substantial. It is known that the number of tufts of neptunegrass per surface unit is lower in the Koper Bay near Žusterna than in other protected Mediterranean sites (near Napoli in Italy, and Port Cros in France). No relevant studies have been carried out but it is presumed that the causes are the pollution and intensive sedimentation.

General degree of research. The research on the Slovenian *coastal sea* has not been extensive. No research on habitat types has been carried out until now. It is generally believed that of all habitats the coastal wetlands have been studied most, in particular those of Sečovljske soline and Škocjanski zatok (sea inlet). The biodiversity of the area, in particular in/of Strunjan, Fijesa, the mouth of the river Rižana and the wetlands of Sv. Nikolaj, has been discussed only in a few papers. Other coastal ecosystems, for example flysh cliffs, mudflats and limestone patches, have been researched to an even lesser extent. The situation is similar for the human modified ecosystems.

Figure 20 (right). *Development pressures on the short, densely populated and heavily industrialised Slovenian coast are still increasing.*

Figure 19 (below). *One of the last remaining sand dunes along the coast of Ankaran is providing a habitat for threatened plants, such as Linum maritimum.*

(Photo: Marko Simič)

Degree of research on fauna and flora. The flora and fauna of the coastal sea have not been entirely identified. The *coastal wetlands* have been researched with regard to their ornithological and floristic aspects (flora and vegetation). Although some studies on mammals, reptiles and amphibians are available, the data on invertebrates is scarce. The knowledge about the fauna of the Slovenian sea is extremely poor and limited to data on the most typical groups (plankton copepods, tunicates, echinoderms, molluscs, plankton invertebrates in general and fish), but the data on most other groups are not available (*Anthozoa, Bryozoa, Acanthoochepala, Gastrotricha, Kaptozoa, Rotatoria, Nemertina, Nematoda, Polychaeta, Crustacea, Amphipoda, Oniscidea*, etc.). In particular the information on the distribution, frequency and ecological characteristics of indicator species is insufficient.

In the 1970s a project concerning the inventory of the maritime fauna and flora was initiated by Dr Matjašič. The relevant taxonomic collections were compiled, but the project has never been finished (the information on some taxonomic groups included in the catalogue is complete, however the data on other groups are partial).

(Photo: Gordana Beltram)

Degree of research on threats. The Red Data Lists for maritime flora (except for flowering plants) have not yet been compiled. Due to the incompleteness of the data and insufficient inventories, it is difficult to precisely evaluate threats to fauna and flora.

Expert coverage. The gaps in the general degree of research on the field arise from insufficient previous studies, especially because there are not enough specialists on specific invertebrate groups (three experts deal with benthic marine species and two experts work on plankton).

Inland waters

Inland waters consist of surface standing and running waters and underground waters. Inland waters are the key habitat of many organisms,

but water research is focused on their usefulness for human consumption, in particular concerning their physical characteristics and quality.

Standing waters

General characteristics. Standing freshwaters are the natural permanent and intermittent lakes, ox-bow lakes (backwaters), artificial reservoirs and small detention basins, and fish ponds. Aquatic vegetation, from microscopic plankton to water plants, is an important element in the food chain of an ecosystem. The vegetation type and productivity are determined by the light and temperature as well as the availability of nutrients, in particular nitrogen and phosphorus. The supply of nutrients in natural conditions depends on the climatic, geological, soil and vegetation properties of a water ecosystem. However, these change due to human activities. Depending on the amount of nutrients contained in water, the standing water may be classified as eutrophic (rich in nutrients), mesotrophic and oligotrophic (poor in nutrients) standing water.

There are only two natural permanent lakes in Slovenia, Bohinjsko jezero and Blejsko jezero. In total, they cover 456.7 ha. Other smaller lakes together cover 173.2 ha and include mountain lakes, spring lakes and backwaters. The intermittent lakes cover 3,151.3 ha, and are situated in the Ljubljanica river catchment (Cerkniško jezero, Planinsko jezero and Pivška jezera). The size and occurrence of these lakes depend on precipitation in a particular season. Among the human-made standing water which cover 3,101.6 ha, the artificial reservoirs are most numerous (2,700.4 ha). Artificial lakes include larger reservoirs of hydro-electric plants (the rivers Drava, Sava, Soča), irrigation reservoirs (Sotla, Pesnica, Klivnik and Mola), abandoned inundated gravel pits, sand pits and clay pits (lakes in Fiesa, Draga near Ig, Bobovek, ponds in Rače) and other detention basins such as fish and karstic ponds.

Biodiversity of standing waters

Large standing waters facilitate the development of characteristic lake flora and fauna, from algae and flowering plants to amphibians, fish and many other species associated with these ecosystems (birds). Small sized standing waters such as mountain lakes and karstic ponds are habitats which enhance the landscape patterns and biodiversity. A special feature are the intermittent karst lakes where living organisms have adapted to the changing rhythm of wet and dry periods. Impounded waters or other artificial standing waters can also function as important secondary habitats.

(Photo: Marko Simić)

Figure 21. *Dvojno jezero (Double Lake) in Dolina triglavskih jezer (Valley of the Triglav Lakes) is one of the outstanding alpine lakes away from human settlements, yet threatened by sewage from mountain huts, grazing, littering and the introduction of alien (non-indigenous) fish species.*

The quality of standing waters

In compliance with the national monitoring programme, the Environmental Agency monitors the quality of the three lakes Blejsko jezero, Bohinjsko jezero and Cerkniško jezero and their main inflowing and outflowing streams. Only the concentrations of the main biogenic nutrients in water are measured and analysed and the process of eutrophication is monitored. Most of the lakes in Slovenia are located on carbonate bedrocks and therefore the acidification is not an issue.

(Photo: Peter Skoberne)

Figure 22. *Blejsko jezero (Lake Bled) is a glacial lake. Algae bloom cause high maximal concentration of chlorophyll and give warning of an unbalanced ecosystem.*

High water flow in Bohinjsko jezero and the low population density in its vicinity are the main reasons for the relative good water quality of the lake. On the other hand, the biological and chemical data show that the input of nutrients has increased in recent years. According to the international criteria for the assessment of the water quality (trophic level), Bohinjsko jezero is considered to be oligotrophic - unpolluted.

The water quality of Blejsko jezero is the result of the high population density in the area

(Photo: Matjaž Bedjanič)

(Photo: Peter Skoberne)

Figure 23 (top). *Ox-bow lake Muriša is a typical habitat of a lowland river at Lendava. Strengthening the river-banks and altering the water dynamics halted formation of new ox-bow lakes. Consequently, the existing ones are extremely endangered.*

Figure 24 (above). *Planinsko polje is a regularly flooded karst polje. Local people adapted to the yearly floods and built their villages at the edge of the floodplain.*

and of the hydrological conditions. An artificial inflow of water from the river Radovna has improved its deep water 'aeration' and reduced the release of nutrients from sediments. The environmental burden and pollution of the entire lake basin induce the 'phytoplankton blooming'. The high maximum concentrations of chlorophyll which result from the blooming of plankton algae indicate the biological instability of the lake. According to the assessment of the water quality, Blejsko jezero is considered to be mesotrophic - moderately polluted.

The water quality of Cerkniško jezero is closely linked to the water level in the lake and its inflowing streams. The lake and its streams are polluted by industrial and agricultural activities as well as untreated discharge of urban waste water in the catchment area. The regular changing of the lake environment, in particular the fluctuation of the water level, affect the nutrient content of the water and, consequently, the living organisms in the lake. Marsh vegetation uses up much of the excess nutrients. The lake sediments, and occasionally waters, are polluted by heavy metals and organic compounds. Cerkniško jezero is an intermittent lake and does not have the typical features of a 'real' lake. According to the criteria for running inland waters the water quality at the sampling point Stržen near Dolenje jezero shows that the water is moderately polluted.

The research on 14 mountain lakes, which was carried out in the 1990s, was extremely important for the monitoring of the transboundary pollution (the National Institute of Biology).

Running waters

General characteristics. Water from Slovenian territory is drained to the Black Sea (Sava, Drava and Mura) and Adriatic Sea (the Soča river and other inflows to the Mediterranean). The total length of running waters is 26,989 km (topographic map TK 25) and the average drainage density of the hydrographic network is 1.33 km/km^2.

Highlands and mountains (average altitude is 550 m) comprise up to 80 % of the country. Around 85 % of all water runoff is from hills and mountains. The energy potential of these streams is the highest. Most of them are torrents with characteristic average annual discharge and time distribution. High water usually occurs after the continuous autumn rain. More than 2/3 of water in mountain streams runs off in the short periods of high flows when a lot of material is removed. During such periods the possibility of floods is high. The erosion areas cover 8,800 km^2 or 43 % of the territory (FGG-LMTE, 1999). Approximately 5,000,000 m^3 of the sediment debris derive from these areas. Part of the material is deposited in river valleys and the rest is transported further to the sea. Water velocity and the river bed structure are natural factors affecting the morphology and nature of the watercourse as well as its biodiversity and the changes in river freshwater communities. Watercourses may be divided into rapidly flowing, fast-flowing, medium-flowing, slow-flowing and very slow-flowing watercourses. The structure of the river bed, from small particles to rocks (humus, peat, organic fine material, clay, silt, sand, gravel, rubble), depends on the velocity of the flow.

In the karst systems, the natural water retention capacity is relatively high because of the underground and surface (karst polje) courses. It mitigates 75 to 85 % of flood peaks (retention of water in the underground system of the karst river Ljubljanica).

Biodiversity of running waters

Watercourses maintain numerous habitats, the riverbed and water body, its banks, the aquatic and riparian vegetation. They function as a link

Rivers	Precipitation per year		Flood plains	Discharge per year			Settlements	Agriculture	Industry
	10^6 m^3	mm	ha	10^6 m^3	mm	%	% inhabitants	% inhabitants	% inhabitants
Mura	1197	861	18.700	340	245	28	7,0	23,7	6,0
Drava	367	1125	16.000	1832	561	50	20,9	24,3	20,7
Sava	20.773	1757	31.700	12.294	1040	59	59,8	45,0	62,0
the Donava river catchemnt area	**25.641**	**1556**	**66.400**	**14.466**	**878**	**56**	**87,7**	**93,0**	**88,7**
Soča	5469	2278	2900	3812	1588	70	6,4	4,6	6,8
Inflow to Adriatic Sea	1070	779	2200	394	287	37	5,8	2,4	4,5
Adriatic catchment area	**6539**	**1732**	**5100**	**4206**	**1114**	**64**	**12,3**	**7,0**	**11,3**
Slovenia total	**32.180**	**10.088**	**71.500**	**18.672**	**922**	**58**	**100,0**	**100,0**	**100,0**

Table 7: *Characteristics of Slovenia's large river basins, such as the Soča and the inflowing streams of the Adriatic Sea, and the Sava, Drava and Mura rivers (Source: FGG-LMTE, 1999).*

between populations and contribute to the expansion of species distribution (for example Alpine vegetation found in lowlands). Certain ecosystems, such as floodplain forests, are linked to and depend on the hydrological regime of the floods and the level of the watertable in the riparian area.

Fresh waters provide a habitat for fish and many invertebrates which spend in water all their lives (flatworms, molluscs) or only part of their life cycle (larvae of dragonflies and damselflies, caddies flies, stoneflies and mayflies). Many terrestrial species also depend on fresh water habitats (the need for water and food supply).

The natural dynamics of streams and rivers contributes to their biodiversity, particularly the diversity of habitats (rapids, gravel and sand shores, steep river banks, meanders, etc.).

Specific, mainly small-sized aquatic habitats with characteristic plant and animal species are thermal and karst springs (*Kerkia kusceri* species in the river Krupa), waterfalls, tufa formations.

(Photo: Marko Simić)

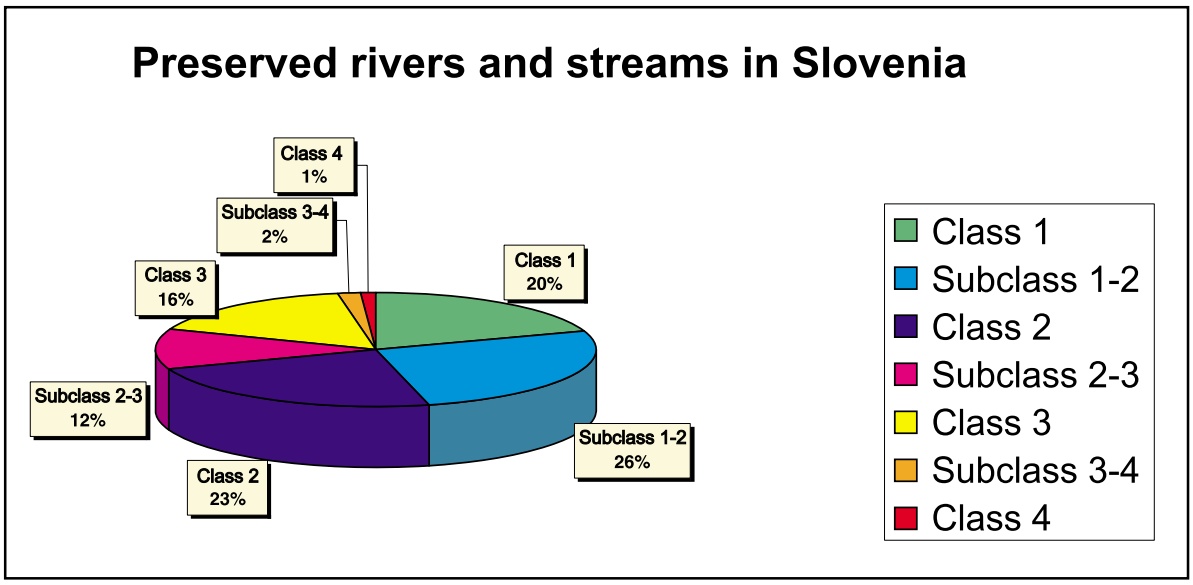
Figure 26. *Tufa formations are typical of the Krka river formed by the deposition of calcium carbonate in the water.*

Conservation of the morphological characteristics of rivers and streams

Watercourses are complex ecosystems where the physical, chemical and biological processes interact in a fragile balance. The alteration of any of the characteristics of the ecosystem, or processes in it, affects the entire system and the consequences are evident from its appearance and, in particular, its functioning. In the study *Categorisation of Rivers and Streams According to Nature Conservation Importance* (VGI, 2000), the degree of morphologically preserved Slovenian rivers and streams has been evaluated according to the intensity of human interference affecting them. Approximately 10,000 km of 26,000 km of rivers and streams have been evaluated. The proportion of specific quality classes in the absolute length of rivers and streams is shown in Graph 3, but the degree of their conservation as integral ecosystems is not evident from it. There are not many rivers and streams which are preserved in the larger part of their course (Map 6), and therefore they are listed as *valuable natural features*. Among the best preserved river networks are parts of the Soča, Ljubljanica in the karst catchment area, Krka, Kolpa and Dragonja river basins.

(Photo: Andrej Hudoklin)

Figure 25 (left). *Altering the natural river processes and changing the river banks are increasingly threatening many bird species including the Kingfisher (Alcedo athis).*

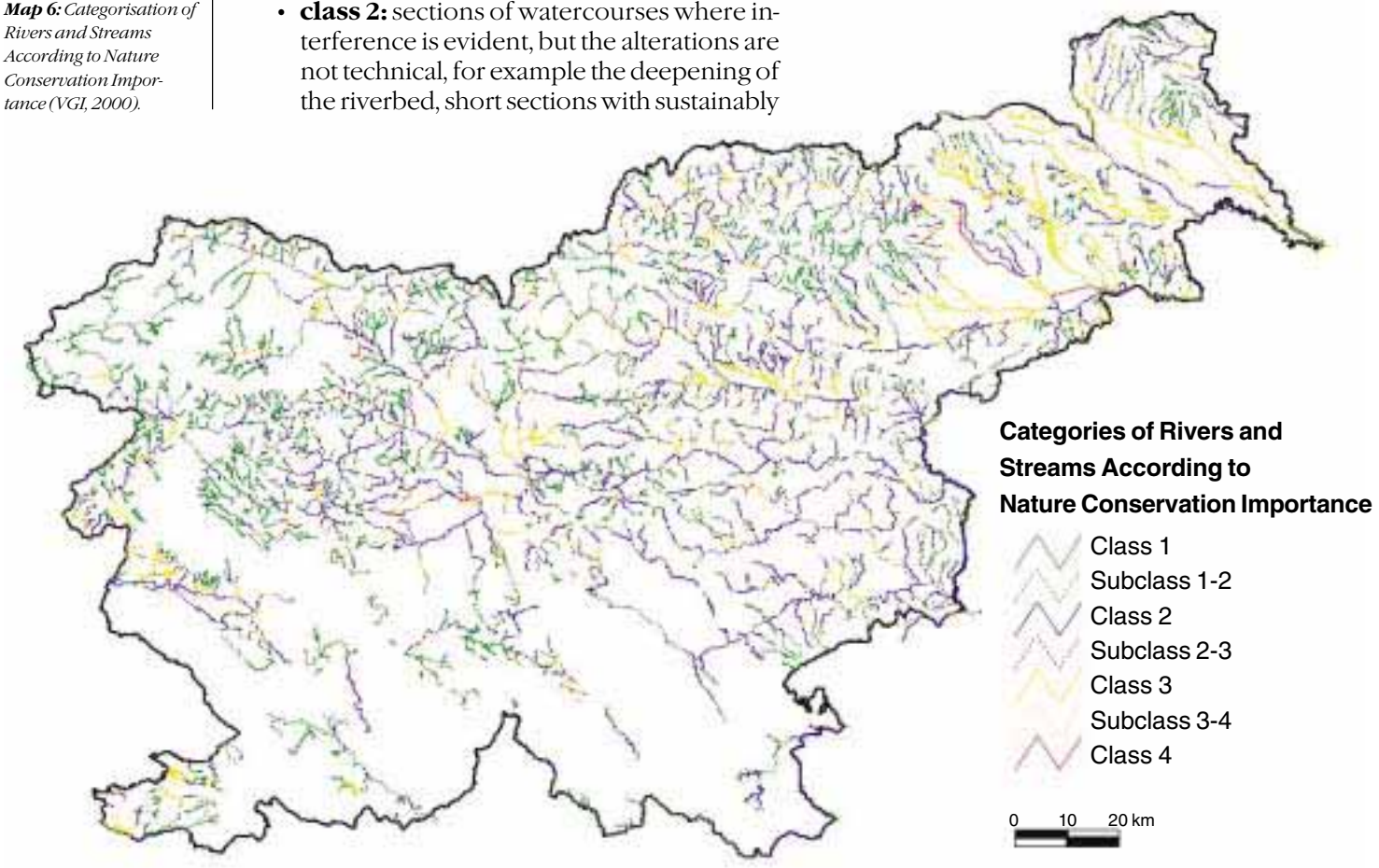


Graph 3: *Proportion of morphologically conserved Slovenian rivers and streams (VGI, 2000)*

Rivers and streams have been classified under 4 classes and 3 subclasses (Graph 3):

- **class 1** (naturally preserved) and subclass 1-2 (insignificantly disturbed): the rivers and streams with morphologically well preserved channel of the evaluated section; the potential disturbances are only aesthetic while the functioning of the natural processes is undisturbed or it may be influenced by the upstream changes, for example, changing regime of sediment transportation;
- **class 2:** sections of watercourses where interference is evident, but the alterations are not technical, for example the deepening of the riverbed, short sections with sustainably solidified and protected banks and individual low barriers, sections with thinned riverine vegetation;
- **subclass 2-3:** is in-between preserved and substantially modified functional properties of rivers and streams; sections of the river which have had the overgrown side of the river bank stabilised; sections of the watercourse have been canalised;
- **class 3:** heavily affected watercourses; in the evaluated section the complete canali-

Map 6: *Categorisation of Rivers and Streams According to Nature Conservation Importance (VGI, 2000).*



sation is characteristic, particularly in intensively managed agricultural areas, where riverbed is heavily modified, etc.

- **class 3-4:** rivers and streams have been completely altered and turned into the drainage canals with constructed banks and riverbed or have even covered.

In the study, classification of watercourse has been based on the assessment of physical human disturbances, while the classification of water pollution is provided by the Environmental Agency - Meteorological Office. Watercourses as ecosystems have not been evaluated for their biodiversity, but their preserved morphological characteristics indicate the high biological and landscape diversity.

Water quality of Slovenian watercourses

The Environmental Agency co-ordinates the programme on the monitoring of the quality of surface waters in Slovenia and keeps the relevant data basis. Participating in the project are: The National Institute of Biology in Ljubljana (saprobiological analyses), the Health Protection Institute Maribor, the Institute of Environmental Protection (analyses of metals and organic compounds in water and sediment) and the Institute of Public Health (bacteriological analyses).

Approximately 100 sampling points on most important rivers and their tributaries comprise the water quality monitoring network. The samples are taken 2 to 24 times per year. The analyses depend on the pollution level and the importance of the section of a certain watercourse.

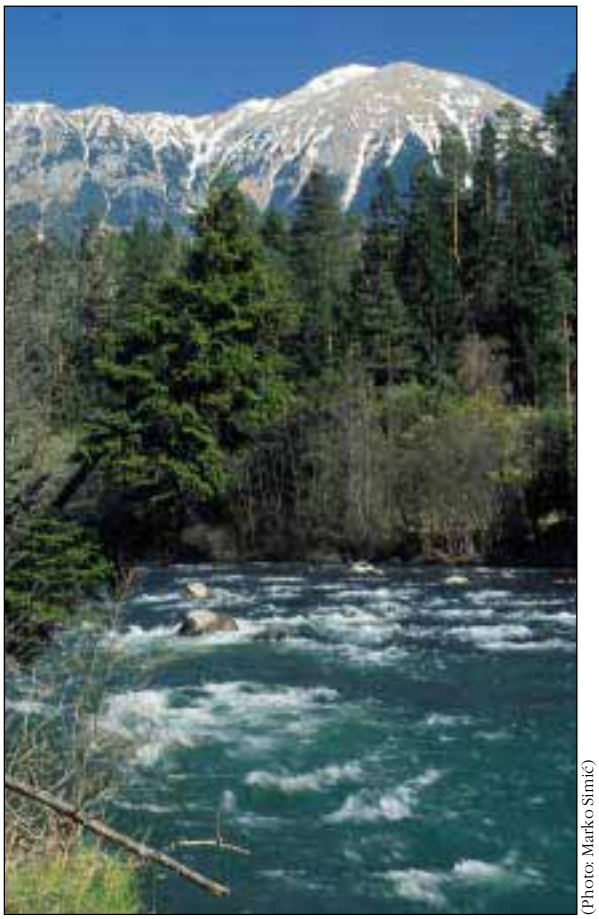
Biodiversity is substantially affected by the quality of water. Taking into account the hydrometeorological conditions at the sampling point, the quality of surface water is assessed on the basis of:

- fundamental physical, chemical and bacteriological analyses;
- saprobiological analyses;
- metal content;
- content of organic compounds in unfiltered water, suspended particles and sediments.

Based on the *water quality*, the watercourses are classified into:

- **1st class:** water which in its natural state, but potentially disinfected, may be used as drinking water, in the food processing industry and for the breeding of salmonid species (*Salmonidae*);
- **2nd class:** water which in its natural state may be used for bathing and recreation, or the breeding of other fish species (*Cyprinidae*); after the regular prior treatment (coagulation, filtration and disinfection) it may be used for drinking and in the food processing industry;

(Photo: Peter Skoberne)

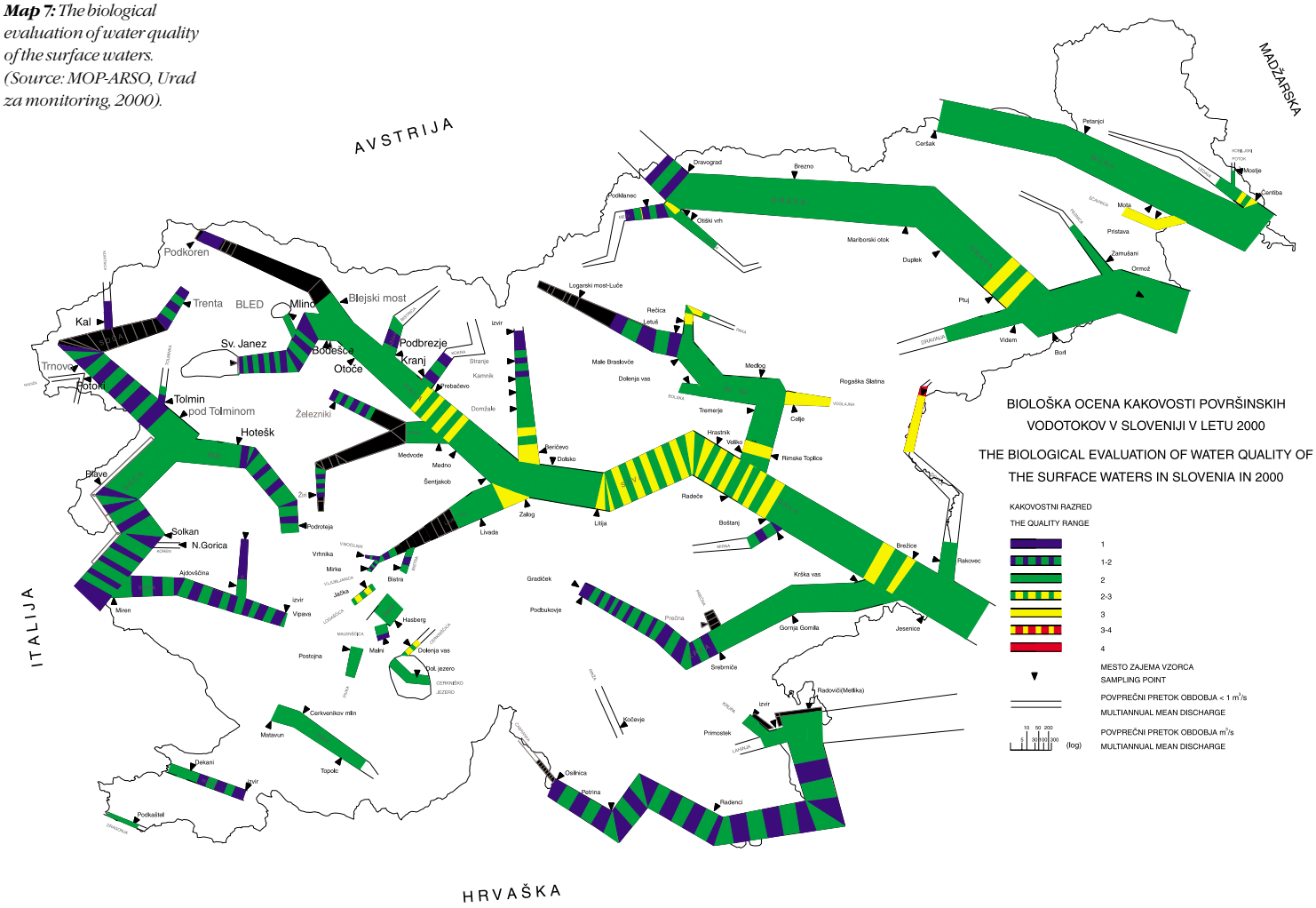


(Photo: Marko Simić)

Figure 27 (left). *The Dragonja is one of the best preserved streams in Slovenia. The river and its tributaries have been already protected, while a large part of the catchment area is proposed for a landscape park.*

Figure 28 (right). *Part of the well preserved Sava river near Bled is threatened by reconstruction of the Moste hydroelectric power plant.*

Map 7: *The biological evaluation of water quality of the surface waters. (Source: MOP-ARSO, Urad za monitoring, 2000).*



- **3rd class:** water which may be used for irrigation; after the regular prior treatment it may be used in industry, except for food processing;
- **4th class:** water which may be used for other purposes only after the appropriate treatment.

Based on the analyses of *specific organic compounds*, watercourses are classified into:

- **class 1:** only the naturally occurring organic compounds in small quantities are found in the water;
- **class 2:** biodegradable compounds are found in the water; they can be removed by the simple processing/treatment for preparing drinking water;
- **class 3:** not readily degradable compounds are found in the water, which during the infiltration into groundwater remain unchanged or are transformed into stable degrading products;
- **class 4:** chlorinated compounds, which are characteristic pollutants, are found in the water; they occur as the result of human activities and they accumulate in living organisms; they are potentially carcinogenic and mutagenic.

With regard to *biological indicators*, the quality of surface waters is evaluated by two methods: physiological and ecological. The ecological method is based on the sampling of organisms on living and non-living solid surfaces and of organisms found in sediments. The sampling is carried out twice a year, in winter and summer when the water level is low and the effects of pollution are most evident. The bioindicators and their quantitative relations in a community clearly show the conditions at the sampling point. For each sample, a saprobic index (SI) is calculated by a special procedure. With regard to the saprobic index value the trophic level and the class of water quality at the sampling point are determined.

In 2000, the results of the saprobiological analyses showed that the quality of water at nearly 83 % of sampling points was identified as class 1, 1-2 and 2, followed by 11.5 % as class 2-3 and almost 6 % as class 3. More sampling points identified class 2-3 of water quality than in 1999. Rivers with water quality at sampling points in class 3 are the Ščavnica in Pristava, Ljubljanica in Zalog, Savinja in Rimske Toplice, Voglajna and Hudinja in Celje, and Hubelj in Ajdovščina.

Trophic level	Value (SI)	Quality class	Description of the quality of the water body
Oligosaprobic	1.00 - 1.5	1	no load or very low load
Oligo-beta	1.51 - 1.8	1-2	low load
Beta-mesosaprobic	1.81 - 2.3	2	moderate load
Beta-alfa	2.31 - 2.7	2-3	critical load
Alfa mesosaprobic	2.71 - 3.2	3	heavy load
Alfa-poly	3.21 - 3.5	3-4	extremely heavy load
Polysaprobic	3.51 - 4.0	4	excessive load

Table 8: *Assessment of water quality based on saprobic index (SI).*

After 1989 the quality of surface water started to improve due to the lower quantities of industrial waste water discharged into rivers and due to the construction of waste water treatment plants. According to the data of the Hydrometeorological Institute, the status of watercourses slightly degraded in 1995 and 1996 in comparison to 1994. The quality of the Drava and Mura rivers has improved because of the improved system of water treatment in Austria (the upper courses of the two rivers). The river Sava is in class 2-3, the river Soča and its tributaries in class 1-2. The quality of water is the lowest in the following rivers' sections: the Ščavnica (Pristava) and Koren (Nova Gorica), occasionally the Kamniška Bistrica (Beričevo) and Sotla (Rogaška Slatina) rivers.

(Photo: Branka Hlad)

Figure 29. *The Ščavnica stream is a typical example of a canalised riverbed flowing through a deprived agricultural landscape and heavily polluted.*

Groundwater

General characteristics. Aquifers are an important source of water. Slovenia is rather rich in water resources (groundwater and springs) which can still be used for drinking water supply without substantial prior treatment. Underground waters support specific subterranean habitats (caves).

In Slovenia, there are two types of aquifers - intergranular aquifers and fractured karst aquifers.

Intergranular aquifers

The main aquifers in Slovenia are along:

- the rivers Drava and Mura (Maribor, Ptuj, Murska Sobota, Vrbanski Plato);
- the rivers Savinja and Sava (Savinjska dolina, Ljubljanska kotlina, Brežiško polje, Kranjsko-Soško polje, Kamniška Bistrica);
- the rivers Vipava and Soča.

They are all intergranular aquifers covered by alluvial sediments. Regardless of the data on pollution caused by urbanisation, industry and agriculture, these aquifers are still the primary source of the drinking water.

Fractured karst aquifers

Karst aquifers are important sources of water in the long-term. Rapid flow of groundwater in fractured karst aquifers facilitates the fast dispersion of pollution. That is the reason why the protection of water quality is very demanding in karst regions.

Biodiversity of underground water

With regard to habitats, the intergranular aquifers are specific systems because their only living components are consumers and decomposers (animals, bacteria). Despite the seemingly unfriendly environment animals characterised by a high level of tolerance (lack of food, low oxygen concentrations) or specialisation do live in these habitats. For the survival and normal functioning of living organisms, the aquifers must be closely associated with the surface habitats. Underground, there are no green plants which would be a source of food. All food is brought from the surface, either through leaching or transport. Since the food supply is scarce, the animal populations are not numerous and the habitats are thinly populated. The population density decreases with the distance from the riverbed, and the species found in its vicinity differ substantially from the species living in the remote sections of the aquifer. Some organisms live at greater depths (a few tens of meters) even though most are found in the upper layers of the aquifer. The size of organisms rarely exceeds 1 millimetre. In

Slovenia, the in-depth research on such fauna has not been completed. Most of the data have been gathered for the artificial wells in alluvial plains. The results of a few pilot studies show that the fauna in underground water is characterised by a high level of endemism. The most frequently found animals are crustaceans (*Ostracoda, Copepoda, Isopoda, Amphipoda, Bathynellaceae*), snails and roundworms. A number of national and international research projects concerning the fauna of underground water are currently being carried out in Europe, and Slovenia participates in them.

Groundwater quality

Within the framework of the water monitoring in Slovenia, the quality of groundwater is assessed by the drinking water standards. Groundwater is primarily polluted by nitrates, pesticides, metals and organic compounds. The pollution caused by pesticides is assessed according to the total content of pesticides in the water. The limit levels are often exceeded in Mursko and Ptujsko polje and more rarely in Dravsko and Apaško polje.

The pollution is mainly caused by agriculture which is evident from the high levels of nitrates, phosphates, pesticides and potassium in water. The concentrations of phenols, PCBs, organic substances and heavy metals clearly show the impacts of industry in the area. Another source of pollution is the water leaching from the old and existing waste landfills. Potential accidental spillages of dangerous substances during transport by road pose an additional threat to groundwater.

Threats to inland waters are discussed in the chapter on wetlands (page 54).

General degree of research. The Environmental Agency and its bodies monitor the quality of standing and running surface waters in Slovenia. The Water Management Institute (VGI) carried out an integral study on the morphologically preserved rivers and streams *Categorisation of Rivers and Streams According to Nature Conservation Importance*. In general, the data dispersed in various institutions can be obtained from individual experts and from the literature. The data on the hydrology of water bodies are limited to large rivers and their sections where individual water management activities have been carried out or planned. One of the tasks of the Geological Survey of Slovenia is to map the water resources. The research on the waters in the north-east of the country, most of the Alpine region and of the karst waters is still not complete.

Degree of research on fauna and flora. No comprehensive overview of the aquatic flora in Slovenia has been published so far. Only the lists of species of specific taxonomic groups are available. Freshwater algae are discussed in "*Distribution of freshwater algae in Slovenia*" (Lazar, 1975), aquatic macrophytes in "*Flora of Slovenia*" (Martin-čič & Sušnik, 1984) and "*Register of Slovenia's flora*" (Trpin & Vreš, 1995). A number of works deal with the distribution of one or two taxonomic groups and their occurrence in a certain region. The least researched habitats are puddles, intermittent lakes and headwaters of streams. Little is known about endemic species and their distribution.

An example of the evaluation of biodiversity in surface waters is the publication "*Life in the waters of the Triglav National Park*" (Brancelj *et al.*, 1995) where all the data on flora and fauna of specific habitats are collected and spatially defined.

Figure 30 (below). *Karst spring of the Krupa river is well preserved, yet water is heavily polluted by polychlorinated biphenyl (PCB) washed from the industrial landfill in the hinterland.*

Figure 31 (bottom). *Troglocaris anophthalmus, a typical representative of subterranean water fauna is threatened by water pollution.*

(Photo: Marko Simić)

(Photo: Valika Kuštor)

Scrubs and grasslands

Scrubs

General characteristics. In Slovenia, the scrub, as the climax of the vegetation development in the given natural conditions, is only found above the forest line. The prevailing vegetation

is dwarf pine (*Pinetum mugo*), heaths are only fragmentary. Other scrub vegetation colonises grasslands and riparian areas or forms hedges in agricultural land. Dwarf pine is an important habitat of many animal species (black grouse, chamois), in particular in connection with high mountain habitats (Alpine grassland, rock chasms, screes). Scrub habitats are not easily passable and are therefore quiet areas with limited human impact. Dwarf pine vegetation is frequent in the Julian Alps, Karavanke, Kamnik and Savinja Alps and Pohorje. Outside the Alpine region, it is found on Snežnik. In recent years it has been gradually spreading, in part because grazing has been abandoned in mountain pastures and in part because of the climate change. Scrub functions as a corridor between various populations. It is a transitional stage in the natural succession from grasslands to forests and its particular stages are not easy to define.

Threats. As the result of the air pollution, the dwarf pine scrub withers locally. The scrub vegetation of the river banks is threatened by the canalisation and maintenance of streams. The hedges are usually affected by consolidation of agricultural land.

Degree of research. The research on the typical vegetation has already been conducted but the data on the distribution of scrubs have not been collected. Scrubby areas are mainly considered in the context of the natural encroachment of vegetation on grasslands.

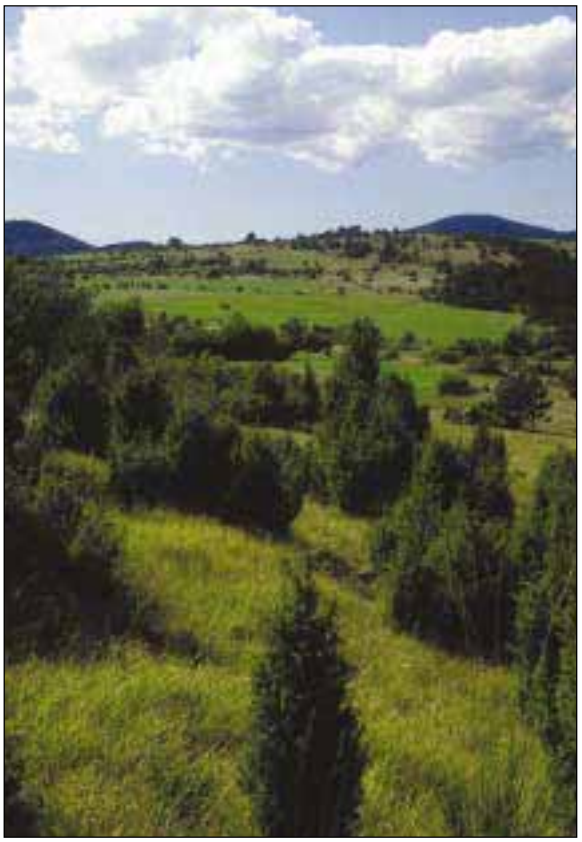
Grasslands

(Photo: Marko Simić)

General characteristics. In Slovenia, the natural grasslands, as the climax of the vegetation succession, are limited to the areas above the forest line and some wetlands. Grasslands, as the transitional stage in the vegetation succession, occur naturally in forest areas, for example after fires or in areas damaged by heavy snows and winds. The human-made grasslands (mowing, grazing) and grasslands formed as a result of the natural restoration of an area after the abandonment of cultivation are the most frequent grassland habitats. From the biodiversity perspective, the most important are the Alpine grasslands, extensively cultivated (no fertilisation, mowing only once or twice a year) dry and semi-dry grasslands on limestone and wet meadows.

(Photo: Marko Simić)

Figure 33. *Daffodils on the Golica mountain are threatened since farmers are increasingly abandoning the traditional grassland management and excessively applied fertilizers.*



(Photo: Peter Skoberne)

Figure 32 (left). *Grasslands and shrubs on the ridge of Čaven.*

Figure 34 (right). *Pivka valley, juniper shrubs are taking over where the traditional land use (mowing and grazing) has been abandoned.*

(Photo: Marko Simič)

Figure 35. *Wet meadows in the central area on Planina polje, are one of the few remaining natural grasslands in Slovenia.*

Threats. Grasslands are mainly threatened by the changed land-use caused by urbanisation or construction of infrastructure, alterations in the water regime (stream canalisation, drainage, land consolidation), intensive agricultural practices and application of new technologies (forage silage). In the last ten years, the surface area of grasslands has been reduced because the traditional use has been abandoned (mowing, grazing) and the land has been colonised by scrub and forest.

Wet meadows (*Molinion community*) are not fertilised and are only mown once a year - in the late summer. The proportion of rare and threatened species is rather high in comparison to other grassland communities. Drainage and application of fertilizers cause the disappearance of highly valuable species, the species composition changes and the diversity depletes, all of which leads to the formation of 'cultivated' meadows (*Arrhenatheretum*). Specific plant species of wet meadows become endangered, for example various gladiolus (*Gladiolus* sp.) and orchids (*Liparis loeselli, Hammarbya paludosa, Spiranthes aestivalis, Orchis palustris, O. laxiflora* and others). The same applies to animal species (for example, large blue butterflies Maculinea).

The grasslands in hills, mountains and karst areas are threatened by the construction of infrastructure and the abandonment of traditional cultivation. The endangered species are plants such as peony (*Paeonia officinalis*), Clusius' gentian (*Gentiana clusii*), yellow gentian (*Gentiana lutea*), orchids (*Ophrys, Orchis, Dactylorhiza*) and animals which live in these habitats, in particular insects (butterflies and moths, spiders, grasshoppers and crickets, true bugs).

Degree of research. No comprehensive overview of grassland habitats of Slovenia has been conducted but floristic and vegetation studies of certain areas have been completed. The Ministry of Agriculture, Forestry and Food keeps spatial records of land-use categories, including grasslands. The botanical features of the grassland vegetation types have been studied but their spatial distribution has not yet been presented.

Forests

General characteristics. Slovenia is a country of forests. They cover 56 % of the entire territory - 1,142,000 ha (Veselič & Matjašič, 2001), which means that Slovenia is the third country in Europe according the forest cover. Forests represent an essential functional and aesthetic component on 75% of the Slovenian landscapes. The forests protect soils from erosion, mediate climatic extremes and regulate the runoff. In addition to the ecological role, forests also have many social functions: they are important for recreation, protect buildings and installations from various negative impacts and are important for national defence, for example.

The forest is a natural and primary biocenosis in the whole of Slovenia, except in the highest

(Photo: Marko Simič)

Figure 36. *A beach forest stand on the Banjšice plateau.*

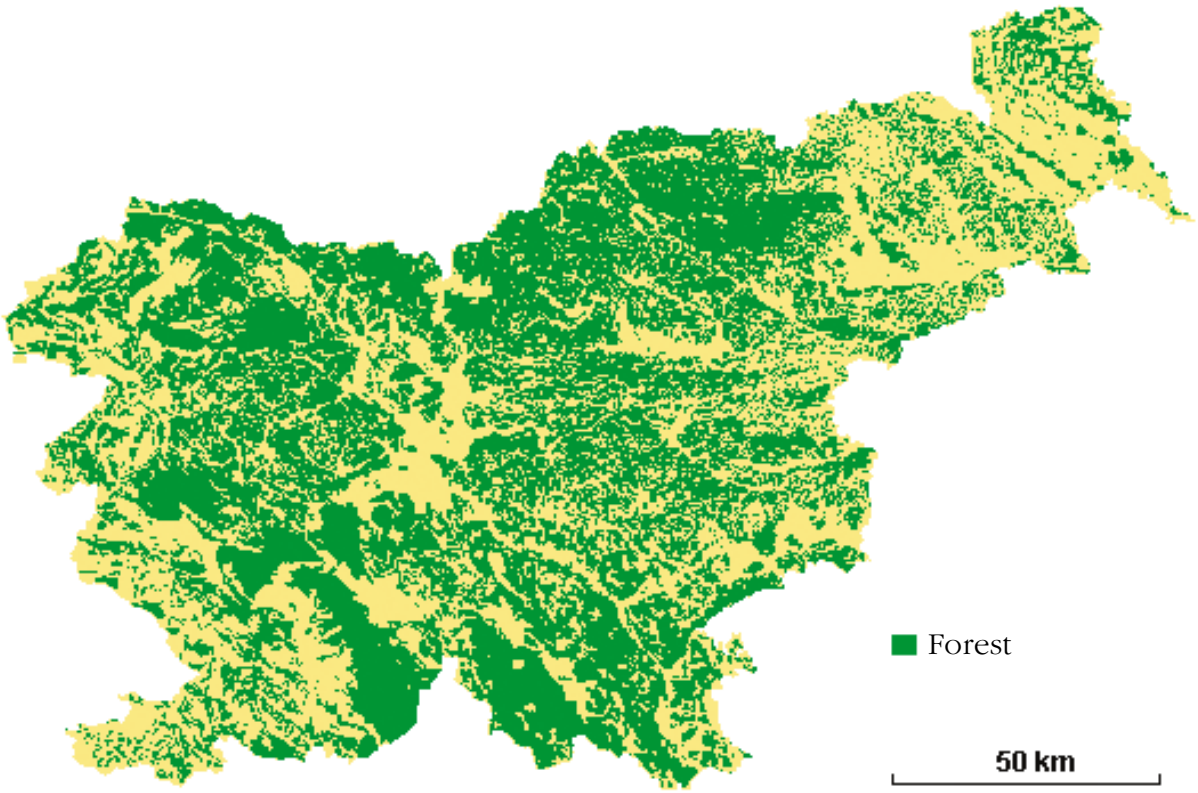
Habitat type	Area	Proportion %
Hornbeam forests with Durmast Oak and English Oak forests	**87,610**	**8.2**
Preserved forests	68,210	6.4
Pioneer stages with broadleaf species	9,690	0.9
Locust Tree forests	790	0.1
Pine forests	6,500	0.6
Spruce forests	2,420	0.2
Wetland forests, maple and ash forests	**7,469**	**0.7**
Acidophilous and thermophilous oak forests	**29,773**	**2.8**
Preserved forests	17,593	1.6
Pioneer stages with broadleaf species	2,750	0.3
Locust Tree forests	7,260	0.7
Pine forests	2,170	0.2
Beech forests of hills and lower mountain belt	**195,213**	**18.2**
Preserved forests	171,963	16.0
Pioneer stages	8,250	0.8
Spruce forests	15,000	1.4
Beech forests of mountain and high mountain belt outside the Alps	**66,479**	**6.2**
Preserved forests	61,749	5.7
Pioneer stages	1,670	0.2
Spruce forests	3,060	0.3
Alpine mountain, high mountain and other beech forests	**95,631**	**8.9**
Thermophilous beech forests	**64,541**	**6.0**
Acidophilous beech forests	**202,108**	**18.9**
Preserved forests	126,518	11.9
Pioneer stages with broadleaf species	7,820	0.7
Pine forests	3,310	0.3
Spruce forests	64,460	6.0
Fir and beech forests	**153,723**	**14.4**
Preserved forests	138,773	13.0
Spruce forests	14,950	1.4
Fir and spruce forests	**69,173**	**6.4**
Basophilous pine forests	**6,372**	**0.6**
Acidophilous pine forests	**31,155**	**2.9**
Hop-hornbeam and Flowering Ash forests	**55,171**	**5.2**
Preserved forests	38,921	3.7
Spruce forests	16,250	1.5
High moor habitats	**174**	**0.0**
Sub-Alpine habitats	**6,571**	**0.6**
Total	**1,071,163**	**100.0**

Table 9: *Basic habitat types and their surface area in Slovenian forests (Source: Classification of forest vegetation according to Dušan Robič; Data on forest stands and vegetation: Slovenian Forest Service)*

mountains and some wetlands. It is a habitat and refuge of many plant and animal species which maintain the ecological balance in the landscape.

The biodiversity and exceptional variety of Slovenian forests, including the well preserved plant and animal species are also extremely important at the European level. The Slovenian forestry theory and practice have contributed greatly to the conservation of various components of forest diversity. The forests are considered a renewable natural wealth and are managed according to the principles of sustainability and multipurposeness.

In the developed countries, wood production - which is the direct interest of the forest owner - is becoming less important than the ecological and social functions of the forest. The coordination of different, even conflicting, interests in relation to forests is one of the main tasks of the forestry service.



Map 8: *Distribution of the forest (Source: ZRC SAZU Geografski Inštitut Antona Melika).*

(foto: Martin Šolar)

Figure 37. *In the Alpine region Norway spruce was given the advantage at the expense of other native species.*

(foto: Marko Simič)

Figure 38. *The proportion of lowland oak forests has been reduced to a great extent in Slovenia. Greater areas of such forests have been preserved along the river Krka (the forest of Krakovo), in the region of Bizeljsko (Dobrova) and at Pragersko (Cigonca).*

(foto: Marko Simič)

Figure 39. *The Karst landscape, which was bare not more than a hundred years ago, was intensively afforested mainly with Austrian pine (Pinus nigra), which is not an indigenous species in this region.*

Diversity of forests in Slovenia

The principal characteristic of Slovenian forests is the high diversity of habitat types which have developed as a consequence of the convergence of four biogeographical regions, many different bedrock types and as a result of sustainable management and other factors. The basic forest habitat types are shown in Table 9.

Preservation of Slovenian forests

The natural tree composition of Slovenian forests is well preserved. Natural conditions are suitable for the growth of mixed forests (potential forest vegetation) and such forests actually prevail. They are composed of approximately 70 indigenous tree species (Brus & Kraigher, 1996). Eighty-seven percent of forests either consist of domestic species, adapted to the sites, or else their species composition is similar to the natural one.

Not more than 13 % of forests could be indicated as unnatural forests. The forestry service is striving to change the composition of species in such forests and make them more natural. As a consequence of the past forest management the tree composition in 9 % of the forests has been significantly changed and in 4 % of forests the composition has been completely changed. However, it should not be taken for granted that the composition of other forest organisms has also been altered (Smolej *et al.*, 1997).

Deviation from the natural vegetation may be mainly attributed to the planting of Norway

spruce in the Alpine and Subalpine region at the end of the 19th and beginning of the 20th century. The European fir was promoted at the expense of beech in the high karst region at that time as well, and Austrian pine was introduced in the Karst. As an overall result, the part of conifers in Slovenian forests has increased at the expense of deciduous species.

In the last few decades, the forestry service has been trying to eliminate the consequences of the promotion of conifers. Since 1975 the share of deciduous trees has increased by 8 % and the ratio between conifers and deciduous trees is now 48 : 52. However, the current ratio is still far from the natural (potential) one, which is 20 : 80.

'Close-to-nature' management of forests conserves the indigenous vegetation (indigenous gene pools) because it gives preference to the natural regeneration of the forests, not the artificial (seeding).

For the biodiversity conservation it is important that forest vegetation is preserved in sites with extreme conditions and where the stands are dispersed and cover small areas. Special attention should be devoted to the conservation of riverine forests, floodplain forests and woods, thermophilic oak forests, natural forests of Scots pine and Austrian pine, spruce forests in '*mrazišča*', forests of sweet chestnut and others.

Fauna of Slovenian forests

Diverse and preserved forests are the habitats and refuges of many animal species. In Slovenia, large forest complexes are sill preserved and many species have survived (e.g. large carnivores), for whom adequate habitats no longer exist in many other countries.

Forest management partly takes into consideration the special needs of the wild animal species. It purposefully maintains undisturbed zones, mating sites, den sites, grazing areas, grassy patches in forests, etc.

Forest management planning combines the management of the plant (wood) and animal components of forest communities. Special plans are drawn up for the management of game species, whose implementation however should be improved after the new hunting legislation is adopted.

Surface area and the forest growing stock

The surface area of forests has been increasing in Slovenia for the last 120 years. The reasons are the abandonment of land which is not suitable for agricultural production, and the reduced population in the countryside. The forest cover has thus increased from 36% in 1875, and 48% in 1961, to 56% in 2000.

The growing stock (quantity of wood which can be economically exploited) increased by index 2.37 % in the period from 1947 to 2000. Substantial increment of the growing stock indirectly indicates that the share of mature forests has increased. This means that habitats for numerous species have appeared, which were not present in younger forests. In addition, the accumulation of wood in forests also has had other environmentally beneficial impacts. The forests enriched in biomass have a greater capacity to:

- influence local and global climatic conditions (carbon sequestration);
- sustain aquifers and guarantee the long-term supply of drinking water;
- improve the quality of water and air and mitigate the effects of the urban and industrial pollution of the environment;
- play an important role in the protection against erosion, landslides and avalanches in the mountains;
- provide natural protection of river banks against erosion;
- provide a high quality recreational environment.

Natural forests are also important for conservation of biodiversity in soils. Forest soils are relatively rich in species, because they develop under the impact of deep reaching roots and accumulating humus. The prevailing soil type in Slovenia is rendzina (49.5 % of the forests). More than 10 % of the surface is taken up by three cambic soil types: brown carbonate soil, eutric brown soil and dystric brown soil. Each of the remaining nine dominant types take up less than 1 % of the total number and surface of compartments (Slovenian Forest Service, Forest inventory, 1994). The soil conditions in Slovenian forests are quite diverse. Two or more soil types are

(Photo: Andrej Hudoklin)

Figure 40. *Brown bear (Ursus arctos). Natural and semi-natural forests are habitats and refuges of diverse wildlife. Especially important in this sense are vast areas of continuous forests, which are habitats of large carnivores, such as bear, wolf and lynx.*

frequently found in relatively small areas (Table 12).

Factors which reduce the biological and ecological stability of forests

- **Deforestation**. The total surface area of forests has been increasing for a long time. However, there are regions where forests are scarce and the existing ones are endangered (north-east of Slovenia). The pressures on forests are particularly evident in the agricultural and urban landscapes. Reduction and fragmentation of forests have serious ecological effects and diminish the biodiversity of landscapes that are already under the heavy human impact. Deforestation in the area enervates the ecological, social and production functions of the remaining forests. A problem is the disappearance of groups of trees, individual trees, riverine forests, wind shelterbelts and hedges outside the forest in areas where forests as such are already fragmented.

Table 10: *Assessed number of forest related threatened plant and animal species according to the assessment made for the Ministerial conference (Source: Annual Report of the Ministry of Agriculture, Forestry and Food).*

	Forest related threatened species	Forest related species	Threatened species - total
plants	47	950	330
amphibians	11	17	18
reptiles	10	10	20
birds	46	95	116
mammals	25	70	29

(Photo: Marko Simič)

Figure 41. *Quarries and gravel pits can usually be qualified as serious wounds in natural ecosystems and the landscape.*

- Forests are under the impact of **illegal activities affecting the environment**, which non-selectively encroach on the most preserved areas, alter the landscape and disturb animals. Such activities are most often the excavation of gravel pits and quarries as well as all construction activities (secondary homes and their infrastructure).
- **Air pollution** has an adverse effect on the vitality and overall stability of Slovenian forests. Forests are most probably affected by climate change, which is the direct consequence of transboundary air pollution. The Slovenian Forestry Institute and the Slovenian Forest Service have been recording in detail the vitality of forest trees in more than 700 sample plots with almost 20,000 trees in regular five-year intervals. Every year they inventory 36 sample plots of the 16 x 16 km European bioindication grid (Table 11). The most affected species are fir, pine, oak and spruce.
- **Damage caused by extreme weather situations, diseases and pests**. In addition to the regular felling, provided for in the forest management plans, a considerable share of felling is carried out in Slovenia, which is not aimed at commercial goals, but primarily for removal of damaged and ill trees by which the degradation of forests is prevented. In the five-year period from 1996 to 2000 the share of trees felled for sanitary reasons amounted to 33.6 % of the total cut. Most of the felled trees were conifers (71 %). The usual reasons for the sanitary and protection felling was damage caused by ice (28.3 %), snow (19.5 %), diseases or fungi (13.7 %) and insects (13.5 %). While carrying out sanitary felling, some proportion of damaged trees is usually left in the forest for biodiversity purposes.

Table 11: *Proportion (in %) of moderately and heavily damaged trees (degree of defoliation over 25 %) in 1987-2000 period - the 4x4 km grid data (Source: Slovenian Forestry Institute)*

	1987	1991	1995	2000
Conifers	30,1	19,7	37,6	32,3
Broadleaved species	8,4	6,3	17,6	16,7
Total	17,1	10,9	24,6	22,2

- **Herbivorous game.** Herbivorous game is too abundant in certain areas and threatens the forests. Severe damage caused by red deer - in particular rubbed bark - sometimes necessitates the felling of young stands, thus resulting in economic damage. From the ecological point of view, the eaten forest tree buds and seedlings are a cause of greater concern because the natural regeneration of forests is hindered, which is of utmost importance for the preservation of natural

populations of forest trees and for the biodiversity of forests at the genetic level. In areas where herbivorous game damages more than 25-30 % of seedlings the natural restoration processes are seriously disturbed.

tive impacts on plant and animal species, for example disturbances and excessive picking of forest fruit. Unsuitable heavy machinery is often used for the construction of forest roads. In sensitive and vulnerable areas such machinery causes intolerable impacts, contradicting the nature conservation interests, as well as creating erosion and all sorts of disturbances.

Soil type	Soil code	Number of sub-compartments	(%)	Surface area of sub-compartments (ha)	(%)
Undefined	00	998	1,16	17.416,94	1,61
Rendzina	01	41.544	48,17	536.256,60	49,54
Ranker	02	431	0,50	8058,90	0,744
Brown carbonate soil	03	10.039	11,64	153.917,19	14,22
Terra rossa	04	141	0,16	1662,84	0,15
Elluvial soil	05	208	0,24	2616,07	0,24
Eutric brown soil	06	15.446	17,91	179.306,45	16,57
Dystric brown soil	07	14.485	16,80	154.009,23	14,23
Brown podzolic soil	08	691	0,80	9202,82	0,85
Podzol	09	141	0,16	1538,87	0,14
Riparian soil	10	742	0,86	5682,21	0,52
Pseudogley	11	810	0,94	9092,21	0,84
Gley	12	560	0,65	3508,14	0,32
Peat soil	13	10	0,01	137,47	0,01
Total		**86.246**	**100.00**	**1.082.405,94**	**100.00**

Table 12: *The share of soil types in Slovenian forests, expressed in the number of forest management compartments and the relevant forest surface area (Source: Slovenian Forest Service, Forest inventory, 1994)*

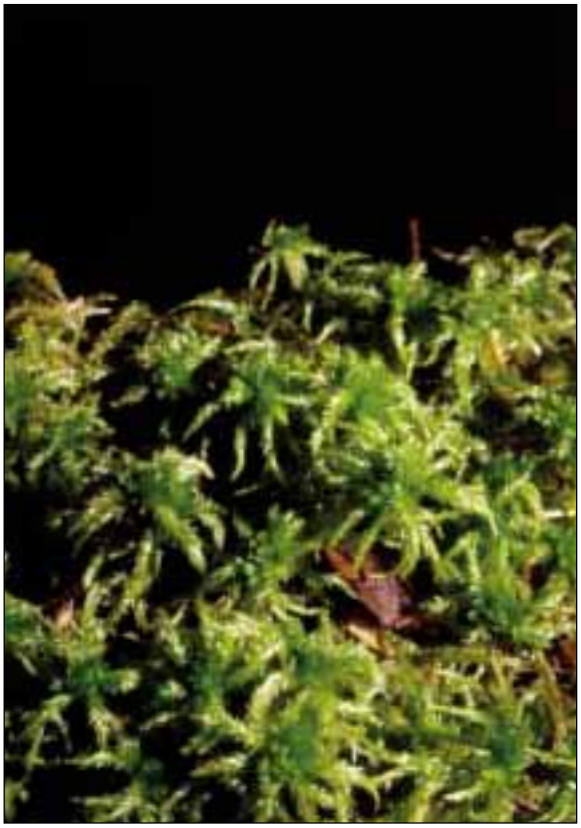
- **Overfelling of old and rotten trees** which provide habitats for and food supply to numerous invertebrates and vertebrates (bats, birds, dormice).
- **Forest fires** affect the development of forests, in particular in the Karst where most fires occur. Appropriate preventive protection measures against fire, the improved technical means for rapid information and effective response by firemen have facilitated the reduction of fires and the total burned area in the last 25 years. However, fires remain an important cause of threat to forests. Most fires are caused by trains, followed by farming, visitors and military training (Table 14).
- **Changes in the water regime of forest sites.** Lowland forests are threatened by changes in the water regime caused by agricultural drainage and construction of hydroelectric power plants.
- **Impact of unsuitable recreational activities and tourism.** The development of some activities, such as tourism and recreation, is not harmonised with the conservation of forests and nature. The tourist and recreational programmes do not adequately take into account forests and other environmental features.
- **Forest roads** facilitate the access to forests and thus increase the possibility of negative impacts on plant and animal species, for example disturbances and excessive picking of forest fruit. Unsuitable heavy machinery is often used for the construction of forest roads. In sensitive and vulnerable areas such machinery causes intolerable impacts, contradicting the nature conservation interests, as well as creating erosion and all sorts of disturbances.
- **Unregulated grazing of cattle and small ruminants in forests.** Pursuant to the Forests Act it is prohibited to graze cattle and small ruminants in forests (exceptions are possible in accordance with the criteria laid down in the forest protection regulation and in line with a silviculture plan). In Slovenia the problem is strictly limited to national forests, in particular those in the Julian Alps (11,000 ha) and the Kamnik and Savinja Alps (9,000 ha). Grazing in forests used to be an issue in the Pohorje region but it has been reduced substantially.
- Forest management activities are often carried out in an **inappropriate manner**, including utilisation of unsuitable machinery (erosion, soil compaction, possibility of fuel and mineral oil spills, tree felling in periods when animals are particularly sensitive to disturbances).

Table 14: *Average annual number of fires and average annual burned surface area in the period 1991-2000; comparison with past periods. (Source: Perko, Pogačnik, 1996; Slovenian Forest Service)*

	1966-1975	1976-1984	1991-2000
Number of fires	103	65	50
Burned surface area (ha)	1295	689	662

Table 13: *Share of damage to seedlings caused by game, by forest management regions (FMR). (Source: Slovenian Forest Service,1996).*

FMR	Number of sampling plots	Share of damaged seedlings - total	Share of damaged seedlings (16-150 cm)
		%	%
Tolmin	250	24	39
Bled	145	20	58
Kranj	186	17	34
Ljubljana	277	22	40
Postojna	171	33	48
Kočevje	213	45	57
Novo mesto	171	15	18
Brežice	203	18	24
Celje	133	16	22
Nazarje	119	7	17
Slovenj Gradec	120	12	22
Maribor	225	20	36
Murska Sobota	56	28	51
Sežana	193	46	57
SLOVENIA	**2.462**	**24**	**37**



(Photo: Peter Skoberne)

Figure 42. *Sphagnum sp., typical moss of raised bogs.*

Bogs, fens and marshes

Bogs and fens

General characteristics. Peatlands are areas where peat is formed. With regard to the chemical composition of the bedrock, water regime and vegetation the peatlands may be classified as bogs and fens. The surface of raised bogs is above the surrounding area and is not connected with the water table. Their water regime depends on precipitation which is the main source of minerals. The substrate is therefore poor in minerals and is oligotrophic. Fens are fed by groundwater or surface water rich in minerals. The transition mires and fens are areas where the poor precipitation and rich groundwater or surface water mix.

The Slovenian *raised bogs and transition mires* are the most southern of the European bog distribution area. They cover the mountain areas of the Julian Alps, the Pokljuka and Jelovica plateau and the rocky parts of Pohorje. In total, the 14 preserved raised bogs cover only 100 ha. On the basis of the morphological properties, they are divided into ombrotrophic and ombrosoligenous bogs. Most ombrotrophic species found in raised and transition mires are endangered (Wraber & Skoberne, 1989; Martinčič, 1992).

In Slovenia, fens are found in the central and western part of the country, mostly in the lowlands and mountainous areas, up to 1,000 m above see level. No precise data on the number of fens is available but it has been estimated that there are between 70 and 100 sites which cover approximately 300-350 ha. These are mostly small areas where the peat vegetation is gradually substituted by the adjacent vegetation. There are only a few bogs and fens which are clearly distinguished by their physiognomic, vegetation and ecological properties from the adjacent areas.

Threats. Currently the raised bogs and transition mires are not significantly threatened. Two raised bogs have been destroyed so far (Malo polje and Ljubljansko barje), but the uncontrolled visiting of peatlands can damage bogs that are easily accessible (Šijec). In most other bogs the human impact is not evident.

Figure 43. *Za Blatom, a raised bog on the Jelovica high plateau is one of the four still preserved raised bogs in Slovenia - on the most south-eastern fringe of the peat bog distribution area.*

(Photo: Peter Skoberne)

(Photo: Peter Skoberne)

Figure 44. *Gladiolus illyricus, inhabiting wet grasslands is threatened by drainage of these wetlands.*

In comparison, fens are much more endangered. Many are surrounded by grasslands and arable land and are thus under constant threat by human activities. Indeed, land reclamation and drainage, water reservoirs and land consolidation have already completely destroyed fens in certain regions (for example, the construction of the small industrial zone near Bled).

Degree of research. The research on the ecology, flora and vegetation of the raised bogs and transition mires of Slovenia has already been conducted. The relevant studies have been completed (Martinčič & Piskernik, 1985) and the spatial distribution of bogs has been presented. However, the data on animal species are incomplete.

Fens have not been researched in detail. The studies on the flora, vegetation and ecology of the fens have been completed for around 30 of these important wetland sites. No data on the destroyed fens are available.

Marshes

General characteristics. Riverine meadows, floodplain forests and lowlands, riparian marshes and reed beds are directly influenced by the fluctuation of groundwater and surface water and the water regime in the entire catchment area. It is estimated that they cover 9,145.3 ha or 25.8 % of all identified wetlands. Two thirds of this surface area are taken up by Krakovski gozd, Šturmovci and riparian forests of the Mura river which are the last extensive remains of floodplain forests in Slovenia.

Threats. Intensification of agricultural practices, exploitation of gravel and canalisation of rivers and streams. Every activity which affects the riparian vegetation (remains of extensive riverine forests) reduces the habitat of wetland plant and animal species. Human activities cause the progression of invasive non-indigenous species which at degraded sites successfully compete with the indigenous ones. Non-indigenous species invade the natural stands of riverine forests (giant and Canadian goldenrod *Solidago gigantea, S. canadensis*; Himalayan balsam *Impatiens glandulifera*; coneflower *Rudbeckia* sp.; knotweed *Fallopia* sp.) and other riparian habitats of all major rivers and most streams.

Rocky habitats, screes and dunes

General characteristics. Rock masses and screes are mostly found in the Alps where they form habitats of specific flora and fauna (for example, *Campanula zoisii, Potentilla nitida, P. clusii, Linaria alpina, Thlaspi rotundifolium*, etc.). However, such habitats with high species diversity are also characteristic of other parts of Slovenia (for example, Donačka gora - *Sempenirum juvanii*, cliffs above the river Kolpa, Karst escarpment - *Moehringia tomassinii*, rock walls in Baška grapa - *Moehringia villosa*, Komen in Smrekovec mountain chain - *Primula minima, P. villosa*).

Threats. These habitats are not generally threatened but different issues are raised at the local level, such as the conflict between nature conservation and the interests of climbers, exploitation of gravel and quarrying.

The degree of research. The research on vegetation has been rather thorough and the most important sites are known, but the data on the distribution of these habitats have not been completed.

Rural and urban landscapes

The chapter deals with rural systems, except grasslands. Cultural landscape is discussed in a chapter on Landscape diversity.

(Photo: Matjaž Bedjanič)

(Photo: Marko Simić)

Figure 45 (top). *Peat bogs are good water sources and habitats to a number of threatened plants and animals. A shallow drainage ditch is enough to destroy their sensitive natural equilibrium.*

Figure 46 (above). *Campanula zoisii, an endemic species inhabiting the rock cracks.*

Figure 47 (right). *'Steljnik' a typical habitat type of a traditional cultural landscape in Bela krajina (south-east Slovenia).*

Rural habitats (except grasslands)

General characteristics. Rural and urban landscapes include many habitats which have been formed by human activities. The richness of the traditional cultural landscape arises from the high diversity of plants and animals and numerous habitats forming a colourful mosaic. All these factors result in the diversity of landscape. The main components of such landscapes are the anthropogenic habitats of fields, forests managed for litter utilisation, orchards, etc.

Threats. The traditional cultural landscape in the Central Europe is threatened, in particular individual habitats such as areas of traditional rotation of crops, orchards with old varieties of fruit trees, '*steljnik*' - woodland managed for litter utilisation, etc. In specific regions, the individual habitats and cultural landscape types have already disappeared. Among the most threatened is the segetal vegetation, including the traditional weed in cereal species, which has almost disappeared outside the sub-Mediterranean region.

Agricultural ecosystems are threatened by:

- changes of land-use - land consolidation and agricultural improvements, abandonment of specific cultivars (cereals, domestic varieties of fruit trees, vegetables, etc);
- changes of the social structure;
- changed agricultural technology: application of mineral fertilizes, biocides, eutrophication of soil, hybrids, intensive agricultural production, abandonment of the rotation of crops, etc.

Threats. The land use data are gathered in the Land Cadastre but have not been maintained and can no longer be used. The project on the monitoring of the land-use categories is carried out at the Ministry of Agriculture, Forestry and Food. Results of the habitat mapping provide a basis for the monitoring of the status and guiding the biodiversity conservation.

Research on fauna and flora has not been conducted. There are a few studies on segetal vegetation and weeds but the data on their actual distribution are lacking.

(Photo: Peter Skoberne)

(Photo: Peter Skoberne)

(Photo: Bojan Marčeta)

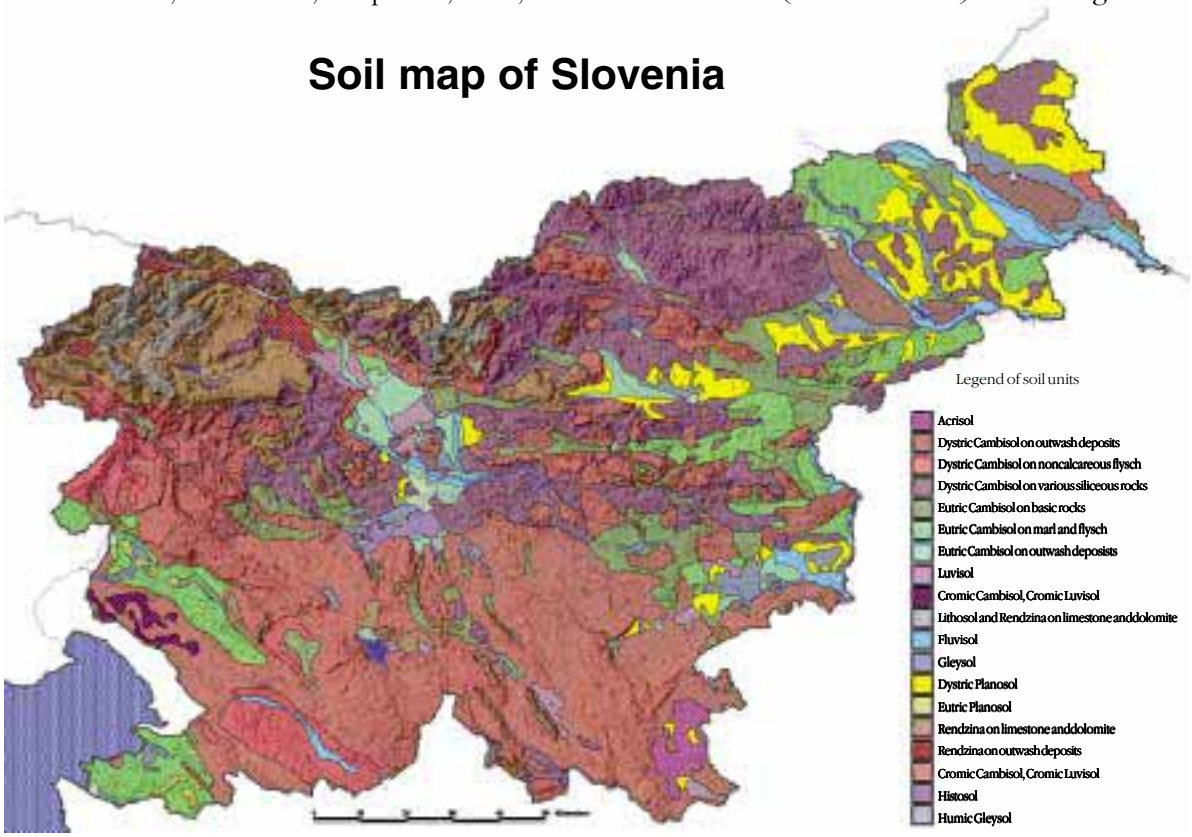
Figure 48 (above). *Falco tinnunculus, having become used to human presence is also nesting in tall buildings.*

Figure 49 (left). *Corn flower is one of the dying out cornweeds. Intensive agricultural production methods are threatening segetal associations with corn weeds.*

Urban habitats

There are many forms of urban ecosystems: green plots in towns, parks, gardens, green zones around towns, river banks, fish ponds, lakes, suburban forests. Open areas in towns provide shelter for individual plant and animal species and play an important role in the 'urban ecology'. Cellars, church towers and other parts of buildings are habitats of many species (bats, kestrels).

Threats. The total surface of open areas in towns is diminishing. The urbanisation and other activities build up pressure on the area, in part because of the relatively low prices of land where new shopping and business centres and parking lots are constructed. The restoration of old buildings, the closure of openings and application of toxic wood coatings threaten habitats of specific invertebrates (bats and birds) in buildings.



Map 9: *Pedological map of Slovenia (Source: BF Center za pedologijo in varstvo okolja)*

SPECIFIC ECOSYSTEMS

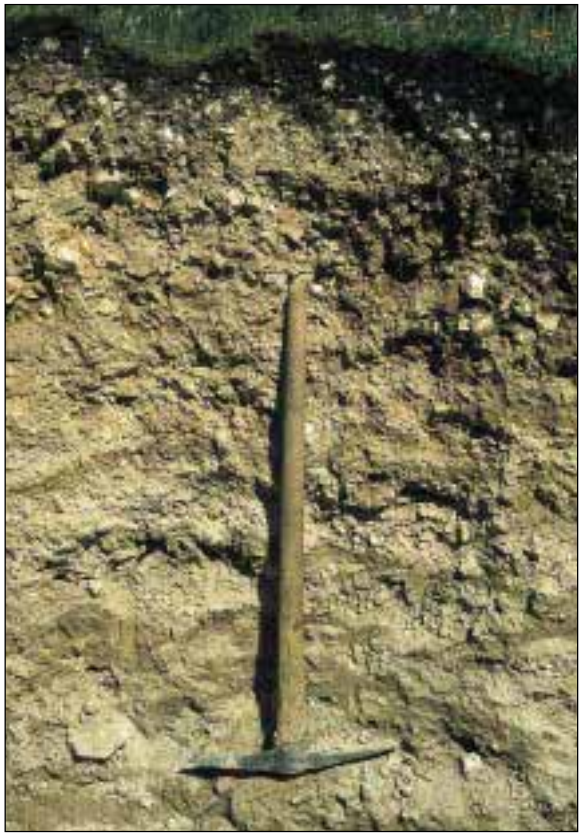
Specific ecosystems are dealt with separately, as a special unit, because they combine various habitats (mountain ecosystems and wetlands), occur in most habitats (soil) or are particularly characteristic of Slovenia (subterranean habitats, '*mrazišča*', intermittent lakes, etc.).

Soil ecosystem

General characteristics. Soil is a natural matter on the surface of the Earth's crust, which has formed and developed under the influence of various factors: parent material, climate, organisms, relief and time (Sušin, 1983). Soils are a complex three-phase system composed of a solid (organic and mineral matter), liquid (soil water) and gaseous (mixture of gasses) phase. They are defined by many properties (morphological, physical, chemical, biological, air and water, radiological, etc.). Many plants, animals, fungi and micro-organisms live in soils and on them. The fertility of soils enables the rooted plants to use the water, nutrients and gasses in soil for their growth and development.

Soil ecosystems are composed of organic and inorganic substances in various *stages* of decay. Individual *components* of soil are irregularly distributed and facilitate the variability of conditions at various *levels* and in different size classes. The interaction of physical and chemical factors contributes to the diversity of soil habitats and thus defines the structure and activity of living organisms in the forest soil at a specific time and in a specific place.

The individual components of living organisms in forest soils (plant roots, micro-organisms, animals) depend on the energy sources and nutrients in soils in different ways. Plants and autotrophic micro-organisms receive carbon from CO^2 in the air. Some micro-organisms are capable of fixing nitrogen from the air. Organic matter and other living soil organisms are the source of energy and nutrients for most organisms in soil. Special attention should be devoted to the transfer of nutrients among different producers and the sources of nutrients and consumers through the mycelium of mycorrhizal fungi which determine the time and spatial distribution of nutrients (in particular in forest habitats).



(Photo: Marko Simič)

Figure 51. *A cross-section of rendzina soil at Krnsko jezero (Lake Krn).*

The size of living organisms in soil (from 0.05 µm to 5,000 µm) depends on the texture and structure of the soil, its particles, size of pores and water in soil and on the moisture tension. The distribution of aerobic and anaerobic micro-organisms in soil depends on the atmospheric composition, water and air properties of soil and its redox potential. The biological activity in soil is closely associated with its pH (soil reaction), temperature and illumination (surface layers). Micro-environment in soil is characterised by high heterogeneity of organisms. Forest soils are rich in biological components, and the various complex forms of interaction (plants, animals, micro-organisms), which affect the nutrient cycle and the stability of forest ecosystems are particularly important.

(Photo: Andrej Hudoklin)

Figure 50. *The importance of the soil's biological component has been neglected and the knowledge is still lacking.*

Soil types

Automorphous soils are formed and developed under the impact of precipitation. Water freely percolates through such soils. We can divide them into six classes: undeveloped soils, humus-accumulative soils, cambic soils, anthropogenic soils and technogenic soils.

Hydromorphic soils are soils which are permanently or periodically waterlogged because of the groundwater, surface water and/or flood water. Such soil can be divided into five classes: undeveloped hydromorphic soils, pseudogley soils, peat soils and anthropogenic hydromorphic soils.

Soil classes include the following soil types:

- undeveloped automorphous soils: litosols, regosols, colluvium;
- humus-accumulative soils: rendzina (carbonate bedrock), ranker (silicate bedrock);
- cambic soils: brown soils (eutric cambisol), brown acid soil (dystric cambisol), brown carbonate soil (calcaric cambisol), terra rosa;
- eluvial soils (eluvial-illuvial soils): luvisols, podzols, brunipodzol (brown podzol);
- anthropogenic soils: cultivated soil, horticultural soil and deposit soil;
- hydromorphic soils: fluvisols, pseudogley, hipogley, epigley, amphigley, peat soils of raised bogs, mires and fens, drained soils.

General relevance of soil for biodiversity conservation. The living components of the forest soil are hidden to the eyes and it is not easy to conduct research on them. Forest soils are an integral part of the forest ecosystems. It has been established on the basis of individual studies of the natural spruce stands in Slovenia, when the biodiversity indexes of surface vegetation and types of ectomy-corrhiza in soil were compared, that the diversity of the biocomponent in forest soil is much higher than above it (Kraigher, 1999). In natural beech forests the diversity in the soil and above it does not vary so much (Al Sayegh, Petkovšek & Kraigher, 2000). It can be concluded that biodiversity in forest soil significantly contributes to the biodiversity of specific ecosystems. However, not enough research has been conducted to evaluate the contribution of the biocomponent of the forest soil to the total diversity in 1.1 million ha of forests in Slovenia.

Threats. Soils can be altered or destroyed by natural or anthropogenic physical, chemical or biological factors. Undeveloped and organogenic humus accumulative soils are sensitive to ground fires. Acidification and degradation (sites colonised by fir trees, litter utilisation of forests) affect dystric soils, poor in nutrients. Loose sediment depositions and soft bedrock are sensitive to erosion (forest clearcuts). Land reclamation alters the water and air properties of hydromorphic soils.

(Photo: Branka Hlad)

Figure 52. *Ljubljansko barje, a cross-section of the peat soil. In the past, peat was cut for fuel, today only fractions of peat remain.*

Causes of the threats. Land use, acidification, eutrophication, degradation, input of heavy metals and forest management. In Slovenia the impacts on the biocomponents in soil have been documented taking into account the soil erosion, changes in land use, direct input of pollutants, soil compaction caused by the use of unsuitable machinery and impacts as a result of other badly organised activities (recreation, grazing, picking of forest fruits which should be limited to specific trails and small areas within forests).

Soil is in particular affected by clearcuts, agricultural use in sensitive ecosystems (mountains), agricultural improvements in lowland forests, pollution of groundwater by discharges from farms, 'natural' acidification caused by spruce stands, construction of roads, etc.

Degree of research. Slovenia is well covered with soil maps of different scales and the general degree of research is satisfactory. However, the soil texture and soil biocomponent have not been studied in detail. So far, a system of systematic and methodological research has not been established.

Most research and inventory projects have been, or are, conducted at the Biotechnical Faculty, mainly at the Department of Agronomy, at the Agriculture Institute of Slovenia, Slovenian Forestry Institute and the Biological Institute at the Scientific Research Center of the Slovenian Academy of Sciences and Arts (ZRC SAZU).

Degree of research on soil biocomponent. The diversity of biocomponent in soil is studied at the Slovenian Forestry Institute (biodiversity of ectomycorrhizal types and multiple symbiosis in the forest mycorrhizosphere), the Agriculture Institute of Slovenia, the National Institute of Biology (bacteria in rhizosphere of particular vegetables), the Department of Biology (edaphic fauna) and the Department of Food Science and Technology of the Biotechnical Fac-

ulty (bacteria, nitrogen fixators). Until now, approximately 60 ectomycorrhizal types on spruce have been described, 40 on beech and 10 on oak. Of the mentioned ectomycorrhizal types more than two thirds have not been described in Central Europe, where around 120 ectomycorrhizal types on spruce have been identified so far. During the project concerning the research on bacteria in soil, the spruce mycorrhizosphere and mycorrhizal fungi *Amphinema byssoides*, 157 bacteria strains have been identified, of these 68 in mycorrhizal roots, 56 in hyposphere of the rhizomorph (in total 80 % of strains) and 33 in non-mycorrhizal and unrooted soils (approximately 20 %). It has been established that the diversity of bacteria in the mycorrhizosphere is 4 times richer than in unrooted soil and the bacteria strains vary. In view of the potential number of mycorrhizal fungi and bacteria in the mycorrhizosphere it is estimated that the diversity of that part of soil biocomponent is extremely rich, even though it has not been researched yet. The subjects dealt with in these studies could be compared to the studies of edaphic fauna, but the latter has a much longer tradition and as a result the degree of research is substantially higher (Tarman, 1967-96, Mršić, 1987-97, Kos, 1988-2000 and others).

Figure 53 (top). *Papaver alpinum, a typical representative of flora on the alpine limestone fans. It is a very diverse species, with a number of subspecies, some of which are endemic.*

Figure 54 (bottom). *Saxifraga sp. is inhabiting the rock cracks.*

(Photo: Marko Simić)

(Photo: Marko Simić)

Mountain ecosystems

General characteristics. The common characteristic of mountain ecosystems is the altitude span between the bottom of the valleys and the top of the summits. Various habitats are found on a relatively small surface and the mountain ecosystems are therefore rich in species. These are well adapted to the extreme conditions (short vegetation period, water shortage, UV-radiation, wind). Glaciations were important in the distribution of plant and animal species. Specific habitats are rock chasms, screes and Alpine grasslands (35-40 % of endemic species in the Alps are found in rocky habitats and screes).

Many mountain ridges are divided by state borders and international cooperation is a necessity when the integrated nature conservation policy is considered.

Threats. The biodiversity of the mountains is threatened by numerous human activities:

- **Pollution.** The less obvious but important factors are the transboundary pollution and global changes:
  - local sources of pollution can be contained;
  - more problematic is the transboundary air pollution originating in industrial and urban centres; it has been recognized that the impact of such pollution is substantial, many sensitive species have disappeared, the communities have been altered and the functioning of ecosystems has been disrupted (withering of dwarf pine); in addition, mountain lakes are adversely affected by such pollution;
  - the impact of global changes, such as climate change, depletion of the ozone layer in the stratosphere and the increased UV-radiation, is considerable; mountain organisms, living in extreme conditions, are effective bioindicators of such changes.
- **Human activities affecting the environment.** The activities which affect the environment most are: forestry, agriculture, transport, energy generation, tourism and recreation:
  - mountain forests have traditionally been managed in a sustainable manner, and the main problems are game management (conflict with agriculture) and the network of forest roads;

- mountain agriculture has traditionally been oriented towards the sustainable exploitation of natural resources; the problems arise from the non-selective application of modern cultivation techniques which are not suitable for mountainous regions (agricultural improvements and application of fertilizes on mountain pastures); mountain agriculture is an activity in decline (emigration from remote mountain farms) and with regard to the conservation of biological and landscape diversity the problem of natural encroachment of vegetation on grasslands (hay meadows, pastures) is becoming increasingly serious;
- the loss of habitats is caused by economic exploitation of screes and gravel and sand deposits (for example, the exploitation of gravel in Matkov kot).

• Mass **tourism and leisure activities** have an adverse effect on the diversity of the mountains. The causes are:

- expansion of ski centres in sensitive areas which affects soil; on the Kanin mountain, the caves are physically threatened and polluted;
- pollution of mountain lakes;
- non-compliance of the strategy concerning the construction of cable ways with the nature conservation guidelines;
- mass mountaineering;
- modern outdoor activities (rafting, canyoning, mountain biking, para-gliding, riding motorcycles and motor sledges) invade the last peaceful corners of the mountains.

(Photo: Marko Simić)

(Photo: Marko Simić)

(Photo: Andrej Bibič)

All these activities adversely affect mostly animal populations. In addition, the animals living in mountains have not been studied as much as plants. The populations are usually small and spatially limited groups on the edge of the area of species distribution. Every activity affecting their environment could lead to their extinction if the current status is not analysed in detail.

Degree of general research. Data on the status of preserved nature in the mountains are more the consequence of the unplanned, partial studies carried out by individuals than of the strategic research programmes focused on the overview of the status of nature in the mountains. Interdisciplinary studies at the ecosystem level, which would provide information on relations between species, conservation of natural resources and impacts of pollution factors, are rare. Most work has been done in mountain forests and the current studies focus on forests and the dwarf pine zone. The zone above the forest line

Figure 55 (top). *Salamandra atra, this salamander species does not have the yellow freckles typical of common salamander.*

Figure 56 (above). *Vršič: larch stands above the tree line interchange with dwarf pine.*

Figure 57 (left). *Falco peregrinus, nesting in the crags, is sensitive to disturbance during the breeding period. The species is additionally threatened due to pesticide use in farming.*

(Photo: Marko Simić)

Figure 58. *Alpine karst pavement (the view below Rombon mountain) is a true rocky desert. The rainwater is caught in the karst grooves and flows underground.*

has not been studied with regard to ecosystems, even though the best indicators of global changes are the communities in high mountains (transboundary pollution, climate change). The adverse effects of human activities (tourism, transport, energy generation) in the mountain areas have not been studied in depth. In addition, not enough basic data are available for an integrated environmental impact assessment of the mountain areas.

Degree of research on habitat distribution. The mapping of habitats, ecosystems and ecologically important areas in mountains is in its initial phase. With regard to the degree of research, the mountains in Slovenia could be divided into two areas: on the one hand, the Triglav National Park, where many studies have been conducted and records and inventories compiled, and on the other hand, other mountains for which the data are fragmentary and incomplete (except for forest ecosystems - projects concerning bioindication, conservation of endangered wild life in forest ecosystems and landscapes).

Figure 59. *Brinščica cave in Matarsko podolje (Matarija valley) is a natural monument known for its cave pearls.*

(Photo: Marko Simić)

Degree of research on fauna and flora. The data on the distribution of plant and animal species are fragmentary and limited to specific locations or taxonomic groups. The critical review and the collection of the existing data could result in a record on the status of plants and animals and their communities. However, it should be supplemented by the systematic research on the less known taxonomic groups, in particular animals. Another problem is that the collected data are not only fragmentary but also obsolete, and thus unsuitable for assessing the status of species and habitats and for the relevant action.

Karst and subterranean habitats

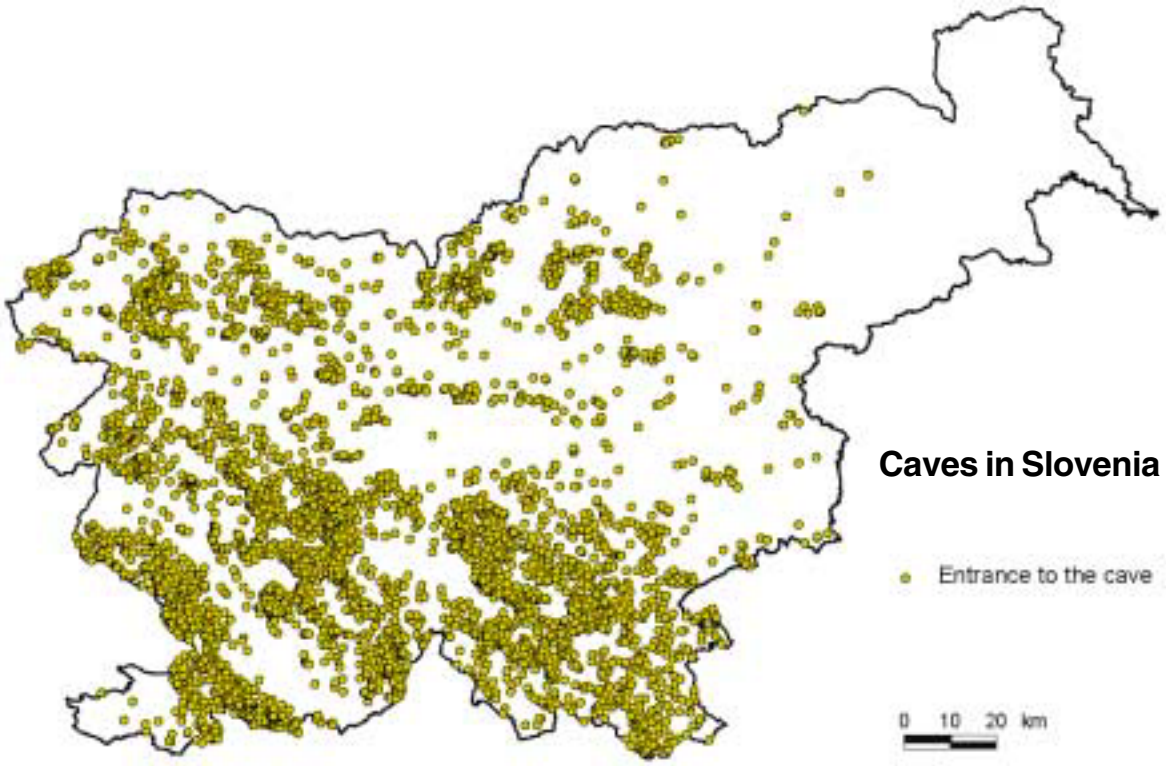
General characteristics. Karst is an area composed of porous and highly soluble bedrock where water flows underground. Specific surface and subterranean landforms are characteristic of the area. In Slovenia, the limestone areas, where karst forms occur most frequently, cover approximately 35 % of the territory. Additionally, around 8 % is covered by dolomite, where karst phenomena are not rare. Karst types can be classified by different criteria, according to the altitude, surface morphology, isolation from or connection to other karst areas, depth of epikarst zone, catchment areas or the water flow. Caves are an excellent indicator of the extent of the karst area. So far 7,405 caves have been registered in Slovenia. In total, more than 450 km of cave passages have been explored (Kataster jam IZRK & JZS, 2001).

The exceptionality of the natural phenomena is the result of the geology and hydrology of the area which are manifested in the surface and underground morphology. The features of international importance are:

- geomorphological forms and the landscape;
- hydrological features;
- karst terminology;
- endemic animal species.

Subterranean habitats are more or less closed and spatially limited systems with no available light. They include caves, crevices and chasms on land and in fresh water (groundwater). Their characteristics are:

- relatively well preserved subterranean habitats as a result of inaccessibility in the past and low population density in the area above the cave systems;
- soil erosion caused by the felling of forests and intensive grazing, consequently there is no intensively cultivated arable land in the area, except vineyards;
- relatively low but specific biodiversity with numerous endemic species and high ecological sensitivity (impact of surface activities);



Map 10: *Map of Slovenia's 7,405 registered caves. The position of caves indicates the location of karst areas in Slovenia (Source: Cave Register of the Speleological Association of Slovenia, 2001).*

- exceptional scientific as well as cultural and historic importance of the area, related to the presence of specific species (*Proteus anguinus, Leptodirus hochenwarti*);
- the aquatic and terrestrial subterranean fauna of Slovenia is among the richest in the world.

Threats. Karst ecosystems (including caves) are threatened by water pollution (urbanisation, agriculture and tourism). Disposal of household waste in karst caves is a serious problem. Dry grasslands are primarily threatened by natural encroachment of vegetation on arable land caused by its abandonment. The introduction of intensive livestock breeding threatens these ecosystems while the controlled grazing maintains them. Unregulated and uncontrolled cave tourism and inappropriate closure of entrances into caves and shafts threaten the subterranean habitats of specific bat species.

Causes of the threats:

- fast economic and social development:
  - dispersion of small industrial plants in the landscape;
  - settlement and construction of infrastructure outside urbanised areas in the vicinity of towns due to available transport facilities, low prices of land and good drinking water supply;
  - decentralised decision-making and regulating procedures and control of development;
- pollution from various sources:
  - inadequate public utility infrastructure (the amount of waste material is increasing);
  - disposal of waste in karst caves and shafts - the most threatened are those near villages and roads;
  - spills of dangerous substances;
  - uncontrolled tourist visits to caves;
  - increased emissions of pollutants and amounts of organic and inorganic substances in water;
  - agriculture - fertilisation, spraying;
- physical interference:
  - hydro-technical interventions on the surface or underground;
  - forest felling, in particular in the vicinity of ice and snow caves;
  - erosion;
- threats to habitats - pollution and invasion of non-indigenous species threaten mainly

(Photo: Peter Skoberne)

Figure 60. *Leptodirus hochenwarti, discovered in 1831 in Postojna cave, was the first discovered and described cave animal in the world.*

the animal species of the underground waters;

- it is difficult to predict the consequences of the impacts on the cave environment but the threats to the area can be seen in accessible parts; however, they do reflect the threatened biodiversity in remote and hidden parts of the underground.

General degree of research. The most complete collection of data is the Cave Register of the Speleological Association of Slovenia. The cave types are identified with regard to the altitude, surface morphology, isolation, connection to other karst regions, river basins and hydrology. The climate of caves has only been researched in ice-caves.

Degree of research on individual karst hydrological systems. The hydrological systems of the karst rivers Ljubljanica, Reka and Rižana, the waters of Bela Krajina, Dolenjska and parts of the Alpine region, the water sources in Trnovski gozd, the Hrušica and Nanos plateaux and the watersheds in Slovenia have already been studied.

(Photo: Marko Simić)

Figure 61. *The entrance shaft to Brinščica cave with a dumped Fiat car. Shafts are often used as local illegal landfills. People are still not aware that all the rubbish dumped in them finds its way to the water springs used for drinking water.*

Degree of research on fauna and flora. Due to the lack of light no flora is found underground. Vegetation only develops near entrances to the caves where there is enough daylight. The exception are tourist caves where algae and mosses develop under the artificial lights. So far, the inventories have been made of algae, mosses, ferns and vascular plants, growing near entrances to caves.

The terrestrial fauna in caves is extremely rich. Most is known about beetles and snails which were intensively collected in the past (and still are). These animals have been studied mostly by the experts at the Karst Research Institute (IZRK) and ZRC SAZU. Less abundant but highly endemic species are chilopods (*Chilopoda*) and myriapods (*Myriapoda*). Springtails (*Collembola*) and in particular mites (*Acarina*) are frequent inhabitants of the underground, but the knowledge about the specific species and their distribution is insufficient.

The subterranean aquatic fauna has been well researched in the "Notranjska triangle" (the area between Cerknica, Planina and Postojna) where many endemic species have been found. The research on other water caves has been focused on specific animal groups, such as snails and slugs (*Gastropoda*), isopods (*Isopoda*) and terrestrial amphipods (*Amphipoda*). Other animal groups (*primarily Entomostraca*) have not been researched in detail, except in specific large cave systems (the cave system of Postojna and Planina, Škocjanske jame, Dimnice, Osapska jama).

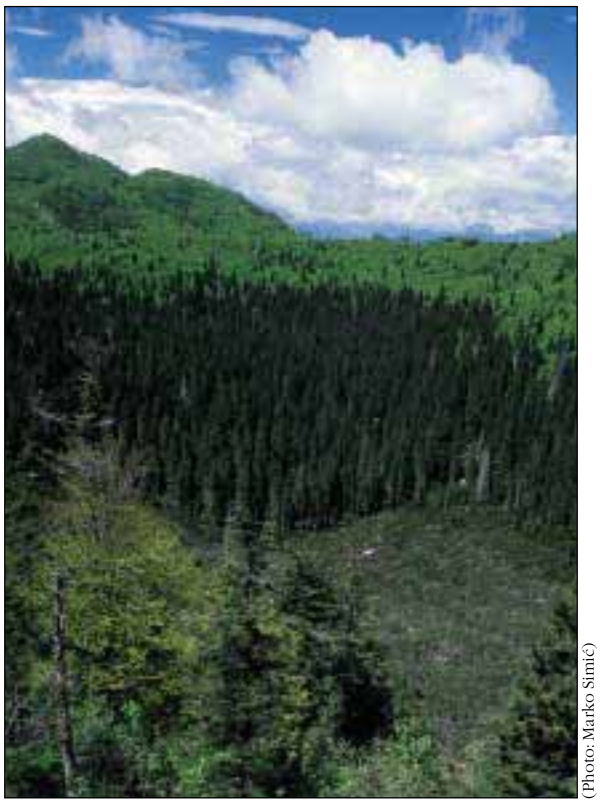
The research in the past showed that the diversity of cave animals is outstanding at the European and global levels. A few tens of endemic species live in the area. From the geographical perspective, the least researched karst is the Alpine (mountain) karst. The least known habitats are the jets of underground water in karst caves. It is expected that the current research (2000/2001) will reveal a series of new species, most of them endemic.

The knowledge about other underground waters is merely rudimentary, but it is evident that the diversity of species is almost as rich as in the caves.

Experts. Karst science and the environmental aspects of karst are well covered with regard to the staff. However, the research on the subterranean fauna is hindered by the lack of experts on specific animal groups.

'Mrazišča'

General characteristics. 'Mrazišče' is an extreme habitat where the cold air trapped in a depression results in temperature and vegetation inversions. These habitats clearly differ from the immediate surrounding and are a result of specific micro- and mesocli-matic conditions. The soil and ground level temperatures are substantially lower than in the surrounding area and are often just a few degrees above zero. A special temperature regime is the consequence of the temperature inversion in the typical funnel-shaped depressions. Such extreme conditions are often caused by extremely cold soil, as a result of its coarse structure or soil chemistry (chert). '*Mrazišče*' is a rather usual habitat in Slovenia. Most of them are found in the mountain karst, particularly in Trnovski gozd plateau, Snežnik range and in Kočevje region, where they had developed in dolines and collapse dolines. There are only a few in the Alps and sub-Alpine area, and they are extremely rare in the sub-Mediterranean region.



(Photo: Marko Simić)

A specific temperature regime defines '*mrazišče*' as an important source of biodiversity since it occurs as an 'isle' within the ecosystems of the area. The bottom and the lower slopes of depressions are covered in psychrophilic vegetation, glacial relicts in low latitudes are frequent (twinflower *Linnaea borealis* in a gorge near Bohinjska Bela, dwarf pine *Pinetum mughii* in Smrekova draga in Trnovski gozd). Outside the Alpine phytogeographic region such plants are found in Velika udorna dolina in Škocjanske jame (Alpine auricula *Primula auricula* and rockfoil *Saxifraga*). Inversion of vegetation zones is characteristic for some of these habitats (for example Paradana and Smrekova draga in Trnovski gozd, Kolobarnica in Snežnik). Indigenous spruce forests in these habitats are found in Kočevski rog (for example Prelesnikova koliševka).

Threats. Most '*mrazišča*' are not threatened because they are not easily accessible. There have only been a few cases when destructive human activities affected '*mrazišča*' (construction of intervention skid trail in Soteska and disposal of waste in Unška koliševka).

Degree of research. The past studies presented well the characteristics of the temperature regime in '*mrazišča*' (Martinčič, 1977; Piskernik, 1973) and their flora and vegetation. With regard to fauna, only partial data on mesoarthropods are available. It should be mentioned that not all '*mrazišča*' in Slovenia have been recorded.

Figure 62. *The collapse doline Smrečje in Trnovski gozd. Large collapse dolines in the Dinaric mountains are typical examples of 'mrazišče'. The cold air trapped in a depression results in temperature and vegetation inversions.*

Wetlands

General characteristics. Wetlands are very dynamic ecosystems with characteristic plant and animal associations. They combine the properties of terrestrial and aquatic habitats which are interconnected and often mixed.

> Wetlands are areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six metres (Article 1 of the Ramsar Convention on Wetlands).

Wetlands are found all over Slovenia and many are among the most biologically rich ecosystems. Human-made wetlands (saltpans, fish ponds, karstic ponds, abandoned clay and gravel pits) are important habitats of plant and animal species, in particular in areas where natural wetlands have disappeared due to the human impacts.

The Ramsar Convention classifies wetlands into three basic groups which are further divided into 12 types of marine and coastal wetlands (in Slovenia 9), 20 types of inland wetlands (17 in Slovenia) and 10 human-made wetland types (8 in Slovenia). The first inventory of all known localities was made by the Water Management Institute (VGI, 2000) and includes more than 3500

(Photo: Peter Skoberne)

Figure 63 (right). *'Mrazišče' between Bled and Bohinj is one of the rare localities of Linnaea borealis in the southern part of the Alps.*

Table 15: *Wetlands in Slovenia, identified according to the Ramsar Classification System for Wetland Type. In the inventory the surface area of wetlands exceeding 0.15 ha was entered, smaller wetlands have only been itemised (Source: VGI, 2001).*

Wetland Type		Area covered (> 0.15 ha)	Number of all sites
MARINE / COASTAL WETLANDS			
J	Coastal brackish/saline lagoons,	74.986	4
INLAND WETLANDS			
M	Permanent rivers/streams/creeks;*	61.77	61
N	Seasonal/intermittent/irregular rivers/streams/creeks;*	0	1
O	Permanent freshwater lakes (over 8 ha);	456.685	2
P	Seasonal/intermittent freshwater lakes (over 8 ha);	3,151.297	6
Tp	Permanent freshwater marshes/pools; (below 8 ha)	168.692	279
Ts	Seasonal/intermittent freshwater marshes/pools;	2,959.55	171
U	Non-forested peatlands;	102.805	17
Xf	Freshwater, tree-dominated wetlands;	6,184.289	28
Zg	Geothermal wetlands	0	2
HUMAN-MADE WETLANDS			
1	Aquaculture (e.g., fish/shrimp) ponds	225.308	312
2	Ponds; (generally below 8 ha)	134.38	1517
4	Seasonally flooded agricultural land (including intensively managed or grazed wet meadow or pasture)	18,079.597	304
5	Salt exploitation sites; salt pans, salines, etc.	662.376	2
6	Water storage areas; reservoirs/barrages/dams/impoundments (generally over 8 ha)	2,700.268	72
7	Excavations; gravel/brick/clay pits; borrow pits, mining pools	363.438	584
8	Wastewater treatment areas; sewage farms, settling ponds, oxidation basins, etc.	16.792	1
9	Canals and drainage channels, ditches	0	156
0	no data on wetland type	3.067	6
Total		**35,345.3**	**3525**

*The inventory does not cover watercourses, only small wetlands along them.

(Photo: Peter Skoberne)

Figure 64. *Marsilea quadrifolia, an endangered species at the European level has the only confirmed locality in Slovenia, near Ptuj.*

wetland sites. The list is incomplete because it does not include all wetland types in Slovenia. However, it provides a good basis for the further evaluation of wetlands and a systematic data collection.

Wetlands are included in all main habitat types (PHYSIS), mostly those in inland waters and coastal and marine habitats. Of all sites, only a third exceed 0.15 ha. The total surface area of wetlands covers 1.74 % of the country. If all floodplain areas are taken into account the percentage does not exceed 5 %. The human-made ecosystems prevail (83 % of sites and 61 % of the total wetland area), mainly seasonally flooded agricultural land (wet meadows), mostly found in Ljubljansko barje. Within the number of natural wetlands, small lakes prevail but the largest surface area is covered by intermittent lakes and marshes. The most extensive inland wetlands are found in the lowlands, along the lower and middle courses of the rivers (Mura, Drava, Sava), in karst poljes (the karst catchment of the Ljubljanica river with Cerkniško jezero and Planinsko polje) and in the river headwater areas (Pokljuka, Bloke, Pohorje). Due to the geological and climatic diversity of the territory the inland surface waters and wetlands of Slovenia are rich in plant and animal species. Around 1,700 algae

species and subspecies and almost 100 species of water and marsh flowering plants have been recorded in the identified wetlands. In addition, around 2000 water animals, including fish and amphibians but not insects, have been identified so far (Sket *et al.*, 1991). It has been estimated that there are approximately 1,000 species of insects which spend part or all of their life in water. Plant and animal species, which are new to Slovenia's identified flora and fauna, are found in wetlands even today.

Slovenian wetlands of international importance

Wetlands are included in the list of the internationally important sites according to two sets of criteria:

- a representative, rare or unique wetland type in a biogeographical region;
- an area which is important for the biodiversity conservation (criteria include species and ecological communities, waterbirds, fish).

According to these criteria, the following wetlands have been listed as internationally important:

- *Sečoveljske soline* (1993) as the first Ramsar Site in Slovenia. These saltpans are a humanmade wetland where the typical saline ecosystem and economic exploitation of the area merge with the historic and cultural heritage. From the nature conservation perspective the rich flora and fauna are particularly important. Halophytic vegetation and waterbirds (more than 260 species) are characteristic of the area. The mixing of salt and fresh water enhances the diversity of habitats in the area. The saltpans of Sečovlje have been designated a Landscape Park and an Important Bird Area - IBA . Under the Barcelona Convention they have been listed as an important protected area of biodiversity in the Mediterranean.
- *Škocjanske jame* (1999) are a subterranean wetland. The cave system is characterised by substantial fluctuation of underground water and by various water forms. Water in the cave system forms typical karst phenomena. The important part of the cave system is its fauna. Škocjan Caves have been designated a regional park. In 1986, they were inscribed on the UNESCO World Heritage List because of their hydrologic characteristics and spatial components.

The data show that the following areas of high biodiversity meet the Convention criteria for inclusion on the list of Wetlands of International Importance:

- the *Mura river floodplain* characterised by wet woods and meadows, oxbow lakes and backwaters; the biodiversity of fauna and flora is rich, over 600 plant and almost 3,000 animal species; it is an IBA;
- the section of the *Drava river between Maribor and Središče ob Dravi* is an important waterbirds habitat; almost a half of all wintering birds in Slovenia are found on the water reservoirs of hydroelectric power plants; they feed along the old riverbed of the Drava river; it is an IBA. The habitat and species diversity of the area is extremely high (750 plant and numerous animal species, among them 9 fish, 9 amphibians, 50 odonates);
- *Krakovski gozd* is one of the largest remains of the alluvial forests in Slovenia (4,000 ha); forest of common oak (*Quercus robur*) with marshes and wet meadows rich in characteristic plant and animal species (134 plant species, 120 bird species (100 nesting birds) and many other animal species); it is an IBA;
- *riparian wetlands of the lower Sava river* include floodplain woodlands, wet meadows and backwaters, numerous sand and gravel

(Photo: Peter Skoberne)

(Photo: Matjaž Bedjanič)

Figure 65 (top). *Sečoveljske soline (Sečovlje Salinas) an exceptional habitat of animal and plant species and a cultural heritage site, was the first wetland site of international importance in Slovenia included in the Ramsar List.*

Figure 66 (above). *Floodplain wetlands along the Mura River (eastern Slovenia) provide habitat for the biggest population of Rana arvalis in Slovenia. For a few days during the mating period in spring the male frogs turn blue.*

banks and eroded banks. *Jovsi,* a floodplain area with wet meadows where 132 plant species have been identified; the area is important for birds, among which are the rarest nesting birds in Slovenia;

- *Ljubljansko barje* is an extensively cultivated cultural landscape which is regularly flooded during the spring and autumn rains. It is an internationally important bird area (IBA), in particular for rare and threatened species which live in the meadows. Half of the Slovenian population of Corn Crake (Crex crex), a globally threatened species, lives in this area. More than 30 % of the populations of four other endangered meadow species live in the wetland.
- *the karst catchment area of the Ljubljanica river and fens of Bloke*, a complex system of surface and subterranean wetlands; the most important are the karst poljes of Cerknica (IBA) and Planina (IBA), Rakov Škocjan and the valleys of the Pivka and Nanoščica rivers (IBA), a special feature of the area is endemic underground fauna. The wetlands on the Bloke plateau are the most important fens in Slovenia.
- *Čezsoški prodi* and *Vrbulje* are extensive gravelbanks of the river Soča with numerous channels, islets and puddles as well as karst springs in the floodplain zone; the area is an outstanding complex of rare plant and animal species.

Threats. The degradation and loss of wetlands is the consequence of intensive human activities. Most wetlands have been intentionally drained for agricultural purposes. The written data show that since the 18th century more than 100,000 ha of land were drained. Between 1973 and 1991, 70,000 ha of land were drained in order to obtain new arable land, mostly in the northeast part of the country (Matičič, 1993). According to the statistical data, approximately 40 % of wetlands were lost between 1952 and 1990. However, the data does not cover all wetland types. The marine and coastal wetlands have been preserved only in fragments. Of the inland wetlands, mostly those along the middle and lower courses of rivers are threatened. Even though the human-made wetlands - which prevail in number and total surface area - have taken over the functions of the lost natural wetlands and are important areas for conservation of biodiversity. Nevertheless, the research shows that the lost natural wetlands are irreplaceable (for example biodiversity of oxbow lakes in the Mura floodplain).

Beside the physical destruction, wetlands are also threatened by pollution and the introduction of invasive non-indigenous species and tourism (inland waters as well as coastal and marine habitats).

A particularly problem is the introduction of fish in mountain lakes (Krnsko jezero, lake in Planina pri jezeru, Dvojno jezero and Črno jezero). In 1999 and 2000 the project concerning the renaturation of Dvojno jezero was carried out. The purpose of the project was to take out most of the Alpine char (*Salvelinus alpinus salvelinus*).

Causes of threats to inland waters and wetlands

- physical interference:
  - urbanisation: construction affects the natural retention capacity of watercourses - the retention zones; the flood control measures affect the hydrological regime, the land use and the aquatic environment;
  - construction of buildings and infrastructure (roads) often affects the wetlands which are being partly or completely infilled;
  - building of small and large hydroelectric power plants significantly alters the hydrological system of the area;
  - excessive need for drinking water due to the uneconomic functioning of the abstraction and supply system (up to 40 % of abstracted water is lost);
  - inadequately controlled exploitation of sand and gravel;
  - constantly increasing number of fish farms and other users of water resources affect the use and quality of water;
  - industry is the largest consumer of water; most of the used water is returned to the system by the waste water discharges

(Photo: Peter Skoberne)

Figure 67. *The area of intermittent lakes in the Pivka valley forms one of the two branches of the upper reaches of the Ljubljanica river. Due to its particular characteristics it is on the list of Slovenian proposals for Ramsar Sites.*

(chemically and thermally polluted water); the situation is gradually improving because the relevant administrative measures have been taken and together with the tax system force the industry to improve the technologies.

- pollution:
  - untreated urban and industrial waste waters from urbanised areas are the most important water polluters in Slovenia;
  - agriculture is the main cause of the burdening of underground water resources and watercourses; the pollution is caused by the application of fertilizes (also in winter) and pesticides (including the prohibited atrazine); the results of such pollution have been proven and the consequences are evident in the areas of intensive agricultural production;
  - collection, recycling, combustion and final disposal of waste are in the initial phase; the main problem of the old and still used landfills is the untreated leachate;
- intentional or accidental introduction of non-indigenous plant and animal (invasive) species changes the structure of a wetland and threatens its biodiversity and functions;
- social aspects:
  - lack of integrated approach towards the protection of wetlands and land use;
  - insufficient awareness about the importance of wetlands for the conservation of biodiversity (in particular small wetlands - puddles and flooded gravel pits) and insufficient knowledge about biodiversity at the local level;
  - insufficient involvement of science in raising public awareness.

The degree of research on wetlands is comparable to the research conducted on inland waters and coastal and marine habitats. The studies are limited to a specific habitat, species or wetland feature. There are almost no comprehensive studies available. *The Conservation and Management of Wetlands in Slovenia in the Context of European Policy* (Beltram, 1996) is so far the only example of an interdisciplinary study in the field.

General degree of research. In the inventory of the Slovenian wetlands (VGI, 2001), the basic data on wetlands, their extent, hydrology, flora and fauna were initially presented. Another project, which had been carried out by the NGOs from Slovenia and Croatia (*Centre for the map-*

(Photo: Branka Hlad)

Figure 68. *An illegal landfill on Ljubljansko barje is just one of many such cases occurring in Slovenia.*

(Photo: Marko Simić)

Figure 69. *Drosera rotundifolia, is a typical representative of raised bog flora and threatened by alteration of its habitats (e.g. drainage, liming, application of fertilizers).*

(Photo: Andrej Bibič)

Figure 70. *Calidris alpina, during migration also feeds in Slovenian wetlands.*

ping of fauna and flora and Societas Herpetologica Slovenica, a Society for the Study of Amphibians and Reptiles of Slovenia), is a study on *Karstic ponds* - the network of aquatic biotopes. Individual studies on the flora and fauna deal with Cerkniško jezero, Blejsko jezero and Bohinjsko jezero, the oxbow lakes in the Mura river floodplain, Ljubljansko barje and the mountain lakes in the Triglav National Park.

Degree of research on flora and fauna. A number of works deal with the distribution of one or two taxonomic groups and their occurrence in a certain region. The least researched habitats are puddles, intermittent lakes and headwaters of streams. Little is known about the endemic species and their distribution. The DOPPS - BirdLife Slovenia has been monitoring the waterbirds on all wetlands which are important birds habitats.

SPECIES

GENERAL CHARACTERISTICS

According to the data compiled, the diversity of species in Slovenia is extremely high, despite the smallness of its territory. Only a small proportion of the species which are believed to live in Slovenia has so far been identified. Approximately 22,000 species have been recorded. The estimated number is between 50,000 and 120,000, which reflects the outstandingly rich biodiversity for such a small area.

Group Scientific Name	Number of Taxa World	 Slovenia	 Slovenian Sea
Bacteria + Archebacteria	3000		
Cyanobacteria	1000		
"Phycobionta"	26.000		
"Mycota"	72.000	5.000	
"Lichenes"	13.500	860	
Bryophyta	10.000	790	
Pteridophyta	19.000	71	
Spermatophyta	280.000	3195[8]	
"Protozoa"			
Porifera	10.000	4	109[1]
Placozoa	1	-	1
Cnidaria	9400	5	84[1]
Ctenophora	100	-	5
Kamptozoa	150	0	5
Plathelminthes	20.000	295	50?
Nemathelminthes	28.900	1500?	12[1]
Gnathostomata	80	-	x
Nemertina	900	1	2[1]
Mollusca	70.000	341[3]	528[1]
Sipunculida	150	-	4[1]
Annelida	15.000	155	256[1]
Tardigrada	750	40	x
Arachnida	75.000	1000	x
Pantopoda	(with Arach.)	0	6
Crustacea	40.000	372[4]	420[1]
Myriapoda	(with Ins.)	250	-
Insecta	950.000	17.000	x
Phoronidea	14	-	1
Bryozoa	4000	6	36[1]
Brachiopoda	350	-	1?
Echinodermata	7000	0	42[1]
Chaetognatha	70	0	7[1]
Enteropneusta	90	-	1?
Tunicata	1400	0	57[1]
Acrania	23	-	1?
Cyclostomata	75	3	1[1]
Pisces (sldk.)	21650 (freshwater)	85	188[1]
Amphibia	4015	23[5]	-
Reptilia	5955	21	3[2] (1)[1]
Aves	9090	233 (gn)[6]	-
Mammalia	4215	83[7]	6[1]

Table 16: *The estimated data on diversity of flora and fauna in the world (according to UNEP-WCMC, 2000) and the data for Slovenia (according to Mršić, 1997; and corrected by Sket, 1997; supplemented by expertise in the framework of the Red Data List revision).*

Data given by authors for the Red Data List of 2000

[1] Lipej Lovrenc (Analysis of the status of biodiversity of marine animals)

[2] Tome Saša (Analysis of the status of biodiversity of reptiles)

[3] Velkavrh France (Analysis of the status of biodiversity of terrestrial and freshwater molluscs)

[4] Brancelj Anton (Status of biodiversity of freshwater entomostracans) and Sket Boris (Analysis of the status of biodiversity of freshwater malacostracans)

[5] Poboljšaj Katja (Analysis of the status of biodiversity of amphibians)

[6] DOPPS (Red Data List of nesting birds of Slovenia)

[7] Kryštufek Boris (Analysis of the status of biodiversity of mammals)

[8] including marine taxa

THREATENED SPECIES

It is considered that taxa are threatened if their abundance decreases and their extinction is possible. The degree of threat is defined according to the World Conservation Union (IUCN) categories. In 1972 the first standardised system was presented. In the 1988-92 period the system was used in the preparation of the Red Data Lists of threatened plant and animal species in Slovenia. In 1994, the IUCN adopted the enhanced system to assess the threats to plant and animal species. The criteria are elaborated, they leave less room for subjective assessments, and they also take

Ex (Extinct). Taxa which are no longer known to exist in the wild after repeated searches of their type localities and other known or likely places.
Ex? (Presumably Extinct). The category denotes that it is virtually certain that the taxa has recently become extinct.
E (Endangered). Taxa in danger of extinction and whose survival is unlikely if the causal factors continue operating.
V (Vulnerable). Includes taxa of which most or all the populations are decreasing because of over-exploitation, extensive destruction of habitat or other environmental disturbance (e.g. '*mrazišča*', marches, thermal springs, peat bogs).
R (Rare). Taxa with small world populations that are not at present Endangered or Vulnerable, but are at risk. These taxa are usually localised within restricted geographical areas or habitats or are thinly scattered over a more extensive range.
nt (not threatened). Taxa which do not qualify for Conservation Dependent, but which are close to qualifying for Vulnerable. These taxa do not belong on Red Data Lists, but they are listed due to special characteristics (e.g. endemism). In these cases their state is monitored.
K (Insufficiently Known). Taxa that are suspected but not definitely known to belong to any of the above categories, because of lack of information. In this category belong e.g. problematic taxa or those mentioned only in old literature and without confirmed data.
I (Indeterminate). Taxa known to be Endangered, Vulnerable or Rare, but there is not enough information to say which of the three categories is appropriate.
O (Out of danger). Taxa formerly included in one of the above categories, but which are now considered relatively secure because effective conservation measures have been taken, or the previous threat to their survival has been removed.

Table 17: *Threatened plant and animal species in Slovenia according to the IUCN categories (Basic data: Vidic, 1992, Wraber & Skoberne, 1989; data given by authors for specific groups have been taken into account)*

SYSTEMATIC GROUP	Number of taxa	Ex	Ex?	E	V	R	O	I	K	Total (Ex, Ex?, E, V, R)	Threatened species (v %)
Musci	790	1	10	57	100	98				266	33
Pterydophyta	71	2		1	3	9				15	21
Spermatophyta	3195	27	16	79	251	248			128	621	19
Hydrozoa	9					1				1	11
Mollusca	341[1]		4	9	30	108	7	4	6	151	44
*Lumbricidae**	75[2]				29	12				29	39
Hirudinea	25				4	6				10	40
Entomostraca	169[3]				8	22	5		4	30	18
Malacostraca	203[4]		1	10	18	46		1	32	75	37
Chilopoda	98				10	28			3	38	39
*Diplopoda**	169				33	38				71	42
Araneae	530			2	8	41				51	10
Opiliones	63			12	4	6				22	35
Ephemeroptera	77		4	12	21	16		7		53	69
Odonata	73	1	2	11	17	8		1		39	53
Plecoptera	100	2		6	9	13				30	30
Orthopteroidea	153			21	16	3				40	26
Coleoptera	6000	7	6	77	94	81			7	265	4
Neuropteroidea	104		1		19	3		1	14	23	22
Mecoptera	9			1	1	1				3	33
Hymenoptera	542		25	3	57	246				331	61
Trichoptera	208		1	1	9	36	1	5		47	23
Lepidoptera[5]	3200		1	174	36	10				221	7
Heteroptera	643		1	15	29	77				122	19
Pisces & Cyclostomata	85[6]	2	2	32	9	7				52	61
Amphibia	21	1		3	14	1	3			19	90
Reptilia	24			7	11	2	4			20	83
Aves	233[7]	10	10	58	47	10			12	135	58
Mammalia	83	6		14	15	1	7		2	36	43

* data for indicated invertebrate taxa refer to the Red Lists of 1992;
[1] number of taxa refers to freshwater and terrestrial Mollusca (Velkovrh)
[2] number of taxa refers to family Lumbricidae (Mršić)
[3] number of taxa refers to Entomostraca of inland waters (Brancelj)
[4] number of taxa refers to Malacostraca of inland waters (Sket)
[5] number of taxa refers to Macrolepidoptera (Verovnik - butterflies; Carnelutti et al.- moths)
[6] number of taxa refers to freshwater Pisces & Cyclostomata
[7] number of taxa refers to birds nesting in Slovenia

into consideration the entire population regardless of the political borders in an area. The 1994 categories will be used in the revision of the Lists, but in the overview the 1972 criteria were used for the available data and the recent expertise undertaken.

DEGREE OF RESEARCH

The knowledge about the areas of distribution of plant and animal species in Slovenia is inadequate. The detailed data are available only for vascular plants and mosses. With regard to fauna, the detailed data are available for specific vertebrates. The knowledge about most invertebrates is highly insufficient and the assessments of threats to individual groups are merely approximate figures. It is therefore difficult to enforce the protection regimes for invertebrates, except for specific butterflies and moths, and beetles of interest to collectors. The protection of ecosystems, important for some key species (brown bear, wolf, European lynx) and other selected vertebrates and invertebrates (dragonflies and stoneflies), has not been sufficiently emphasised. The nature reserves, which have been established in the last decade, are either very small or unimportant for the conservation of the viable populations of vertebrates. The concept of conservation of species through the conservation of their ecosystems is even more important for invertebrates than vertebrates.

It is important to conserve the classical or typical sites (*Locus typicus and Locus classicus*), sites where an individual species was described. Such sites are the source of a 'prototype' for the morphological or biochemical comparison with other species. In the case of endemic, in particular cave species, these are simultaneously the only sites where a species is found.

The following data are important for the conservation of plant and animal species and their viable populations:

- taxa catalogues by individual taxa;
- data on the species' distribution area;
- basic biological data;
- population density and trends;
- data on threatened species (at the local, national, European, global levels);
- data on the causes of threats.

INVASIVE SPECIES

In addition to human alteration and fragmentation of natural habitats, the introduction of invasive non-indigenous species is one of the main threats to biodiversity loss all over the world (IUCN/SSC, 2001). The development of transportation has increased human mobility, and tourism and trade are spreading throughout the world providing opportunities for the distribution of plant and animal species to areas where, due to natural constraints, they could not be normally present. Proliferation of invasions could be caused by the abolition of natural barriers between biogeographical regions (for example, in 1869 the Suez Canal joined the Mediterranean and the Red Sea; or the construction of canals between different river basins), as well as incidental (e.g., ballast waters) or intentional introductions for decorative, agricultural (nutrition) or sports purposes.

Introduced species can either die out or establish well in the new environment. According to Jogan (2000: 32) 10% of introduced species colonised well in Europe. Some of those that are established could also spread easily and become invasive. For Slovenia, data are available for plants and freshwater fishes, but it is estimated that similar problems occur for other taxa as well.

The highest proportion of invasive plant species is in ruderal habitats (e.g. along railway lines and streets, in landfills, etc...), clear-cuts and riparian communities of tall herbs where non-indigenous species have entirely out-competed the native ones (e.g., *Impatiens glandulifera, Echynocystis lobata, Fallopia* sp.). Among the woody invasive plants, *Ailanthus altissima* and *Robinia pseudoaccia* spread considerably.

(Photo: Peter Skoberne)

Figure 71. *Fallopia japonica, was introduced to Europe in 1825. Since then it has spread enormously and is a typical example of an invasive non-indigenous species.*

In the last hundred years, 14 non-indigenous fish species have been, intentionally or incidentally, introduced to Slovenia (M. Povž & R. Ocvirk, 1990), mostly from America and Asia. Out of them, seven reproduce successfully. Mosquitofish (*Gambusia affinis*) was introduced in the Primorska region to reduce the number of mosquitoes, while other fishes were mainly introduced to increase the number of angling fishing species. The American trout is spawning wherever it has been introduced and it has spread all over Slovenia. It is successfully invading the native species, brown trout and grayling. Pumpkinseed and largemouth bass are also on the list of invasive species (illegally introduced also into the accumulation lake of Vogerščeк). *Ctenopharyngodon idella* has been successfully introduced into stagnant waters threatening water plants and, in turn, all the vegetation dependent species.

In addition to these introductions, local fishes are threatened by exchanges of fish species between the two neighbouring catchments, the Adriatic and the Danube. Two species, *Chondrostoma genei* and *Chondrostoma soetta*, have become extinct in the Adriatic catchment due to the introduction of nase (*Chondrostoma nasus*) native to the Danube catchment. This species was introduced into the Soča basin in the 1960s (M. Povž, 2001).

PRESENTATION BY TAXONOMIC GROUPS

Micro-organisms

Micro-organisms are prokaryotes (bacteria and archaea), eucaryotes (certain fungi, including those which form lichens, slime moulds and yeasts, algae and protozoans) and viruses. They are an essential component of biodiversity but are often neglected. Without micro-organisms the ecosystems could not be maintained and the survival of macro-organisms would be impossible.

Micro-organisms occupy important ecosystem niches and contribute to the formation of biomass (80 % of the sea biomass are plankton algae), recycling of elements in nature, formation of soil, maintenance of climate balance and balance of atmospheric gasses. Bacteria, fungi and protozoans in the intestines of insects and herbivorous animals play an important role in the processing of cellulose and lignin. Most of the vascular plants form mycorrhizal associations with fungi. Micro-organisms have always played an important role in the traditional and modern biotechnology, but with the development of the genetic engineering their importance has even increased.

Until now, approximately 159,000 micro-organism species (3 % of the expected number) have been identified. The scientists believe there are between 5 and 6 million micro-organism species in the world. The data for Slovenia are not available, the taxonomic basis has not been developed, and only a few modern monographies, keys and similar instruments for the identification of microbes have been published. Taking action at the national and international levels is of primary importance.

Slovenia's distinctive feature is its rich diversity of habitats, not only of habitats with numerous plant and animal species but also of extreme environments important for microbes. The areas and habitats with a high diversity of macro-organisms are at the same time rich in micro-organisms, the host-specific parasites, mutualists, saprobes and symbionts. However, many habitats can not be populated by macro-organisms because of the unfavourable abiotic conditions, yet are still important for the conservation of the diversity of micro-organisms. These habitats are extreme environments, such as:

- areas of extremely low water activity: dryness caused by the lack or surface runoff, high concentrations of salt or ice;
- high concentrations of heavy metals, sulphur and other, mostly toxic, substances;
- extremely low or high pH;
- extremely low or high temperatures;
- anaerobic environments;
- environments with no light (caves).

The only living forms found in such environments are micro-organisms which conserve and stabilise the system.

(Photo: Branka Hlad)

Figure 72. *One of the many mineral springs in the Ščavnica valley nearby Ivanjševci. Mineral springs are considered extreme environments.*

Extreme environments are a rich source of mostly unknown organisms belonging to different groups. Therefore, such environments should also be in the preparation of the international and national plans of protected areas. The examples of extreme habitats in Slovenia are:

- saltpans (microbe crust - 'petola');
- thermal waters, waters rich in sulphate, magnesium and iron ions;
- marshes, peatlands, bogs, intermittent lakes;
- mountain areas above the forest line;
- rocks covered with lichens in all climate zones;
- karst caves and mine shafts.

In Slovenia, the areas rich in micro-organisms are the naturally preserved forests, wetlands, grasslands and mountains. Moreover, the karst areas are populated by many endemic and rare species. It is expected that many new microbe species will be discovered when the mutualism of microbes with other organisms is studied. It should be pointed out that specific karst areas have remained virtually intact and represent ecological niches where microbes have developed in isolation.

The Convention on Biological Diversity, among other topics, deals with micro-organisms. However, its implementation is still partial. The reasons for insufficient coverage of micro-organisms are:

- psychological:
  - people are not familiar with micro-organisms, in particular with the role they play in biological processes;
  - what one can not see may be close to one's mind but not to one's heart;
  - micro-organisms are known to the public mainly as potential pests (pathogens);
  - not much is known about the importance of the diversity of microbes for the economy and for human benefits (traditional and modern biotechnology, ecology);
- scientific:
  - there is no clear evidence of the extinction of microbe species, except for obligate symbionts of plants and animals (extinction of coral reefs caused by the extinction of symbiotic algae species);
  - evolutionary adaptability of microbes is high;
  - the concept of species is rather ill-defined;
- others:
  - ignorance of the problems;
  - insufficient protection of various environments, in particular extreme ones;
  - insufficient financial support for the *ex situ* conservation of micro-organisms;
  - overexploitation of areas which are important for micro-organisms, for tourist purposes or intended 'rehabilitation' of a specific area;
  - extinction of a host affects all its symbionts, saprobes and parasites; the problem is particularly evident for the rare or endemic plant and animal species.

In 2000, none of the areas in Slovenia were protected with the purpose of conserving the diversity of micro-organisms, yet most of the existing protected areas include environments which are important for micro-organisms (for example the Sečovlje saltpans).

Micro-organism habitats have not been studied enough. The only exception are the still functioning saltpans at Sečovlje, where it is of utmost importance to protect the microbe crust 'petola' which covers the bottom of the crystallisation basins. Seven hundred years of constant development have resulted in the diversity of micro-organisms which can only be found in a few saltpans in the world.

(Photo: Branka Hlad)

Figure 73. *Reconstructed saltpans in the museum complex of Sečovlje Salinas. Traditional salt production is based on the 'petola'.*

Viruses

In 1993 it was estimated by the International Committee on Taxonomy of Viruses that around 5,000 species had been identified and that the number of known viruses will grow to 500,000. Unknown viruses are expected to be discovered on the yet unstudied crops and insects, sea plankton and fungi plasmids. Bacteriophages are expected to be found on uncultivable bacteria.

Bacteria

In 1991 approximately 3,000 bacteria species, 4,000 including cyanobacteria, were identified. It is estimated that the final number is around

3 million meaning that only 0.1 % of all bacteria are known to humans. In recent years the understanding of the diversity of bacteria has further developed because of the application of molecular techniques which facilitate the indirect assessment of the species' diversity. It has been established that many uncultivable bacteria exist in different environments: soil, deep-sea sediments, extreme habitats. Many live in mutualistic relationships with other organisms and, with regard to their number, the symbionts with insects and crustaceans are important.

In Slovenia the biodiversity of bacteria is studied on:

- symbiotic bacteria in view of biological conversion of nitrogen in soil;
- bacteria in associations with plants' roots;
- plant bacteria;
- bacteria used in medicine, in particular mycobacteria;
- bacteria mutualism in the intestines of ruminants;
- diversity and importance of symbiotic bacteria in the intestines of crustaceans.

Fungi

It is estimated that there are approximately 1.5 million fungi species in the world (Hawksworth, 1991). Until now, approximately 72,000 species have been identified (55,000 micromycete species and 17,000 macromycete species) (Hawksworth *et al.*, 1995). Of the expected 15,000 species (10,000 micromycetes and 4,000 - 5,000 macromycetes) around 5,000 fungi, including those forming lichens and mycorrhiza, have been identified in Slovenia.

For practical reasons fungi are artificially divided into micromycetes and macromycetes. Micromycetes form basidia which are usually extremely small, microscopic structures directly connected to the growth substrate. Macromycetes form clearly visible fruiting bodies of various shapes, growing out of the substrate (mushroom).

Micromycetes

Some micromycetes are parasites, mutualists, symbionts or saprophytes and thus depend on other organisms for their food supply (plants, animals, other micro-organisms). Because they live in various habitats they also depend on the special characteristics of the environment.

Until now, approximately 2,230 micromycete species have been identified (but not stored and documented properly) in Slovenia. Most data on their abundance is based on the references in the literature, and no samples are available for inspection in herbarium collections. Studies have mostly been focused on the parasitic micromycetes which cause plant diseases. No systematic research on the generally spread micromycetes has been conducted and no relevant data are available. An interdisciplinary research has been conducted for lichenised and lichenicolous fungi, of which 860 species are found in Slovenia (Suppan *et al.*, 2000).

On the basis of the studies concerning the species composition of micromycetes it has been established that there is a constant ratio between the species of higher plants and micromycetes (Hawksworth, 1991). In a moderate climate the ratio is 1 : 3 in favour of micromycetes. According to that estimate, around 10,000 micromycete species could be found in Slovenia. The other estimate (Rossmann, 1994) is based on the analysis of the potential species composition of fungi in an individual ecosystem. It is expected that 10,000 - 50,000 fungi species grow in a specific

Table 17: *Overview of the number of described fungi species in the world and micromycetes in Slovenia (specific fungi species do not belong to the kingdom of fungi but are classified as protozoans and chromists)*

Kingdom	Phyllum*	No. of genera in the world	No. of species in the world	Approximate number of micromycete spec. in Slovenia
PROTOZOA	*Acrasiomycota*	4	12	50
	Dyctiosteliomycota	4	46	
	Myxomycota	74	719	
	Plasmodiophoromycota	16	45	
CHROMISTA	*Hypochytriomycota*	7	24	90
	Labyrinthulomycota	13	42	
	Omycota	95	694	
FUNGI	*Ascomycota*	3,255	32,267	1,300
	Basidiomycota	1,428	22,244	260
	Chytridiomycota	112	793	?
	Zygomycota	173	1,056	?
	Deuteromycota	2,547	14,104	530
Total			72,065	2,230

* Only the phylum *Ascomycota* (sac fungi) in *Basidiomycota* (club fungi) include macromycetes. All other phyla include merely micromycetes. Of all world sac fungi almost half belong to taxa which form lichens. Only 3,000 - 4,000 species are macromycetes. Of club fungi, there are 13,857 macromycetes and 8,198 micromycetes (7,134 species of rust fungi and 1,064 smuts). The data in the table are based on the work of Hawksworth et al., 1995 (world data) and all the available Slovenian sources (data for Slovenia).

homogenous terrestrial ecosystem on a surface area of 50,000 - 100,000 ha. With regard to the high diversity of terrestrial ecosystems the number of fungi species in Slovenia is much higher according to the latter estimate. The comparison of the number of the determined species (2,230) with the probable number of micromycetes (more than 10,000) shows the insufficient knowledge about this group in Slovenia.

Causes of threats to micromycetes - according to the insufficient knowledge about the group, it is assumed that the main causes of threats are:

- changes in the habitat caused by direct physical destruction and alterations;
- extinction or removal of host organism, affecting all symbionts, saprobes and parasites which are attached to (or inside) it.

Macromycetes

A part of club fungi (*Basidiomycota*) and a part of sac fungi (*Ascomycota*) belong to macromycetes (hereinafter referred to as fungi). Fruiting bodies, also referred to as mushrooms, can grow to a considerable size but they are only a reproductive phase in the fungi life cycle. Fungi are microscopic organisms in the form of a vegetatively reproducing mycelia in the ground, as parasites inside their hosts or as symbionts in the rhizosphere.

(Photo: Peter Skoberne)

Figure 74. *Macrolepiota sp. a common fungi species often picked.*

According to the UNEP data there are 22,500 club fungi species (*Basidiomycota*) and 30,000 sac fungi species (*Ascomycota*) in the world. There are only 17,000 macromycetes. It is estimated that 4,000 - 5,000 macromyceta species grow in Slovenia but so far only 2,700 species have been identified (Poler, 1998). With the development of biochemical methods and systematics of fungi the number of identified species will increase.

In comparison with the vascular plants, the number of endemic macromycete species is lower because fungi are cosmopolitan. One of the rare endemic species is *Tricholoma goniospermum* which grows in the Karst.

Fungi are a unique group of organisms characterised by:

- close adaptation to a specific substrate, mycorrhizal partner or host;
- sensitivity to changes in the environment, in particular pollution;
- need for a stable living environment in the long-term, in particular with regard to mycorrhizal fungi;
- specific mycocenosis that develops in long periods (tens and hundreds of years);
- unpredictable formation of fruiting bodies and irregular mushroom seasons.

Due to all these characteristics, the long-term observation periods (10 to 15 years) are needed for the monitoring and identification of fungi.

Assessment of macromycete studies. The initial studies of fungi began early. Fungi were first mentioned in the work by Mattioli (1569). Clusius (1601) discussed them in a written form and added a collection of water-colour paintings of the Pannonian macromyceta (*Codex Clusii*). An extensive work in the field of macromyceta was done by Scopoli. He described more than a hundred fungi species in the first and second publication of his Flora Carniolica (1760, 1772). Others, like Voss (1876-1892), Robič, Plemel and Dolšak were also interested in fungi. Dolšak left an extensive collection. After 1945 only individual works could be found. In the second half of the 1970s the picking of mushrooms for food became popular. Dušan Vrščaj (1990) contributed substantially to the development of mushroom picking and mycology. At that time an important mycological work was done by Stana Hočevar and her colleagues who dealt with fungi in the primeval forests of Slovenia (1975, 1976, 1980, 1985, 1995). In the period from 1960 to 1990, the fungi were studied by the only professional mycologist on the territory of Yugoslavia, Milica Tortić from Zagreb. In the last two decades higher fungi have been studied by Andrej Piltaver, who participates in the main projects in this field. Within the

projects carried out by the Slovenian Forestry Institute, macromycetes are being surveyed in permanent observation plots in forest reserves. The research on micorrhyzal fungi is carried out as part of the project dealing with the rhizosphere. However, it can be concluded that macromycetes have not been studied in detail. It is difficult to taxonomically identify fungi - in addition to the knowledge of taxonomy, the genetic and biochemical methods are also becoming increasingly important. The data on fungi are insufficient, the list of identified fungi is not available, nor are the data on the area of distribution of specific fungi species in Slovenia. Moreover, no national studies at the loss of fungi species are available. The specific taxonomic groups have not been equally studied, and most research has been focused on lignicolous fungi in primeval forests of Slovenia.

Areas important for the conservation of macromycetes

Areas which are particularly important for the conservation of macromycetes are the naturally preserved areas and cultural landscapes, since many fungi species live in these 'semi-natural' habitats which were created by humans.

Forests are the most important habitats of fungi. The diversity of mycorrhizal fungi is the richest in the sustainably and extensively managed forests where litter is occasionally exploited, the cutting residues and dry branches are removed and there is not much undergrowth. Forests which were maintained in such a manner used to be an important part of the cultural landscape. More than one hundred of the fungi species can be found there.

Abundant wood biomass is important for the growth of lignicolous fungi. Their diversity is therefore highest in forests where all wood biomass remains intact. Primeval forests and forest reserves are essential for the survival of such species. The beech forests of Slovenia are examples of the longest uninterrupted periods of natural succession in Europe.

Most **grasslands** are anthropogenic. On the regularly but non-intensively mown dry grasslands with low nitrogen and phosphorus input - which are at least 30 years old and used to be managed constantly for a long time - specific mycocenosis develops. They are unique habitats for species of various genera, for example *Hygrocybe, Entoloma, Dermoloma,* and families *Geoglossaceae* and *Clavariaceae.* These mycocenosis are extremely sensitive to fertilisation. A good example are *Hygrocybe* species. In the current Danish studies, the abundance of *Hygrocybe* species in a certain meadow is used as a direct indicator of the preserved condition of a site. On the basis of the abundance of *Hygrocybe* species, the non-fertilised and well preserved meadows can be considered as biodiversity rich sites of local, regional, national and international importance.

Meadows, riverine meadows, parks and tree-lined roads. The cultural landscape of small sites of open, light forests, riverine woodlands, pastures and meadows is gradually disappearing. These habitats are rich in mycorrhizal fungi. Some species, which are abundant and usual at these sites, are rarely found in thick forests. Lines of old trees along the roads and large parks surrounding mansions, churches, monasteries, graveyards and similar buildings, which have been sustainably managed for decades, are rich in mycoflora. Specific lignicolous fungi species develop a long time before they form their first fruiting bodies, which occur exclusively on old trees, which would already be cut down in a managed forest. Such species are frequently found in parks. An interesting phenomena are lignicolous fungi occurring exclusively on the trees in seeded park gardens and tree-lines, for example *Ganoderma pfeifferi.*

Wetlands. Wet meadows and raised bogs, are rare and threatened habitats in Europe. In the past, the alternation and disappearance of these habitats were the result of the drainage, exploitation of peat and changes in land-use categories for economic land development. Wetlands also changed naturally, through succession. In raised bogs many specific mycocenosis are found and for many species these are the only sites. The same holds true for mineral bogs, which have been drained and cleared for cultivation. They are sites of rich flora and fauna and important habitats of fungi saprobes and parasites. Many species of the order *Leotiales* only live in mineral bogs.

(Photo: Branka Hlad)

Figure 75. *Coprinus comatus, in the meadow next to a tennis court near the Kokra River.*

Other fungi habitats. Fungi grow in various, often extreme, living environments and can therefore be found almost everywhere. In these areas the number of species may not be as high as elsewhere but they are often endemic. Grasslands above the forest line, where specific mycorrhizal fungi occur, should be mentioned. The role of the mycorrhizal partner is played by the dwarf willow (*Salix*) and other dwarf scrub, such as mountain avens (*Dryas*) and Scots broom (*Cystus*).

Threats. In Europe, the problem of the disappearance of fungi became evident in the second half of the 20th century. The process is difficult to assess because it is slow and long-time monitoring is needed. On the other hand, no detailed data from the past studies are available for comparison. The observations carried out in the last 30 years show that the growth of the fruiting bodies of mycorrhizal fungi has reduced. It is estimated that between 10 and 15 % of species face extinction. Among the most threatened are (ecto)mycorrhizal fungi which are extremely sensitive to air pollution. This applies in particular to species which grow on acid soil, poor in minerals. These species are so sensitive that 10-15 kg/ha of annually deposited nitrogen from the air threatens their existence. Lignicolous fungi, which disappear from managed forests, as well as fungi of old, dry and extensively managed meadows and orchards, are also threatened.

An essential condition for the assessment of the threatened fungi is their systematic research at three levels:

- mycofloristic, horologic, ecological and taxonomic field studies, with the purpose of establishing what species live in the researched area, what is their area of distribution, abundance of organisms and the frequency of occurrence of fruiting bodies and the quantity production of fruiting bodies and what are the ecological requirements of specific species with regard to the site and substrate;
- research on permanent observation plots where the impact of human activities on mycoflora is assessed;
- laboratory research for assessing the impact of specific chemical, physical and biotic factors on fungi organisms.

Due to the lack of national data, the status in Slovenia can only be assessed by the comparison of European studies and the results of monitoring in Slovenia. The decline in fungi species in Slovenia and elsewhere in Europe can be compared, although in Slovenia the process is not so obvious and is somehow delayed. The reasons for this delay may lie in the relative stability of ecosystems, which resist the adverse environmental impacts, and in the lower level of pollution than in the west European countries.

The Decree on the protection of wild fungi lists 70 species which are undoubtedly endangered. However, the list is still incomplete because it merely takes into account the larger, noticeable species, which are interesting for mushroom pickers who pick and often destroy them. Conservation measures are not focused on the microscopic, tiny species, which are threatened by the degradation of their habitats, environmental pollution and changes in the management. These species are usually not even noticed and recognised by mushroom pickers but present the larger and more important part of the threatened mycoflora. A Red Data List of threatened fungi should be drawn up, which would facilitate the implementation of the conservation measures in compliance with the current legislation.

Causes of threats

- **Habitat fragmentation** - is every decrease in the surface area of habitats. Changes in the land use result in reduced natural sites when large areas are gradually divided into smaller patches. The increased distances between individual sites hinder the reproduction and spreading of fungi species. The fragmentation of sites into smaller units contributes to the reduction of populations and thus threatens the stability of the entire ecosystem. The problem is particularly evident in respect to heterothallic fungi.
- **Interference with the water regime** - Canalisation of rivers and streams and the drainage of land cause the changes in the water table which affect habitats in the long-term.
- **Changes in traditional farming** - Abandonment of the traditional (extensive) farming directly threatens dry grasslands which are being colonised by scrubs and trees. One of the important reasons for the reduced growth of mycorrhizal fungi is overgrowth where large quantities of biomass are not removed. Due to the introduction of intensive agricultural production (fertilisation, application of biocides, agricultural improvements) the input of the fossil fuel energy in the food production process has increased. The consequences are the waste and pollution which drastically affect the diversity of fungi.
- **Pollution of the environment** - is one of the main causes for the loss of fungi species. Particularly significant is the pollution of air as the result of emissions from transport, industry, energy and the pollution from households. These all have transboundary effects. Soil acidification and the input of

organic nitrogen directly affect the mycorrhizal fungi. They are affected first and the dying out of trees follows. In polluted and dying forests, mycorrhizal fungi are reduced and the number of parasites and saprophytes increases. It is possible to evaluate the degree of forest damage on the basis of the ratio between mycorrhizal fungi and saprophytes.

- **Mushroom picking** can seriously threaten rare and sensitive species. The picking of fungi in the wrong way damages the mycelium and threatens the site. It prevents fungi from concluding their life cycle. Removal of unripe fruiting bodies from the forests prevents ripening and spreading of spores and thus reduces the possibility of potential colonisation of new sites. The threat of excessive picking is increasing because mushrooms are valuable market goods. Intensive picking of mushrooms (spatially limited to the vicinity of large settlements and known mushroom sites) directly damages the sites and results in compaction of soil and damage to ground vegetation. The attempt to educate the pickers and widen the selection of edible species and thus reduce the pressure on boletes (*Boletus* sp.) and chanterelles (*Cantharellus* sp.) has proven a mistake, for it simply led to an increase in the pressure of pickers on other edible species. Complex, intensive and long-term field studies are necessary for the quantitative assessment of the impact of excessive picking on the occurrence of mycorrhizal fungi. The development of mycocenosis in forest is closely linked to the life cycle of individual trees and the entire forest. From the time perspective, these processes exceed the lifetime of one generation. The current short-term studies do not suffice because of the natural fluctuation in the occurrence of fruiting bodies of fungi. These fluctuations can be statistically evaluated by taking into account the results of long-term studies. The time dimension of the development of individual mycocenosis of mycorrhizal fungi is indicated by the studies concerning the possibilities of accelerating the growth of truffles (*Tuber*) in sustainably managed sites. It has been established that the processes are extremely slow and that the first signs of changes can be expected only after ten or twenty years.
- **Introduction of non-indigenous tree species** grown from seeds reduces the diversity of mycorrhizal fungi because such trees are not their hosts. The adaptation of fungi to a new mycorrhizal partner is a long-lasting process and the diversity of such fungi is rather low in forest stands of non-indigenous trees.

(Photo: Marko Simić)

Figure 76. *Clathrus ruber, a rare and endangered species has been legally protected in Slovenia.*

Fungi symbioses (Lichens and mycorrhizae)

Lichens

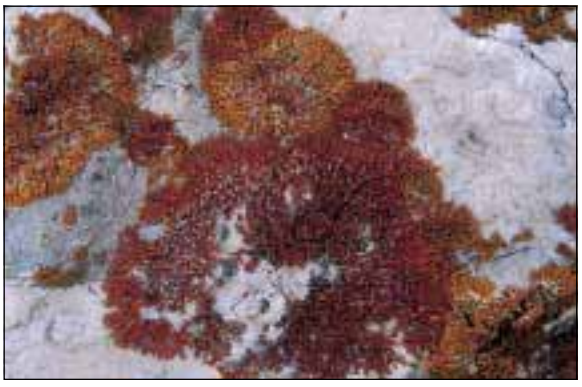
Lichens are an ecological and taxonomic group. They are formed by two or more fungi and algae species which have already been classified. According to Kušan there are 244 lichen species in Slovenia. According to Suppan and his colleagues (2000), 787 species have been identified. The expected number is around 1,200 species. The studies of lichens began in Slovenia rather early. J. A. Scopoli mentioned 64 taxa in his *Flora Carniolica* (vol. 2, 1772). Many others contributed to the knowledge about lichen flora, for example Wulfen (1787-1790, 20 taxa), Biasoletto (1846), Glowacki (1846-1915), Kernstock (1889, 1893), Schuler (1893, 1902), Robič (1876, 1877), and in the 20th century the Czech Servit (1934-1955), who studied lichens in the Julian Alps, and the Swede G. Degelius according to whom some interesting taxa can be found in Slovenia. In 1953 the Croat Kušan published *Prodromus of the Yugoslav flora*. In his work he listed 244 taxa. The research on lichens began again after 1965. In the first two years of studies the number of identified taxa increased by almost 60, mostly within the framework of the mapping of the reserves of primeval forest in Slovenia (Hočevar *et al.*, 1980,

1985, 1995). The interest in lichens awakened when it had been established that they are an important indicator of air pollution. The credit for the research should go to the high school biology professors and the Natural History Society of Slovenia. At the time, the Natural History Society organised a campaign concerning lichens. The students and pupils of primary and high schools, together with their teachers and professors, mapped lichens all over Slovenia, resulting in the first map of lichens in Slovenia (Batič, 1984). Before that, some maps of local distribution of lichens had been published (Skoberne, 1975). However, due to the difficulties concerning the taxonomic identification of lichens, it was mainly the thallus types of lichen which were inventoried (crust, foliose and shrub lichens). The method, supplemented by new discoveries, has since 1985 been used for recording the forest damage (Batič & Kralj, 1989; Batič, 1990; Batič & Mayrhofer 1996; Mavsar *et al.*, 2000). Since no measuring equipment is installed in forests, the epiphytic lichens are used as bioindicators for assessing air pollution in these inventories. Trends in the results of inventories and the comparison of the measured content of sulphur dioxide in the air as well as the total content of sulphur in spruce needles collected at observation plots show that the status of epiphytic lichens reflects the quality of air in the area. Significant progress in the research on lichen flora of Slovenia was achieved by cooperation with the University of Graz, Austria (Karl-Franzens Universität Graz, Institut für Botanik). Within the joint projects of Graz University and the Slovenian Forestry Institute, the intensive research on lichens in Slovenia began, in particular in view of bioindication techniques for assessing the quality of air in the study of forest damage. Participating in the project were biology and forestry students from Slovenia, who studied the lichens of different regions of Slovenia to include the results in their graduation papers, master's and doctor's theses. In the period between 1994 and 1996 a EU Tempus project was carried out which led to regular cooperation between the Universities of Ljubljana and Graz. As a result, a reference lichen collection was compiled (Jurc *et al.*, 1998) at the Slovenian Forestry Institute. It forms a part of the herbarium of Ljubljana University. In 1997, the herbarium comprised 3639 exsiccates of 582 lichen species, including the exsiccates of former periods. As a result of the extensive field mapping of Slovenia's various regions, *Catalogue of Lichens of Slovenia* (Suppan *et al.*; 2000) was published. It is a compilation of all lichens found in Slovenia. The number of identified species included in the Catalogue is substantially higher than in the previous publications. According to these data the lichen flora in Slovenia comprises 860 taxa, 787 of which are lichenised fungi ("true lichens") with 9 subspecies, 22 varieties and 2 forms, and 24 are fungi, traditionally discussed in the literature on lichens.

(Photo: Peter Skoberne)

Figure 77. *Epiphyte lichens are good bioindicators of air pollution.*

In view of the global diversity of lichens with 13,500 (Gilbert, 2000) to 20,000 species (Hawksworth, 1974) the number is relatively low. However, in comparison with the size of the territory and the fact that the flora of Britain and Ireland comprises approximately 1,700 species, the lichens are relatively abundant in Slovenia. The Austrian colleagues believe that more than 1,000 species will be identified when the entire territory is researched. That is certainly possible because only a few studies have been carried out lately concerning epilithic lichens whose diversity is much higher than that of epiphytic lichens. Large sections of Dolenjska and Primorska regions, parts of the Julian Alps and large sections of the Karavanke and the Kamnik and Savinja Alps remain unresearched. The diversity of lichens is therefore relatively high in Slovenia. Nevertheless, it is lower than expected because of the limited patches of acidic bedrock, in particular bare rocks and barren land of mountain taiga and tundra. Such flora is not as well developed in Slovenia as in Austria because of the significantly lower mountains. There are no eumediterranean areas nor any steppe in Slovenia, and the lichen flora reflects such conditions. The attention has lately been focused on the study of epiphytic vegetation. That is why the current knowledge about epilithic and terrestrial lichens is insufficient. Despite the high air pollution the epiphytic lichens are quite abundant, because Slovenian forests are well preserved and the agricultural production is not too intensive.



(Photo: Marko Simić)

Figure 78. *Much has still to be discovered from lichens growing on the solid bedrock.*

Distinctive features of lichens at the national level

Contrary to the higher plants, there are no endemic lichen species in Slovenia because of their cosmopolitan nature. It should be taken into account that extreme sites, such as deserts, steppes, arctic and mountain tundra and taiga, tidal areas and specific bedrock, where most endemic lichen species occur at the global level, can not be found in Slovenia. However, it is possible that endemic species will eventually be identified in Slovenia.

With regard to the biogeographical and ecological conditions, the epyphytic lichens in forests stand out. In this respect two factors should be mentioned: firstly, the relatively well preserved forests contribute to epyphytic and other lichen flora and, secondly, the extreme precipitation which together facilitate the growth of oceanic lichens in the Alps and Snežnik area. The lichen flora in Slovenia is characterised by species found on limestone and dolomite. In Slovenia, the crystalline bedrock, which is rich in lichens, is rarely exposed. The lichen flora in lowlands, in particular of the oak forests, has not yet been studied. Unfortunately, it has been significantly reduced because of the air pollution, deforestation and eutrophication.

Threats to the group. As a group, lichens are mostly threatened by air pollution. In the past, the most problematic were the emissions of sulphur compounds, in particular sulphur dioxide, and, in specific areas, hydrogen fluoride. The consequence is the poor epiphytic lichen flora in large cities (Ljubljana, Celje, Maribor, Kranj, Jesenice), in the vicinity of thermal power plants (Šaleška dolina, Zasavje) and in old industrial centres (Mežiška dolina, Zasavje, Celje, Kidričevo, Idrija). The improved technologies, the closure of non-profitable companies and the rehabilitation of thermal power plants (Šoštanj) substantially reduced the emissions of sulphur compounds into the atmosphere. On the other hand, the emissions from transport and industry (volatile organic compounds, resistant polychlorinated aromatic hydrocarbons) have increased in the last decades. These substances pollute air, soil and water. It should be mentioned that thermal power plants have reduced their emission of sulphur compounds, but not the emissions of nitrogen oxides and other pollutants. Lichens are adversely affected by large amounts of nitrogen compounds and biocide residues from agriculture. Due to the geographic position of the country, the sources of pollution are not merely domestic. The movement of air masses from the west towards the east contributes to the transboundary pollution. Such pollution has been recorded by the mapping in the Snežnik area, Trnovski gozd and upper Posočje, where most of the polluted precipitation deposit and where epiphytic lichens are significantly affected. The same factors cause the destruction of flora, in particular of epiphytic lichens, in the east and north-east of Slovenia.

In addition to air pollution, the lichen vegetation is slightly affected by the changes in the land-use, in particular by chemisation in agriculture. The most critical factors are eutrophication, caused by mineral and natural fertilizes, and the application of biocides. In comparison to the countries with a well developed agricultural sector, the situation in Slovenia is rather favourable. The intensity of production and the chemisation is limited to specific areas (the vicinity of Ljubljana, Kranj and Kamnik, Savinjska dolina, Podravje and Slovenske gorice, Prekmurje and the wine-growing areas).

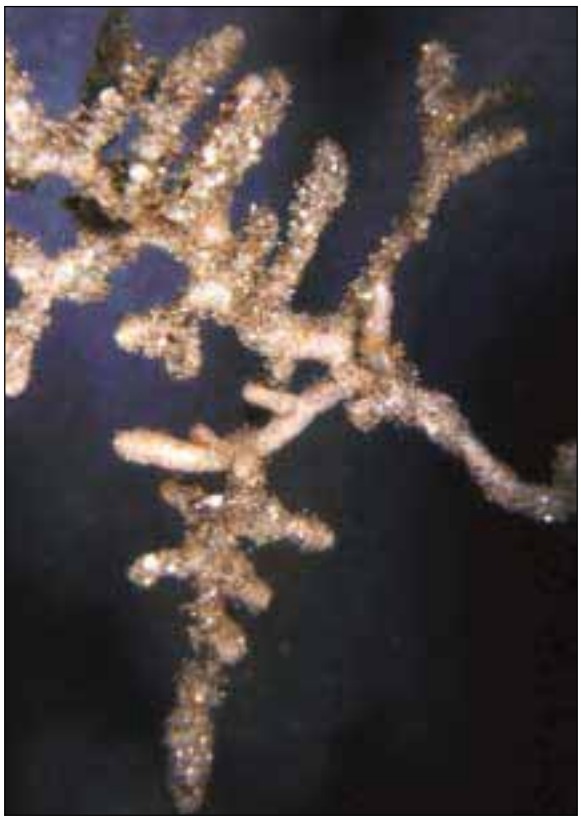
Undoubtedly, the guarantee of high diversity of lichens is the sustainable forestry which has been enforced in Slovenia for decades.

The collecting of lichens for medical and other trade purposes does not present a serious threat, however the eutrophication promotes the spreading of indigenous but more adaptable species. The crust lichen species *Scoliciosporum schlorococcum* is now widely spread even though it was not listed in the past inventories.

The preliminary list of threatened species in Slovenia was compiled according to the categories which are taken into account in the assessment of the threatened lichens in the world (Batič, 1996).

Mycorrhizal fungi

Mycorrhiza, a permanent symbiotic association between plant roots and fungi hyphae, facilitates the normal growth and development of plants. It is of specific importance for their survival in stress conditions. In the forest ecosystems of the north moderate (and boreal) climate, including 56 % of the territory of Slovenia, ectomycorrhiza prevails. Most absorption roots of the prevailing forest tree species are ectomycorrhizal roots. The mycelium of ectomycorrhizal fungi combines various biotic and abiotic components in forest soil and forest ecosystem into an integral unit. The species composition and abundance of mycorrhizal fungi change in various development stages of forests, in different sites and under the impact of various disturbances in the forest ecosystems. The efficiency of the symbiosis depends on the physiology of specific species and populations of all symbionts in the mycorrhizosphere. The structure of associations of mycorrhizal fungi is therefore an important factor in the stability of forest ecosystems.



(Photo: Hojka Kraigher)

Figure 79. Mycorriza, a symbiotic association between plant roots and hyphae of certain fungi, is essential for the growth of vascular plants.

The importance of mycorrhiza for the diversity of other organisms in terrestrial ecosystems is evident from the fact that the diversity of fungi component in the soil is the essential condition for the diversity of flora and, very likely, for the stability of terrestrial ecosystems. This has been confirmed by many studies. It has been established on the basis of the research on the mycorrhizal potential of sites, the impact of disturbances in an ecosystem and the structural distribution of other ecosystem components, such as large wood residues, that the diversity of plants and the productivity of an ecosystem increase with the increased number of fungi symbionts.

Threats. Mycorrhizal fungi are mostly threatened by environmental pollution; the effects of recreational activities, (tourism and picking of forest fruit) on the compaction of forest soil; the excessive picking of mushrooms; the impact of forest machinery during the felling and skidding of wood on the compaction and damaging of forest soil; the effects of agricultural practices, the fertilisation with nitrogen compounds and the pollution caused by discharges from animal farms; the input of nitrogen compounds from these farms into the soil; the solid air deposits and precipitation; the fragmentation of extensive forests; and the changes in the land-use categories of natural terrestrial ecosystems. The introduction of non-indigenous mycorrhizal fungi is not an issue in Slovenia. However, the situation abroad shows that negative impacts on the naturally occurring associations of mycorrhizal fungi can be expected.

The conservation of ectomycorrhizal fungi is closely associated with the conservation of natural forest ecosystems in various development stages, the diverse species and diameter structure of trees, the conservation of various forest management practices and 'protective' forests, forest reserves, eco-cells, etc.

The issues related to endomycorrhizal fungi concern grasslands, agricultural land and forest ecosystems. Cooperation between experts in different fields is needed for their research. Complex studies of associations of sensitive plant species with ericaceous, arbutoid, orchid and monotropoid mycorrhiza are essential for the research on other forms of mycorrhiza.

In Slovenia, the mycorrhiza has been researched since the 1960s. However, the mapping of ectomycorrhizal types, which indicates the diversity of the mycorrhizal fungi component in the forest soil far better than the mapping of mushrooms, was systematically introduced in the studies in the 1990s. The main advantage of the mapping of ectomycorrhiza over the mapping of mushrooms is its reliability, since the development of fruiting bodies is highly irregular and mushrooms are rather hard to find. On the other hand, the identification of the ectomycorrhizal types is a lengthy and demanding process. It is necessary to combine the mapping of mushrooms with the mapping of ectomycorrhiza and the mapping based on molecular ecology.

The uniform method for the identification and classification of ectomycorrhizal types was designed in 1987 when the Colour Atlas of ectomycorrhizal types was first published. The method has been used in Slovenia since 1990. In the 1998 - 2000 period, the experts in Slovenia designed an internationally comparable database on samples of mycorrhizal fungi, by which fast identification of an ectomycorrhizal type up to the species level is possible, even for the anatomically extremely similar groups (Mycological collection and herbarium of the Slovenian Forestry Institute).

Plant species

Plants are algae, mosses, vascular plants. Like animals, they are characterised by the diversity of species as the result of the geographical position, relief and geology of the area. The degree of endemism is lower in algae and mosses, which are highly cosmopolitan, than in seed-bearing plants where 66 taxa of limited range have been identified.

The conservation of the diversity of algae depends mainly on the quality of the water. Mosses are threatened by the changes in their

(Photo: Marko Simić)

Figure 80. *Eryngium alpinum, is rare and endangered, therefore a legally protected species.*

living environment. These changes are the prevailing reason for the threats to vascular plants, which are additionally affected by the commercial exploitation as well.

Until now, no comprehensive overview of algae species and their area of distribution has been done in Slovenia, except for the private database DABA. Algaeology has not been organised within the national scientific institutions. The Red Data List of threatened species has not yet been compiled.

The catalogue of 'true' mosses and the relevant Red Data List, comprising the third of identified species, are available. Liverworts have not been studied in detail, but the causes of threat are similar to those of mosses. Bryology is yet another science which has not been organised within the national research institutions.

More data are available for vascular plants. However, they are dispersed and of unequal quality. The Red Data List of threatened species (1988) indicates one tenth of species found in Slovenia as being endangered. Twenty-seven species became extinct over the last 100 years.

Freshwater algae

Algae is a general term used for a large group of organisms which contain chlorophyll and are capable of photosynthesis. That is why botanists classify them as plants. Indeed, many algae resemble true plants but, on the other hand, there are algae which do not have a lot in common with plants. They are the most diverse group of plant organisms. Some algae have remained at the same developmental stage as their fossil remains from billions of years ago, while others specialised significantly during evolution and are now found all over the world.

The simple structure, fast growth and reproduction as well as the ability to adapt to the most extreme ecological conditions enabled algae to inhabit sites where other organisms could not survive. Algae are found in different ecosystems: on land, in the sea and freshwater, and in extreme ecosystems, such as snow, thermal waters and caves. Some live in symbiosis with other organisms, such as fungi, but also in lichens and with other plants and animals. The overview of the status of algae is focused merely on species found in freshwater ecosystems. Such algae significantly differ in size. Some are microscopic, their size is only one micrometer. Others can grow up to one meter. Photosynthetic pigments enable algae to feed autotrophically. However, among these species some can constantly or occasionally feed on organic substances. Even though the aquatic environment seems more uniform than the terrestrial, the diversity of species in water is much higher. With regard to the actual location in water, algae are divided into two main groups: algae floating in water (phytoplankton), and algae adhering to the bottom (periphyton). Most algae in freshwater habitats are blue-green algae (*Cyanophyta*), green algae (*Chlorophyta*), diatoms (*Bacillariophyta*) and red algae (*Rhodophyta*). Other taxa occur as well, such as golden algae (*Chrysophyta*), yellow-green algae (*Xanthophyta*), cryptomonads (*Cryptophyta*) and fire algae (*Pyrrophyta*) which are mostly found as phytoplankton. Even though these species differ in evolution, genetic traits and chemical character-

Table 19: *Number of freshwater algae species and subspecies identified in Slovenia from 1900 to 2000 (DABA database, 2000).*

Taxonomic group	No. of species (subspecies included)
Cyanophyta	421
Euglenophyta	135
Cryptophyta	8
Dynophyta	29
Chlorophyta	
- *Chlorophyceae*	395
- *Zygnematophyceae*	477
Heterokontophyta	
- *Bacillariophyceae*	279
- *Chrysophyceae*	59
- *Xsantophyceae*	62
Phaeophyceae	1
Rhodophyceae	20
Total	**1,886**

istics, their form is common. The morphological diversity of blue-green algae, green algae and diatoms, with their unicellular, colonial and thread-like structure, is rich.

In view of the ecology and environmental pollution, algae are useful as indicators of the pollution of aquatic ecosystems. The problems concerning the pollution of water occasionally arouse the interest of the public in algae, for example at the time of the algal bloom of lakes (Sedmak & Kosi, 1997) and the Adriatic sea.

Diversity of freshwater algae in Slovenia. The first data on research on algae in Slovenia date back to 1845 when Kützing mentioned Slovenia in his *Phycologia germanica*. A few studies followed, which indicated algae sites in Slovenia. The first systematic research was done by Lazar. In the period from 1937 to 1957, he identified 977 algae species and varieties in more than 1,000 sites. Prior to his studies, only 512 species had been identified in Slovenia. His work, *Algae of Slovenia* was published in 1960. It listed all known freshwater species, their sites and the identification keys, including the relevant illustration material. He concluded his rich and extensive research with Distribution of freshwater algae in Slovenia which was published by the Slovenian Academy of Sciences and Arts in 1975. All algae of Slovenia, identified by him or his predecessors, are listed in that publication. Lazar was followed by Golubić, who studied lithophytic algae in certain regions of Yugoslavia, including Škocjanske jame where 11 blue-green algae species were found. In 1974 Munda supplemented the list of algae in Slovenia by 97 new species of which 82 were diatoms. After 1990 the idea of a systematic overview of algae in Slovenia was revived again. First, the old, already published data were arranged in the data base. It was soon found out that specific geographical areas had not been researched and that some water ecosystems had disappeared. That stimulated the Slovene algologists to supplement the already started work with modern and applicable aspects. By 1998 the gap was filled and some less known geographical regions were researched. It is estimated that there are approximately 26,000 species of freshwater algae in the world (Stevenson, 1996). So far 1886 species, including blue-green algae, have been identified in Slovenia. It is not easy to verify this number because the data relate to water ecosystems which are long gone or have been changed or polluted. However, the number of newly discovered species keeps increasing. The data on algae in Slovenia, which are constantly supplemented, are entered into the DABA data base where different users have access to them.

A comparison of the national data with the UNEP data is not possible because the UNEP lists include freshwater and marine algae.

Threats. In view of the fact that most algae are cosmopolitan, but still associated with specific aquatic ecosystems, they are not considered as a threatened group. Moreover, it is difficult to say that any algae species are threatened.

Due to the insufficient research, the problems concerning threats to individual species seem less acute in comparison to higher plants and animals. When a specific species disappears it is very likely that it will emerge again, but only if a supporting ecosystem is available which facilitates their colonisation and competitiveness.

More problematic are threats to water ecosystems. The loss of specific ecosystems, and the changes within them, cause the quality and quantity changes in algae associations. These changes can be seen in the drainage of marshes, the canalisation of rivers (expansion of urbanised areas, construction), the construction of reservoirs and the pollution of river ecosystems. The canalisation of rivers and streams drastically alters its basic ecological conditions, such as substrate, light and water flow. The pollution of water in watercourses causes the changes in the structure and functioning of the periphyton (Smolar, 1997). Similar are the consequences of intensive tourist and recreational activities (bathing, canyoning, rafting). In most of the indicated cases the diversity of species is lost. Species which easily adapt to the changes in an ecosystem become abundant. An example is the river Sava where the number of species decreases downstream from the headwater area (Zelenci) (Vrhovšek, 1983). If these changes are the result of the canalisation of rivers and streams or the pollution of water bodies, the diversity of an ecosystem may be restored with its revitalisation and reduced pollution. In cases when the changes are permanent, for example the drainage of wetlands, the algae species in this area are lost forever.

A special category of water bodies are lake ecosystems and artificial reservoirs where the changes in the algae associations can be observed in short-term periods. Lake Blejsko jezero is the most studied of such water bodies. More than 200 algae species were found there in different periods. Many of them have already disappeared (Vrhovšek & Kosi, 1981). In artificial reservoirs, the transitions from the diverse pioneer associations of phytoplankton algae after the containment of water to the intensive bloom of specific algae species, usually blue-green algae, are frequent. These phenomena are caused by the anthropogenic, not natural, ageing of lakes. The result is the direct confrontation of algae with humans, in particular when the toxic blue-green algae occur masively (Kosi, 1999).

Threatened species. Only a few countries have compiled a complete Red Data List of freshwater algae (Germany, Lange-Bertalot, 1999). No

data on endemic freshwater algae species are available in Slovenia. It is generally believed that all oligotrophic freshwater systems are threatened because the pollution and canalisation of such water bodies increases the threats to algae. In Slovenia enough data have been collected to facilitate the compilation of the lists of rare and threatened freshwater algae species.

On the basis of the DABA database on algae it would be possible to prepare a list of species which live exclusively in specific areas but it is believed that the list would not reflect the actual status of rare and threatened species due to the insufficient research on such sites.

The knowledge about the extreme freshwater ecosystems will supplement the understanding of the presence of algae and facilitate their reasonable protection. Regular studies will provide an insight into the diversity of algae and facilitate meeting the requirements of the ratified agreements which are stipulated and proposed by the international organisations dealing with biodiversity and threatened species.

Mosses, liveworts and hornworts (bryophyta)

On the basis of the taxonomic approach according to Corley and colleagues (1981), Corley and Crundwell (1991), Düll (1992) and Groll (2000) the Europe flora of mosses comprise in total 1 96 species. Of these, 1235 are 'true' mosses (*Musci*), 453 liverworts (*Marchantiopsida*) and 8 hornworts (*Anthocerotopsida*). In Slovenia 790 species have been found, 632 'true' mosses, 156 liverworts and 2 hornworts (Düll *et al*., 1999).

Slovenia is relatively rich in mosses (51 % of 'true' moss species found in Europe and 33.5 % of liverworts and hornworts).

The research on mosses began relatively early in Slovenia. The first data were provided by Scopoli in the first edition of *Flora Carniolica* (1760). In the second edition (1772), he indicated 75 moss species that were found in the territory of Carniola. Until the 20th century most information on moss flora in Slovenia was provided by foreigners, for example J. Breidler and J. Glowacki. Among the rare Slovene researchers S. Robič (1893) and J. Šafer (herbarium collection) should be mentioned. In the last 50 years, the researchers interested in mosses were S. Grom and A. Martinčič.

Characteristics of bryoflora. Mosses in Slovenia are mainly psychrophilic species found at higher altitudes, such as arctic-orophytic, orophytic and boreal mosses, which represent one fourth of 'true' moss species. Particularly interesting are specific old species, presumably Tertiary, which are limited to the south fringe of the Alps (for example *Anoectangium aestivum, Geheebia gigantea, Scopelophila ligulata, Mielichhoferia mielichhoferioides*). The influence of the Mediterranean moss flora, which is extremely rich and diverse to the south of Slovenia, is minute. From the ecological point of view, the Alpine, grassy or rock moss species, and the species found in raised bogs and fens, are important. A significant group, in particular with regard to the liverworts, comprises the species which grow on rotten tree trunks and stumps.

No ecological analysis has been conducted for liverworts but the characteristics are undoubtedly similar to the 'true' mosses.

In mosses the level of endemism is much lower than in vascular plants. In many macrodisjunct ranges identical moss taxa occur in individual disjunctions even though they are distant and had been separated a long time ago. No endemic *Bryophyte* species have been found in Slovenia. However, more than 10 endemic taxa have been described (in particular by Glowacki, Grom), mostly of the form level. The status of other *Bryophyta*, which had first been described as species or subspecies, is dubious. Only the following taxa, all of the Musci group (Martinčič 1966), should be considered:

- *Bryum intermedium* (Brid.) Bland. subsp. *carniolicum* (Glow.) Podp.
- *Ctenidium molluscum* (Hedw.) Mitt. var. *distinguendum* Glow.
- *Dicranum scoparium* Hedw. var. *hartelii* Glow.
- *Eucladium verticillatum* (Brid.) B. S. & G. subsp. *styriacum* (Glow.) Amann
- *Fissidens crassipes* (Wils.) ex B. & S. var. *rekaënsis* Pilous
- *Orthotrichum cupulatum* Brid. subsp. *tomentosum* (Glow.) Martinčič

No endemic taxa of liverworts have been described.

Threats. A third of all moss species are included in one of the threatened species categories. In comparison to some Central European countries the number is relatively low. The reason lies in the restrictive approach. If new criteria, based on the number of sites, were used, the share of threatened species would increase to 50 %. The assessment of the degree of threat is closely associated with the degradation of moss habitats which disappear because of the natural processes, such as the natural encroachment of vegetation on marshes and grasslands. Mosses are even more threatened by human activities which affect the natural and semi-natural habitats - land reclamation, agricultural improvements, urbanisation, construction of roads and the resulting

(Photo: Peter Skoberne)

degradation of tree species. The threatened "true" mosses, as well as their sites, have been entered in the Red Data List (Martinčič, 1992). However, the liverworts have only been listed by names (Martinčič, 1996).

Degree of research. Even though the territory of Slovenia has not been evenly researched, the available data show that mosses are most diverse in the Alpine and Dinaric regions where the amount of precipitation is the highest. Higher altitudes contribute to the higher moisture content of the air. The impact of the geology is reflected in the increased diversity of mosses in non-carbonate bedrock dominated areas (silicate bedrock in Pohorje, andesite rock in Smrekovec range, areas of porphyritic rock in the valley of the river Kokra). The bedrock has an indirect effect. It alters the temperature and, in particular, moisture regime. In Slovenia, many habitats are still preserved where the conditions for the development of mosses are suitable: raised bogs, fens, marsh grasslands, marsh forests, Alpine regions with bare rocks, snow-covered valleys and grasslands, well preserved forest associations with rotten trunks, primeval forest stands, numerous watercourses, in particular in the headwater area, rocky patches at all altitudes as well as the secondary habitats - cultivated land, old fruit trees, stone walls, fish ponds.

The degree of research on 'true' mosses and liverworts is not equal. Musci species are relatively well known with regard to their number. Only a few new discoveries can be expected during further research. However, the situation is quite different for their area of distribution. Floristically, the territory of Slovenia has not been equally researched. Most data have been collected for the Julian Alps, Kamnik Alps, Pohorje and the Dinaric region. The research on the sub-Alpine regions has been extremely irregular. The data concerning the sub-Mediterranean and the sub-Dinaric area are scarce, but even less data are available on the mosses of the Karavanke and the sub-Pannonian region. The liverworts have not been researched as well as 'true' mosses. It is expected that another 190 to 200 species could be identified. Overall, the knowledge about the distribution of moss species in Slovenia is rather poor. Moreover, many floristic data are over 50 years old.

	Ex	Ex?	E	V	R	Total
'True' mosses	1	10	47	85	74	217
Liveworts & hornworts	0	0	12	15	24	51

Table 20: *Mosses in Slovenia by IUCN categories (Martinčič, 2000).*

Figure 81. *Half of the European species of "true" mosses can be found in Slovenia.*

Ferns and angiosperms and gymnosperms

Approximately 250,000 ferns, angiosperms and gymnosperms are found in the world. The European flora is poorer than the flora of the tropics. Areas of high biodiversity of this group (species' area of distribution centres) are in the Alps and the Mediterranean. In Slovenia, 3,266 taxa of ferns and seed-bearing plants are found (Martinčič *et al.*, 1999), making it a floristically rich European country.

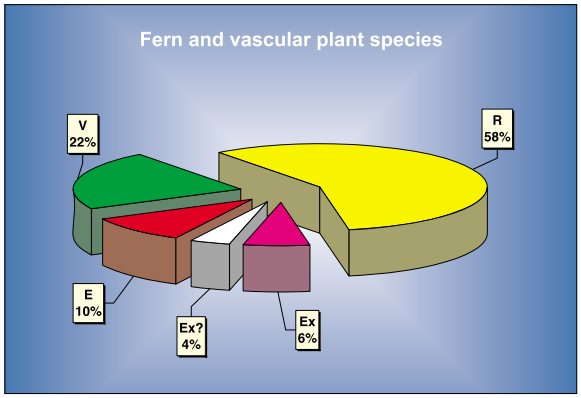
The Slovenian flora is characterised by the Alpine and Central-European floristic elements. Its diversity is emphasised by the Pannonian, Dinaric and Mediterranean species

Threats. Around 19 % of all vascular plants are threatened. In total 636 species were listed in the Red Data List of threatened plants (Wraber & Skoberne, 1989, supplemented in 2001), 29 extinct (Ex), 80 endangered (E), 254 vulnerable (V) and 257 rare (R).

(Photo: Peter Skoberne)

Figure 82. *Matteucia struthiopteris, considered a rare species, yet there are by now a number of known localities.*

In the 19th and 20th centuries, the main cause of threats to plant species was the excessive picking of attractive specimens, often with commercial interest. Edelweiss (*Leontopodium alpinum*) was protected as early as in 1896 in the Gorica region. In the second half of the 20th century, the main causes of threats to plants were the changes in their living environment. Extensive canalisation of rivers and streams, in association with agricultural improvements, significantly affected the marsh vegetation, in particular in Vipavska dolina (Vipava Valley) and the north-east of Slovenia. The number of sites of leper lily (*Fritil-*



Graph 4: *Threatened fern and vascular plant species by IUCN categories (Wraber & Skoberne, 1989 - supplemented 2001).*

laria meleagris) in the vicinity of Trzin and Pesnica and along the river Ledava, as well as swamp gladiolus (*Gladiolus palustris*) in Vipavska dolina, dropped significantly.

Grasslands are no longer cultivated and are being colonised by scrubs and trees. That threatens heliophilous species, such as yellow gentian (*Gentiana lutea*), Koch's gentian (*Gentiana kochiana*) and orchids of dry grasslands. The flora of karst grasslands is also endangered (for example, *Paeonia officinalis, P. mascula, Fritillaria tenella*). The intensification of agricultural production (mainly fertilisation) substantially reduces the number of species. Some turf species keep disappearing, for example Clusius' gentian (*Gentiana clusii*), orchids and globeflower (*Trollius europaeus*).

A few species have died out due to the changes in their habitats: pillwort (*Pilularia globulifera*) - the canalisation of the stream Lijak; dwarf birch (*Betula nana*) in Velo polje - the destruction of the peatland; sea holly (*Eryngium maritimum*) - the destruction of the sandy sea shores.

A few local populations have been destroyed, in particular the species found in fens (construction of a small industrial zone near Bled in helocrene springs), for example the isolated inland populations of maidenhair fern (*Adiantum capillus veneris*) in the thermal spring in Pirniče.

Figure 83. *Anemone hortensis, a thermophyte inhabiting warm localities on limestone bedrock, for example at Stena in the Dragonja valley.*

(Photo: Marko Simić)

Figure 84. *Pulsatilla grandis, is an endangered species of steppe vegetation. In Slovenia it has only two localities.*

Causes of threats are:

- changes in the habitat (changes in the water regime and soil chemistry, urbanisation);
- commercial exploitation (herbs);
- direct destruction (picking).

Special attention and responsibility should be devoted to the conservation of endemic taxa. In total 66 ferns and seed-bearing endemic plants can be found in Slovenia (Table 15 - Wraber, 1996), 22 of which grow mostly in Slovenia.

(Photo: Marko Simić)

The research on the Slovenian flora reaches back to the 16th century (Mathioli, Clusius). The important milestone was the publication of *Flora Carniolica* (1760 and 1772) by J. A. Scopoli. He was followed by a number of botanists who accumulated a lot of data in their written work and herbariums (F. K. Wulfen, B. Hacquet, F. Hladnik, K. Zois, M. Tommasini, Ž. Graf, H. Freyer, A. Fleischmann, O. Sendtner, V. Plemel, F. Krašan, A. Paulin). The first identification key by A. Piskernik was published in 1941. After the Second World War, E. Mayer published *List of flowering plants and ferns of the Slovenian territory* (Seznam cvetnic in praprotnic slovenskega ozemlja). In 1969, *Flora of Slovenia* (1999), *Register of Slovenia's flora* (Trpin & Vreš, 1995) and *Materials for the Atlas of Flora of Slovenia* (N. Jogan, 2001) were published.

In addition to the herbarium collections compiled by institutions and individuals, the two central collections are kept at the Ljubljana University Herbarium (LJU) and the Herbarium of the Slovenian Natural History Museum (PMS). Another collection is kept at the Ljubljana Botanical Garden which has been operating since 1810.

Despite the long tradition of research, it has been established that the field regressed in the last decade. The funds available for the principal activities of the institutions are not equal to funds in other fields, and the status of the herbariums and the botanical garden has not been evaluated and formalised. The data on flora are kept at various institutions. They are not connected and are thus not easily available.

Scientific name
Aconitum angustifolium
Aconitum tauricum subsp. *hayekianum*
Alchemilla carniolica
Alchemilla gracillima
Alchemilla illyrica
Alchemilla pseudoexigua
Allium kermesinum
Alyssum montanum subsp. *pluscanescens*
Athamanta turbith
Campanula justiniana
Campanula marchesettii subsp. marchesettii
Campanula x vrtacensis
Campanula zoysii
Centaurea haynaldii subsp. *julica*
Cantaurea x vossii
Cerastium julicum
Cerastium subtriflorum
Festuca calva
Festuca laxa
Gentiana froelichi
Festuca spectabilis subsp. *carniolica*
Gentiana x komnensis
Gentianella liburnica
Gentianella pilosa
Helictotrichon petzense
Heracleum austriacum subsp. *siifolium*
Hieracium crucimontis
Hieracium dragicola
Hieracium leiocephalum
Hieracium pseudoboreale
Hieracium sanctoides
Hladnikia pastinacifolia
Iris acuta (I. erirrhiza)
Iris cengialti f. vochinensis
Knautia fleischmannii
Leontodon berinii
Leontodon brumatii
Leucanthemum lithopolitanicum
Medicago pironae
Moehringia tommasinii
Moehringija villosa
Nigritella lithopolitanica
Papaver alpinum subsp. *ernesti-mayeri*
Papaver alpinum subsp. *victoris*
Pastinaca sativa var. fleischmannii
Pedicularis elongata subsp. *julica*
Potentilla micrantha subsp. *carniolica*
Primula carniolica
Primula x serratifolia
Primula x venusta
Ranunculus aesontinus
Ranunculus pospichalii
Ranunculus thora f. pseudoscutatus
Ranunculus traunfellneri
Ranunculus wraberi
Rubus trifoliatus
Satureja x karstiana
Saxifraga exarata subsp. *atropurpurea*
Saxifraga exarata subsp. *carniolica*
Saxifraga hohenwartii
Saxifraga paradoxa
Saxifraga tenella
Scabiosa cinerea subsp. *hladnikiana*
Scopolia carniolica subsp. *hladnikiana*
Sempervivum juvanii
Silene veselskyi subsp. *glutinosa*
Silene veselsky subsp. *widderi*

Table 21: *Endemic angiosperms and gymnosperms in Slovenia (Wraber, 1996).F*

(Photo: Marko Simić)

Figure 85. *Primula carniolica, is one of the most popular protected endemic species in Slovenia.*

Animal species

General characteristics. With regard to biodiversity, the status of animal species is relatively favourable. The level of endemism is fairly high, in particular of the subterranean fauna. However, the populations of many species are in decline. Only the populations of a few species are increasing. It is suspected, that the general status of specific groups, as well as areas, has deteriorated (subterranean species, impact of transport and pollution, night lighting, etc.). Human activities and the presence of humans in nature cause increasing disturbances in ecosystems.

The taxa of subterranean organisms are extremely important for biodiversity and must therefore be protected. As an example, 170 taxa found in interstitial systems (groundwater) and underground waters should be mentioned. They place Slovenia among the richest areas in the world with regard to the subterranean animals (Sket, 1995). Many of these species are endemic and some are found only in restricted sites (stenoendemic species). Olm (*Proteus anguinus*) was discovered in Slovenia and is the endemic species of the Dinaric karst region (from Doberdob in Italy to Montenegro). An example of the stenoendemic species is *Jugogammarus kusceri*.

Threats. The basic cause of threats to animal species is the degradation of habitats and ecosystems. The threats are posed by pollution, urbanisation and alterations in land-use. They include:

- activities (infrastructure, buildings) affecting the natural environment and sensitive ecosystems (wetlands, waters, caves, etc.);
- insufficient knowledge about the areas of distribution of threatened species and their habitats;
- abandonment of the economic exploitation of land which maintained the secondary biodiversity (mowing of dry grasslands, grazing, meadow orchards);
- intensification of agriculture (drainage, fertilisation, etc.);
- hunting and fishing of specific threatened species;
- collecting;
- insufficient knowledge, and ignorance about the factors which affect animals and the degree of their endangerment;
- lack of information available to the decision-makers, insufficient education on the conservation of animals and habitats;
- lack of systemic and financial support for the *ex situ* and *in situ* conservation.

Figure 86 (above). *Proteus anguinus, an endemic species of the Dinaric karst, is the biggest subterranean vertebrate species and a symbol of Slovenian natural history.*

Figure 87 (below). *Euscorpius sp., data are lacking on the status of endangered scorpion species.*

(Photo: Peter Skoberne)

(Photo: Marko Simić)

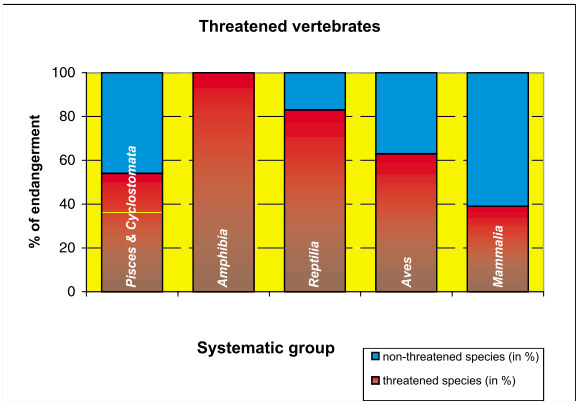
The general degree of research is irregular. The basic biological data concerning numerous species are dispersed in scientific literature.

Degree of taxonomic research. The list of vertebrates of Slovenia is nearly complete (B. Kryštufek & Janžekovič, 1999). It is not expected that many new, non-confirmed species will be found, except marine vertebrates. Main gaps in the taxonomic data concern amphibians (complexes of *Rana esculenta*, *Hyla arborea/italica* and *Bombina bombina/variegata*) and reptiles (complex of *Lacerta viridis*).

As a result of the neglected taxonomic research on one hand, and the diversity of species on the other, the situation is worse for invertebrates. Except for some groups, the data were collected unsystematically. Taxa lists (mostly published in the catalogues of the flora of Yugoslavia) were compiled for the terrestrial and freshwater molluscs (Bole, 1969), aquatic worms (Kerovec & N. Mršić, 1981, N. Mršić, 1991), isopod crustaceans (B. Sket, 1964), amphipods (Karaman, 1974), pseudoscorpions (Ćurčić, 1974), daddy-longlegs (J. Hadži, 1973), spiders (Nikolić & Polenec, 1981) and myriapods (Strasser, 1971). Catalogues of insects include springtails (Bogoević, 1968), grasshoppers, crickets and katydids (Us, 1968), dragonflies and damselflies (M. Kotarac, 1997), scorpion flies (B. Devetak, 1988), stoneflies (Sivec, 1980), true bugs (M. Gogala & A. Gogala, 1986, 1989), butterflies and moths (J. Carnelutti, 1992) and bees (A. Gogala, 1999). With regard to beetles, the catalogues were compiled for carabids (B. Drovenik & Peks, 1994), cave *Calosoma* (Pretner, 1968), ground *Calosoma* (Nonveiller *et al.*, 1999), longhorn beetles (Althof & Danilevsky, 1997) and hydrocanthares (Gueorguiev 1971).

Biology and ecology of species and populations. The marine meiofauna and benthic invertebrate fauna, including their ecology, are inventoried and researched at the Marine Biology Station in Piran (Avčin & Vrišer, 1983, and Vrišer, 1989). Biological data were compiled for mammals (B. Kryštufek, 1991), birds (J. Gregori & Krečič, 1979, Božič, 1983, A. Sovinc, 1994, I. Geister, 1995), reptiles (N. Mršić, 1997), freshwater bony fish and hagfish (M. Povž & B. Sket, 1990), grasshoppers, crickets and katydids (Us, 1992), dragonflies and damselflies (M. Kotarac, 1997) and threatened butterflies (T. Čelik & F. Rebeušek, 1996).

Degree of research on distribution. The maps on species area of distribution (point data or data according to the UTM system) are available



Graph 5: Threatened vertebrates in Slovenia according to the IUCN categories (Vidic, 1992).

for mammals (B. Kryštufek, 1991), birds (A. Sovinc, 1994, I. Geister, 1995), reptiles (S. Tome, 1996), dragonflies and damselflies (M. Kotarac, 1997) and threatened butterfly species (Čelik & F. Rebeušek, 1996). Distribution maps of specific species or lower taxonomic groups have been published.

Threatened species. The national Red Data List of threatened animal species had been compiled (J. Vidic, 1992) and was later on updated in the Overview of the status and perspectives in nature (J. Gregori *et al.*, 1996). Specific Red Data Lists were drawn up for dragonflies and damselflies (M. Kotarac, 1997) and birds (Bračko *et al.*, 1994). Detailed analyses were conducted on birds (I. Geister, 1998) as well as butterflies and moths (Čelik & F. Rebeušek,1996).

Of 635 vertebrates, identified in Slovenia (Vidic, 1992), 238 are threatened (Ex - 19, E - 56, V - 116, R - 47) (Graph 5). The most threatened taxa are amphibians. The data on invertebrates are incomplete and limited to specific taxa.

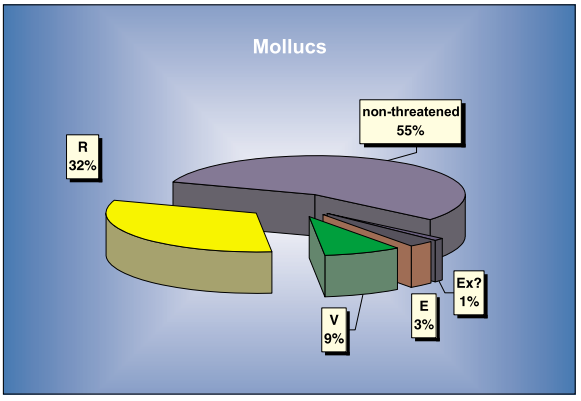
Groups of vertebrates	No of species
freshwater fishes and lampreys	85
marine fishes	188
amphibians	22
reptiles	24
birds	233
mammals	83

Table 22: Number of vertebrate species by taxa in Slovenia.

Overview by taxonomic groups. In detail, those groups are presented for which the data are available and which are studied by at least one expert. The overview starts with invertebrates, followed by vertebrates. A special group are subterranean freshwater species which are a characteristic of the Slovenian karst regions and for which special conservation measures should be established.

Molluscs - terrestrial and freshawater (*Mollusca*)

Basic characteristics and number of species. Molluscs are a large animal taxa with almost 70,000 species recognised world-wide. The representatives of 6 classes live in the sea. The land and freshwaters were inhabited only by snails and slugs (*Gastropoda*) and bivalves (*Bivalvia*). More than 20,000 species are terrestrial. They belong to two subclasses, prosobranchs (*Prosobranchia*) and pulmonates (*Pulmonata*). On the surface, both groups live in water and on land. The subterranean *Prosobranchia* species almost exclusively inhabited waters, and the subterranean *Pulmonata* species the land. Most slugs and snails are herbivorous, some are omnivorous. Among them, predators and cannibals can be found. Subterranean species feed on microscopic organisms and organic material mixed with clay. Most are hermaphrodites, some species are unisexual and some reproduce by parthenogenesis. In inland Slovenia, the bivalves of the subclass *Heterodonta* include 3 families. Most are undemanding and well adapted to their environment and can be found in various aquatic habitats.



Graph 6: Threatened molluscs in Slovenia according to the IUCN categories.

Degree of reasearch. In Slovenia 323 slug and snail species and 18 bivalve species have been identified. With regard to the size of the territory, Slovenia is probably among the richest regions in the world, because one sixtieth of all terrestrial slugs and snails and bivalves are found here. In total, 62 aquatic prosobranchs of the family *Hydrobiidae*, of which 44 are endemic species, can be found in Slovenia. Of 38 subterranean prosobranchs found, 28 are endemic. A member of the family *Carychiidae* is *Zospeum spelaeum* which was found in Postojnska jama in the first half of the 19th century. It is the first identified cave snail in the world. The most frequent bivalve genus of the family *Spheridae* is pea mussel (*Pisidium*) with eight species. The family *Unionidae* is represented by 4 genera and the family *Dreissenidae* by 2 genera with one species each.

Endemic species. There are 12 species of snails of *Zospeum* genus in Slovenia. Of these, 10 are endemic. All 12 species represent more than a half of all world species of this genus which is distributed from the Pyrenees to Montenegro.

(Photo: Matjaž Bedjanič)

Figure 88. *Helix pomatia, the Roman snail is appreciated as a culinary speciality. It used to be massively gathered. The species is protected in Slovenia, meaning that only farm-bred snails are allowed to be sold.*

Slovenia is the genus's range centre and here the level of differentiation is highest. The endemic species are also *Kerkia kusceri* and *Hadziella krkae*.

Molluscs are threatened by:

- decline in the diversity of surface standing water and number of river sources;
- changes in the water regime;
- introduction of non-indigenous species.

Leeches (*Hirudinea*)

Basic characteristics and number of species. Leeches mainly inhabit freshwaters. Some species are inland and some marine. Most of them live in eutrophic standing and slow, running water. More than a half of them are predators and some are parasites - they live on aquatic water snails, fish and endothermal vertebrates. Medicinal leeches (*Hirudo medicinalis*) are occasionally used for medical and pharmaceutical purposes.

(Photo: Matjaž Bedjanič)

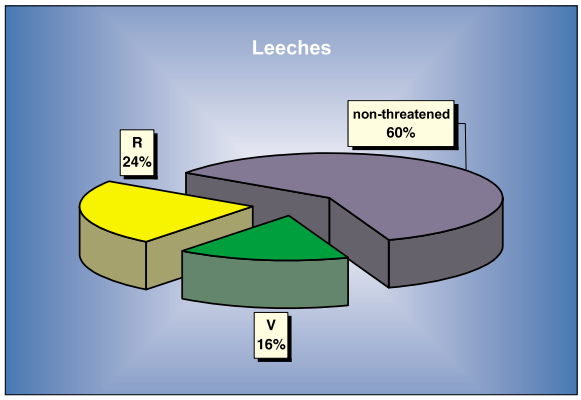
Figure 89. *Haemopis sanguisuga, is still common in Slovenia and can be found in ponds, puddles and canals. The Horse Leech is not a blood-sucker but feeds on carcasses, unlike the endangered species, Hirudo medicinalis, for which it is often mistaken.*

Degree of research. In Slovenia, around 25 leech species have been identified. One of them is a marine species, two are inland and others live in freshwaters. The number of species is similar to that in the neighbouring countries since the areas of distribution of the Central European species are rather extensive. The mentioned number represents more than 25 % of all European leeches (90 species). Leeches in Slovenia are relatively well studied. However, it can be expected that the current molecular research will help solve some of the taxonomic classification problems.

Endemic species. The endemic species, whose area of distribution extends from the south of Slovenia to the Croatian Istria and Italian Karst, is *Dina krasensis*.

Threats. The two main causes of the threats are:

- destruction of eutrophic puddles and similar habitats;
- water pollution.



Graph 7 (left): *Threatened leeches in Slovenia according to the IUCN categories.*

Spiders (*Araneae*)

Basic characteristics and number of species. Spiders are a numerous animal taxa. Most species are predators feeding on a wide range of prey. Their diversity mostly depends on the diversity of habitats. Spiders inhabit various terrestrial habitats, from karst cave rockwalls, underground passages, leaf litter, all sorts of vegetation, rocks, screes and even glaciers. More than

(Photo: Peter Skoberne)

Figure 90. *Karst meadows are rich in thermophilic species, including spiders.*

40,000 spider species have been identified. Not many of them inhabit caves and other subterranean habitats, which indicates that such habitats are not suitable for them. In the humid, entrance parts of caves mostly troglodytic species are found. These species are rather generally distributed. Subterranean spiders are found all over the Slovenian karst regions. They are mostly true troglobionts and their area of distribution is therefore rather limited. A number of species are micro-cavernicolous which means they do not live in real caves but in pits and tunnels made by small mammals and in rocky rubble.

Degree of research. The first cavernicolous spider *Stalita taenaria* was discovered and described in Postojnska jama. The Slovenian spider fauna is not well researched. Until now, 530 species (29 subterranean) have been identified but the experts believe that over 800 species could be found in Slovenia. The east of the country is inhabited by poor forest communities of spiders, mainly of the Central European species. However, in the south-west, much richer forest communities of Mediterranean, Central European and Dinaric species can be found. The typical Mediterranean elements stretch from the coast over the Karst escarpment to the slopes of Nanos mountain and Vipavska dolina. Among the important Dinaric species, those of the genera *Stalita, Mesostalita, Parastalita* in *Troglohyphantes* should be mentioned.

Endemic species. Most endemic species have been identified in the Alpine region because the area was researched in greater detail. Other endemic species can be found in karst caves and high karst regions. The areas of distribution of all troglobionts are rather limited and therefore these are endemic species. A few species, some of them exclusively, live in karst areas which border on Croatia, Italy and Austria.

Threats. The main causes of threats to spiders are:

- anthropogenic changes of landscape, in particular agriculture;
- drainage of standing water;
- direct destruction and tourist exploitation of caves;
- pollution of caves.

Endemic species	Locality
Zelotes oblongus (C.L. Koch)	Kubed, Divača
Zodarion scutatum Wunderlich	Slavnik
Zodarion italicum (Canestrini)	Kubed
Troglohyphantes diabolicus Deeleman	Dobrovlje
Troglohyphantes confusus Kratochvil	Ivanje selo (Pivka), Žirovski Vrh
Troglohyphantes helsdingeni Deeleman	Menina planina
Troglohyphantes poleneci Wiehle	Mala Hrastnica, Osovnik, Preska, Šmarna gora
Troglohyphantes thaleri Miller & Polenec	Slovenske gorice, Goričko, Raduha
Troglohyphantes vicinus Miller & Polenec	Ratitovec, Češnjica
Troglohyphantes wiehlei Miller & Polenec	Storžič, Golnik, Logarska dolina, Križna gora
Troglohyphantes trispinosus Miller & Polenec	Pasja ravan, Dravh, Jelovica

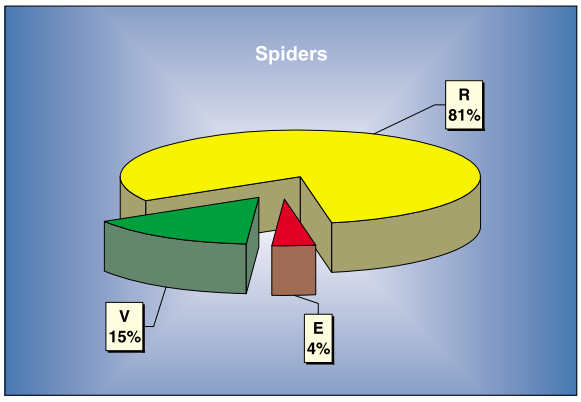
Table 23: *Endemic species of Araneae in Slovenia and their localities (Polenec, 1992).*

Daddy-longlegs (*Opiliones*)

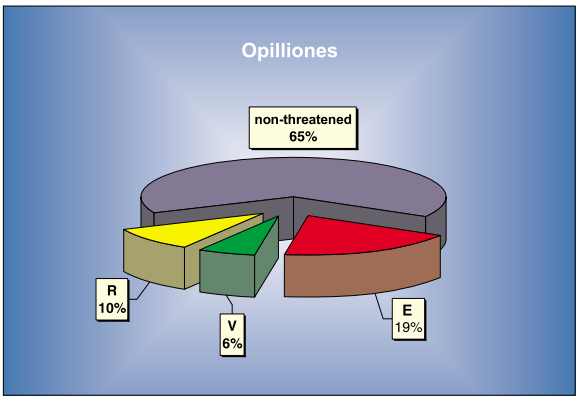
Basic characteristics and number of species. With regard to the number of species, daddy-longlegs (*Opiliones*) are considered a smaller group of arachnids (*Arachnida*). Around 5,000 species have been identified around the world. They can be found from the tropical areas to the sub-Arctic regions. Approximately 300 species live in Europe. Daddy-longlegs live in terrestrial ecosystems and habitats, on and in the soil. Some can even be found underground.

Degree of research. Until now, 63 *Opiliones* species have been identified in Slovenia. The maximum potential number is expected to be 68. Slovenia is believed to be one of the evolution centres of the genus *Trogulus* with 8 identified species.

Endemic species. None of the *Opiliones* have been found only in Slovenia, although two species are endemic to the Julian Alps (*Ischyropsalis*



Graph 8 (left): *Threatened spiders in Slovenia according to the IUCN categories.*



Graph 9 (right): *Threatened* Opiliones *species in Slovenia according to the IUCN categories.*

muellneri) and the Kamnik and Savinja Alps and East Karavanke (*Ischyropsalis hadzii*).

Threats. The main causes of threats are:

- degradation of forest soil - clearcuts, removal of waste biomass, litter utilisation of forests, etc. (forest management);
- ploughing, fertilisation, spraying, intensive cultivation of arable land;
- changes in riverine habitats and wetlands;
- intensive tourism in specific mountain areas.

Entomostracans (*Entomostraca*)

Basic characteristics and number of species. The inland waters of Slovenia are inhabited by 4 groups of entomostracans (*Entomostraca*): fairy shrimps, phyllopods, copepods and seed shrimps. In Europe around 36 fairy shrimp (*Anostraca*) species have been identified. They mainly live in intermittent water holes. Approximately 400 *Phyllopoda* species have been discovered in the world, in Europe around 150. Most species live in standing or slow running water. A numerous group are copepods (*Copepoda*). Several thousands have been globally identified. They are mainly free living but some are parasites. Seed shrimps (*Ostracoda*) are tiny (0,5 - 2 mm) benthic crustaceans. Many species live underground. Around 50,000 species have been identified around the world. Due to their high abundance, entomostracans are very important in nutrient cycling and energy flow in a variety of aquatic ecosystems.

Degree of research. In the past, entomostracans were not studied in detail in Slovenia. Only in the last two decades have the freshwater species been researched intensively. The water flea fauna of the mountain lakes in the Julian Alps and in the plankton of the lowland lakes, as well as the copepods of large cave systems, have been studied well. In total, 4 species of fairy shrimps, around 60 species of phyllopods and more than 105 species of copepods have been identified in Slovenia. The research on seed shrimps (around 18 species) is incomplete.

Table 24: *Number of Entomostraca species in Europe and Slovenia.*

Group	No. of species in Europe	No. of species in Slovenia
Anostraca	36	4
Cladocera	150	60
Copepoda	460	105

Endemic species. Most endemic species are found in karst areas. There are 16 known endemic species of *Entomostraca* in Slovenia: 2 phyllopods (*Alona stochi* in Kompoljska jama and *Alona sketi* in Osapska jama) and 14 copepods. It is expected that many more endemic *Ostracoda* and *Copepoda* species will be discovered in the karst areas. An interesting species is *Chirocephalus croaticus* which is endemic to Dalmatia and Slovenia. Here it has only been found in lake Petelinje jezero and in the sporadically occurring waterholes in the area of Cerkniško jezero.

Threats. The two main causes for threats are:

- pollution of underground and surface waters;
- drainage of marshes.

Freshwater and brackish water malacostracans (*Malacostraca*)

Basic characteristics and number of species. Malacostracans (*Malacostraca*) are divided into several groups: isopods (*Isopoda*), amphipods (*Amphipoda*), decapods (*Decapoda*) and *Bathynellacea*. Around 50 *Bathynellacea* species have been identified in Europe. Most of them are omnivorous, feeding on decaying organic matter on the surface or detrital material in the underground.

Degree of research. Freshwater and brackish isopods found in Slovenia belong to around 20 species and subspecies. The fauna of the freshwater isopods (*Isopoda*) is among the richest in Europe, owing exclusively to the subterranean species. Around 50 species of freshwater and brackish amphipods (*Amphipoda*) can be found in Slovenia. In the inland waters, 3 crayfish and lobster species (*Astacidae*) and 4 shrimp and prawn species (*Atyidae and Palaemonidae*) have been identified. In the interstitial waters of Slovenia two Bathynellacea species have been found (*Bathynella natans* and *Parabathynella stygia*). The mentioned crustacean groups have been researched only moderately. The range of

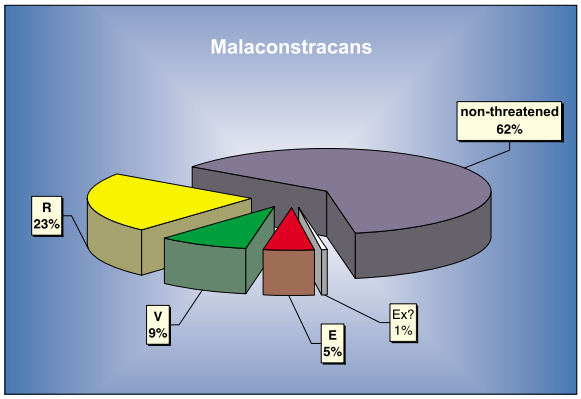
Figure 91. *Austropotamobius torrentium, inhabits the waters of the Danube catchment.*

(Photo: Jana Vidic)

specific species is not yet known. Some species and races have not yet been described.

Endemic species. Among the isopods 16 endemic species have been identified in Slovenia (Table 25). *Proasellus istrianus* is an endemic species to Slovenia and the border areas of Italy and Croatia. Several species of the same genus are distributed in interstitial and cave waters around the territory. Mostly they are endemic.

Moreover, several stigophilic and stigobiontic *Niphargus* species are also endemic. In all, 12 endemic species of amphipods can be found in Slovenia (Table 26).



Threats. The main causes of threats are:

- pollution of karst underground streams, cave waters and groundwater;
- pollution of watercourses and lakes,
- pollution of coastal fresh and brackish water;
- landfilling, drainage and pollution of backwaters.

Chilopods (*Chilopoda*)

Basic characteristics and number of species. Chilopods are predatory myriapods. They are the most numerous predators of large arthropods in European forests. They play an important role in controlling the sizes of populations of terrestrial invertebrates. More than 3000 chilopods have been identified world-wide, approximately 500 in Europe. They mostly live in soil, under rocky rubble and rotten wood, in litter. They can be found from the tidal zone to high mountains. Due to their predatory feeding behaviour and position on the trophic level, chilopods are extremely sensitive to the accumulation of specific pollutants.

Degree of research. In Slovenia, 98 species have been identified but the experts believe that at least 12 more have not yet been described. Forest ecosystems are the best researched habitats for chilopods. Riparian, grassland and field habitats have been researched to a lesser degree.

Scientific name	Note
Asellus aquaticus carniolicus Sket	
Asellus aquaticus cavernicolus Racovitza	
Asellus aquaticus cyclobranchialis Sket	
Asellus aquaticus irregularis Sket	
Asellus aquaticus longicornis Sket	
Proasellus deminutus	
Proasellus parvulus (Sket)	only in Slovenia
Proasellus pavani orientalis (Sket)	only in Slovenia
Proasellus slavus histriae (Sket)	only in Slovenia
Proasellus slavus "variabilis" nomen nudum	only in Slovenia
Proasellus slovenicus (Sket)	
Monolistra (Typhlosphaeroma) racovitzai conopyge Sket	
Monolistra (Microlistra) bolei bolei Sket	only in Slovenia
Monolistra (Microlistra) bolei brevispinosa Sket	only in Slovenia
Monolistra (Microlistra) calopyge Sket	
Monolistra (Microlistra) spinosissima Racovitza	

Scientific name	Note
Niphargus aberrans Sket	only in Slovenia
Niphargus hadzii Rejic	
Niphargus illidzensis slovenicus St. Karaman	only in Slovenia
Niphargus timavi St. Karaman	
Niphargus puteanus spoeckeri Schellenberg	only in Slovenia
Niphargus sphagnicolus Rejic	
Niphargus stenopus Sket	only in Slovenia
Niphargus stygius stygius (Schioedte)	
Niphargobates orophobata Sket	only in Slovenia
Carinurella paradoxa Sket	only in Slovenia
Jugogammarus kusceri S. Karaman	
Ingolfiella beatricis Ruffo & Vonk	

Endemic species. The species *Lithobius zveri* is well known due to the first description of a specimen found in Planinska jama. As far as it is known the species is endemic to the Postojna-Planina cave system. In Slovenia, there are 35 endemic *Chilopoda* species with extremely small areas of distribution.

Threats. The main cause of their threat is the pollution of their living environment.

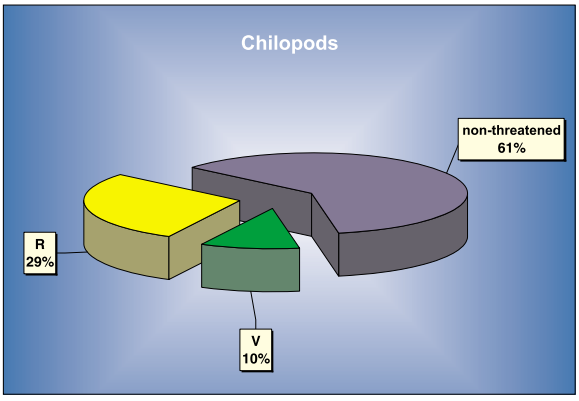


Table 25 (top): *Endemic freshwater Isopoda species in Slovenia.*

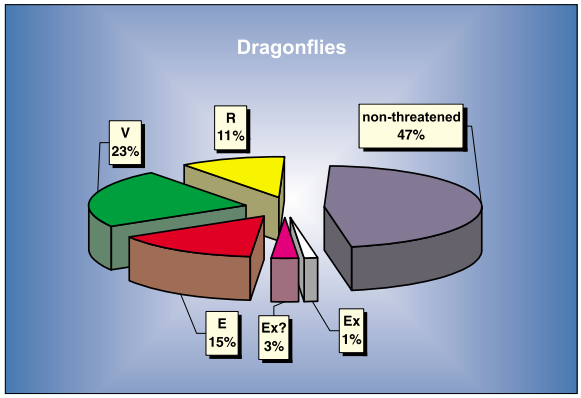
Table 26 (above): *Endemic Amphipoda species in Slovenia;*

Graph 10 (above left): *Threatened Malaconstracans species in Slovenia according to IUCN categories.*

Graph 11 (left): *Threatened Chilopods in Slovenia according to the IUCN categories.*

Dragonflies and damselflies (*Odonata*)

Basic characteristics and number of species. Odonates are a group of insects with incomplete metamorphosis. They spend most of their lives, even several years, as larvae in water. Their adult stage is much shorter, usually only several weeks. *Odonata* species in Europe and Slovenia are divided into two suborders: damselflies (*Zygoptera*) and dragonflies (*Anisoptera*). Odonata larvae and adults are predators and contribute to the maintenance of the ecological balance in their living environment. Dragonflies and damselflies are important bioindicators. The survival of a species depends on various factors and structures in their aquatic and terrestrial habitats. The diversity of dragonflies and damselflies therefore indicates the status of preserved aquatic and terrestrial environment.



Graph 12: *Threatened dragonflies in Slovenia according to the IUCN categories.*

(Photo: Matjaž Bedjanič)

Figure 92. *Calopteryx virgo is most commonly found along the torrents in the hilly areas. While males are brightly coloured, females are drab brown in colour.*

Approximately 6000 odonates have been described around the world. They are most abundant in tropical areas. Only around 130 can be found in Europe.

Degree of research. Odonatology has a long tradition in Slovenia. At the end of the 17th and in the 18th centuries, the odonates were in general studied by J. V. Valvasor and I. A. Scopoli. After the Second World War the Slovenian *Odonata* fauna was first inventoried by Boštjan Kiauta. In the territory of the country,54 species were found. Under the auspices of the Slovenian Dragonfly Society, the mapping of the Odonata fauna was conducted in the period from 1991 to 1997. The result is the publication of *Atlas of the Dragonflies (Odonata) of Slovenia* with the *Red Data List*. According to the collected data 73 species occur in Slovenia. No new discoveries are expected.

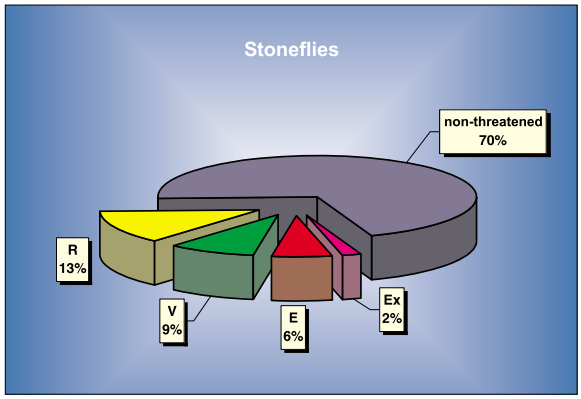
Endemic species. No endemic *Odonata* species have been found in Slovenia.

Threats. The main causes of threats are:

- eutrophication and the destruction of the ecological structure of the standing water ecosystems;
- excessive population of every standing water body with fish;
- altering the natural species composition of fish fauna and introduction of non-indigenous fish species;
- canalisation of rivers and streams and thus the destruction of the natural river dynamics and riverine wetlands;
- drainage of marshes and periodical wetlands;
- mechanised clearing of channels and drainage ditches;
- removal of riverine vegetation;
- reactivation of old clay and gravel pits for the conservation of biodiversity.

Stoneflies (*Plecoptera*)

Basic characteristics and number of species. Almost 3000 stonefly species are distributed around the world, except in the Antarctic and remote ocean islands. They can only be found on the islands close to the land which used to be part of the continents. Stonflies are insects which spend most of their lives as larvae in water. Adults live on land and are poor flyers. They stay near the water, rest in the riparian vegetation or hide



Graph 13: *Threatened stoneflies in Slovenia according to IUCN categories.*

under the rocks. Most stoneflies do not feed, but live on the food they had accumulated during the larvae stage. Adults do not live long, for only a few hours to several weeks. Particular species only occur during a specific season. They are extremely sensitive to the reduced oxygen content and the presence of toxic substances in water and are thus important bioindicators in the biological evaluation of the quality of surface waters.

Degree of research. The first data on stoneflies can be found in the works by Nicolaus Poda (1761) and J. A. Scopoli (1763). In Slovenia, the detailed and systematic studies of this insect group started in the late 1970s and early 1980s. Stoneflies are a relatively well researched group, approximately 100 species have been identified.

Endemic species. No endemic stonefly species are limited to the Slovenian territory. Numerous species of the *Leuctra* genus are typical Alpine endemits (*Leuctra helvetica, L. alpina, L. pseudorosinae, L. armata, L. braueri, L. autumnalis, L. signifera* and *L. pseudosignifera*). In the Alps, the following species can also be found: *Protonemura nimborum, P. julia, Isoperla lugens, I. goertzi* and *I. pusilla*. The endemic species *Leuctra istenicae* is found in Pohorje. *Perla illiesi, Brachyptera tristis, Isoperla illyrica* and *I. inermis* are endemic to the Balkans.

The two main causes of the threats are:

- water pollution;
- activities affecting the water environment and the riparian vegetation.

Mayflies (*Ephemeroptera*)

Basic characteristics and number of species. In the world, the genus of mayflies is represented by around 2000 species. They are distributed nearly all over the world, except in Antarctica, parts of the Arctic and some islands (for example, the Maldives). Highest mayfly diversity is found in the running water of the temperate zones. *Ephemeroptera* belong to the aquatic insects with incomplete metamorphosis. They spend most of their life as larvae in water. Metamorphosis into the adult stage has two stages. In the first stage they moult to a winged form (the subimago) which is characteristic only for mayflies. After a brief period, few hours or days, they further moult into a mature adults. Adults only live for a few hours, they do not feed and merely use the stored energy for reproduction. Due to their widespread distribution and sensitivity to pollution, mayflies are used as bioindicators in the monitoring of water quality. Mayfly larvae mostly feed on periphyton and are an important source of food for fish.

(Photo: Peter Skoberne)

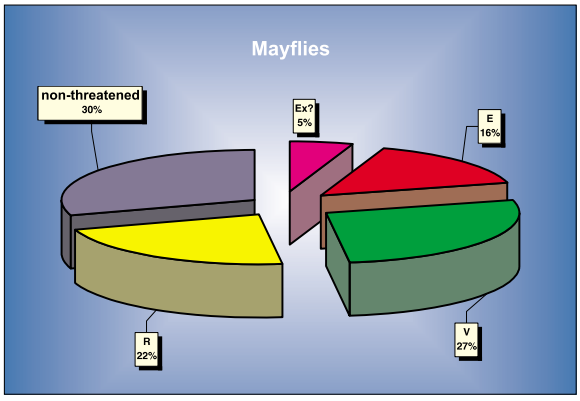
Figure 93. *Plecoptera, most of its brief life is spent within the riparian vegetation.*

Country	Number of species
Slovenia	65 (77)
Austria	88
Switzerland	82
Italy	84
Slovak Republic	91
Czech Republic	101

Table 27: *Abundance of mayflies in Slovenia in comparison with some European countries.*

Degree of research. After the Second World War the first written record on mayfly species in Slovenia was published by Tanasijević in 1974. The systematic research on mayflies only began in 1996. In the past, 77 species were described but new researches confirmed the existence of 65 species in Slovenia. The information on 8 species is available only in literature, and the accuracy of the classification should be verified for 4 species. The list of mayflies is still rather incomplete. Many habitats, particularly lentic (lakes, fish ponds), have not been enough studied. Due to the difficult sampling, the species inhabiting the lower parts of large rivers are not well known. Some completely unknown. It is believed that the mayfly fauna, in particular of the families *Baetidae* and *Caenidae*, is much more diverse than had been mentioned.

Endemic species. Based on the written data, two endemic species can be found in Slovenia.



Graph 14: *Threatened mayflies in Slovenia according to IUCN categories.*

Ecdyonurus siveci was found in the area of the river Ščavnica near Maribor and the river Savinja near Luče and *Electrogena vipavensis* in the area of the river Vipava near Ajdovščina. During the current studies none of the findings of endemic species were confirmed. In Slovenia, 7 species of the genus *Rhithrogena* are endemic to the Alps: *R. allobrogica, R. colmarsensis, R. degrangei, R. endenensis, R. landai, R. puthzi* and *R. vaillanti*. *Rhithrogena braaschi* is a species endemic to the Balkans. An interesting feature is the presence of subspecies *Ecdyonurus carpathicus carpathicus* which is endemic to the Carpathians.

Threats. The two main causes of the threats are:

- pollution of watercourses and lakes,
- activities affecting the water environment and the riparian zone.

Grasshoppers, crickets and katydids (*Orthoptera*)

(Photo: Matjaž Bedjanič)

Figure 94. *Polysarcus denticauda, the male can grow up to 4 centimetres, and is the biggest and most beautiful grasshopper species in the country. It inhabits mountain pastures and meadows. While in Slovenia is not on the list of threatened species, it is a listed species at the European level.*

Basic characteristics and number of species. *Orthoptera* are terrestrial insects which are most diverse in tropical areas and subtemperate regions. Approximately 20,000 species have been described world-wide. Most orthopterans live on plants, except specific families (*Gryllotalpa, Grylloidea, Rhaphidophoridae*) which live in upper soil horizon or caves. However, most of them find food on the surface. Orthopterans are ecologically linked to specific habitats and are good bioindicators of the status of their living environment. Due to this link they are extremely sensitive to the changes in habitats, in particular the stenotopic and non-winged forms.

Degree of research. In Slovenia *Orthoptera* were occasionally studied by some West European orthopterologists, for example F. Schmidt in the 19th and W. Ramme at the beginning of the 20th century. The *Orthoptera* fauna of Slovenia was most systematically studied by P. Us in his *Fauna of Orthopteriod Insects of Slovenia*, 1992. The contribution by the Swiss orthopterologist Adolf Nadig was important. During the last few decades many other authors published their works on *Orthoptera* fauna but the general level of research is relatively low. However, the interest among professional biologists and amateurs has increased recently. Until now, 143 species of suborders *Ensifera* and *Caelifera* have been recorded in Slovenia. The areas of distribution of most species are unknown. However, it is expected that a few more species will be discovered.

Endemic species. No species endemic only to Slovenia have been identified, but *Metrioptera kuntzeni* is endemic to the south-west Dinaric range, *Antaxius difformis* to the south Alps, *Chorthippus alticola rammei* to the Julian Alps, Karavanke as well as Kamnik and Savinja Alps and *Stenobothrus ursulae* to the Alps.

Threats. The main causes of threats are:

- drainage and filling of wetlands and particulary wet meadows;
- natural encroachment of vegetation on grasslands in most karst regions and in the hills;
- intensive fertilisation of meadows and early and frequent mowing;
- loss of river gravel banks and bare soil in lowlands.

Table 28: *Review of the number of Orthoptera species by superfamilies in Slovenia, Europe and around the world.*

	Slovenia	Europe	World
Ensifera	**76**	**593**	**over 9000**
Tettigonioidea	60	458	?
Rhaphidophoridea	2	44	?
Grylloidea	14	91	?
Caelifera	**67**	**381**	**10,590**
Tetrigoidea	7	12	?
Tridactyloidea	2	6	?
Acridoidea	58	363	?
Total	**143**	**974**	**20,000**

Mantids (*Mantodea*)

Basic characteristics and number of species. In Slovenia only two mantid species live and they have been well researched. The European mantis (*Mantis religiosa*) inhabits the extensively managed grasslands, the forest edges, rural areas and the slopes of hills where orchards and vineyards are located. The European mantis is not an endangered species. Mantis (*Empusa fasciata*) is a Mediterranean species which lives in thermophilic slopes of the Karst escarpment and in the Slovenian coasts as well. It is one of the most beautiful species found on the Adriatic coast. Due to the natural encroachment of vegetation on the Karst area and the degradation of coastal sites it is highly endangered and is close to extinction. It is limited to small sites where only a few specimens can be found.

(Photo: Matjaž Bedjanič)

Threats. No endemic mantids have been identified in Slovenia. The main cause of threats is the colonisation of grasslands by scrub and trees in the Karst area.

Earwigs (*Dermaptera*)

Basic characteristics and number of species. Approximately 1300 earwig species, which are a small order of hemimetabolous insects, have been identified world-wide. In Slovenia 6 earwig species have been recorded but the group is not well researched. The situation is similar in the neighbouring countries. Only the two most frequent species are well known, the European earwig (*Forficula auricularia*) and little earwig (*Labia minor*).

Threats. No endemic earwig species have been found in Slovenia. The threatened species are the seaside earwig (*Anisolabis maritima*) and shore earwig (*Labidura riparia*). The two main causes of threats are:

- destruction of sandy beaches and sand river banks;
- construction on the coast.

Termites (*Isoptera*)

Basic characteristics and number of species. More than 2300 termite species have been identified worldwide. In Slovenia only two species occur in the wild, the *Reticulitermes lucifugus* and *Kalotermes flavicollis* which live in the coastal area. Both species are rare and can be found in the rotten stems of conifer trees but they also attack the wooden parts of old houses in coastal towns.

Threats. No endemic termite species have been found in Slovenia. They are threatened by loss of their habitat.

Leaf insects (*Phasmoptera*)

Basic characteristics and number of species. The scrubs of the Slovenian coast are inhabited by only one leaf insect species - *Bacillus rossius*. The species is extremely rare and limited to the warm and preserved coastal areas. Leaf insects do not move far. Sometimes they spend their entire life on one and the same shrub.

Threats. No endemic species have been found in Slovenia. The main causes of threats are urbanisation and other activities affecting the environment.

Roaches (*Blattoptera*)

Basic characteristics and number of species. In Slovenia the roaches have not been well researched. Until now, 14 species have been identified. Of these, 3 are cosmopolitan and can be found in storage facilities, ports, commercial facilities and apartments. They can not spend the winter outside. Other roach species are indigenous and mostly sylvan. They live in trees and shrubbery and inhabit meadows all over Slovenia.

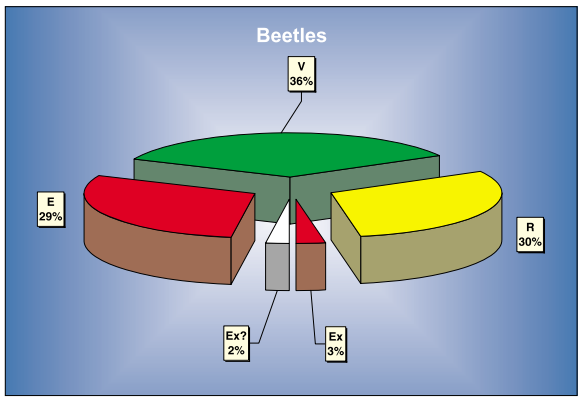
Threats. In view of the poor research on the group, roaches can not be considered threatened, but further studies are needed.

Figure 95. *A young sand lizard (Lacerta agilis) has become prey to the European mantis (Mantis religiosa).*

Beetles (*Coleoptera*)

Basic characteristics and number of species. Beetles are the most numerous animal group in the world, and in Slovenia. Among the more than one million insect species almost one third are beetles. The most distinctive feature of beetles is the hardening of the forewings into elytra which serve to protect the more delicate hind flight wings. Most species are found in tropical areas. In Central Europe only around 8,000 species live. Beetles inhabit all environments, except glaciers and oceans. They are of various shapes and colours and characterised by extreme specialisation of their feeding habits and reproduction.

Degree of research. The first data on the beetle fauna in Slovenia were gathered in *Entomologia Carniolica* (Entomology of Carniola, 1763) by J. A. Scopoli, where more than 60 new taxa of the Carniola were described. The intensive research in the last 15 years has resulted in around 300 new taxa identified in Slovenia. However, the data on the fauna and species diversity are incomplete. In Slovenia, approximately 450 species and subspecies of *Locus typicus* beetles have been recorded. The first described cave species, beetle



Graph 15: *Threatened beetles according to the IUCN categories.*

Leptodirus hochenwarti was discovered in Postojnska jama. In Slovenia 110 species and 205 subspecies of cave beetles have been identified but even today new species and genera are found in caves and soil. The data on cave beetles have been collected for around 1,000 caves, that is some 13 % of all discovered caves in Slovenia. In the last 10 years, 50 new beetle species and subspecies, including a new genus, were found in these caves and subsequently described. According to the unpublished data, approximately 6000 beetle species live in Slovenia.

Endemic species. Of the classified cave beetle species more than one half are strict endemic species. In the case of some endemic species (inhabiting border mountain ranges or areas) their area of distribution extends across the state border to the neighbouring country, but many live in extremely limited areas, in a specific mountain range or only in a few caves. Several different species can be found in just one single cave. The high level of endemism can be detected in the South East limestone Alps (the Julian Alps, Karavanke as well as Kamnik and Savinja Alps) whose beetle fauna is extremely specific. It is surprising that many beetle species were considered endemic to the Carpathians have a disjunct area of distribution in Slovenia.

Threats. The main causes of threats are:

- intensive construction of infrastructure facilities and hydro-electric power plants, urbanisation;
- intensive fertilisation of meadows;

(Photo: Andrej Hudoklin)

Figure 96. *Rosalia alpina, a rare species in the Slovenian forests, ranks among the first beetles protected in Slovenia.*

Table 29: *Number of taxa of cavernicolous beetles (number of all identified cavernicolous beetles according to Deco & Juberthie, 1998).*

	World No. of species	Slovenia No. of species	No. of subspecies	% Slovenia/ World
Carabidae	1,180	66	132	5.6
Trechinae	1,047	52	124	5
Cholevidae	600	29	55	4.8
Leptodirine	562	29	55	5.2
Curculionidae	22	3	4	13.6
Pselaphidae	82	6	7.3	
Staphylinidae	27	3	11	
other	49	1	2	
TOTAL	**1,960**	**110**	**205**	**5.6**

- disappearance of steppe and grasslands;
- removal of old and dead trees from forests;
- clearcuts;
- pollution of water and changing of the water and riparian environment;
- direct destruction of caves (filling, waste disposal), tourist exploitation of caves;
- indirect pollution of caves.

Neuropterans (*Neuropteroidea*)

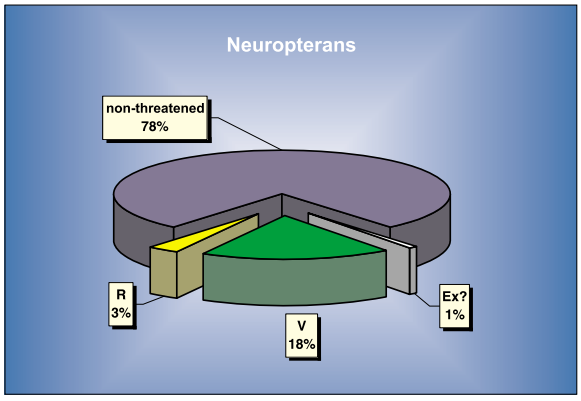
Basic characteristics and number of species. Neuropterans (*Neuropteroidea*) are a relatively scarce group of insects. Dobsonflies and alderflies (*Megaloptera*), lacewings, antlions and owlflies (*Neuroptera*), and snakeflies (*Rhaphidoptera*) belong to this group.

There are about 4,500 species of neuropterans found around the world. Of these, 333 species have been identified in Europe. They live in various habitats. The larvae of some species are aquatic (alderflies *Sialidae* and sponge flies *Sisyridae*) or live in the area between water and land (osmylids *Osmylidae*). Most other Neuropteroidea species live in trees or scrub. A few of the species found in Slovenia inhabit meadows and pastures, forest clearings, shrubbery or rocky thermal habitats. Adult neuropterans and their larvae are predatory. In ecosystems they are considered useful because they feed on crop and fruit pests.

Degree of research. In Slovenia, 104 *Neuropteroidea* species have been identified: 3 *Megaloptera*, 8 *Rhaphidioptera* and 93 *Neuroptera* species. With regard to the number of the identified species the following families are the richest: brown lacewings (*Hemerobiidae*, 35 species), green lacewings (*Chrysopidae*, 29 species) and duskywings (*Coniopterygidae*, 18 species).

Threats. There are no endemic *Neuropteroidea* species in Slovenia. The main causes of threats are:

- pollution of watercourses and lakes;
- canalizing the streams and rivers;



Graph 16: *Threatened neuropterans in Slovenia according to the IUCN categories.*

Species (southern area of distribution limit)	Species (northern area of distribution limit)
Drepanepteryx algida	*Mantispa apahvexelte*
Wesmaelius fassnidgei	*Dichochrysa zelleri*
Nineta vittata	*Italochrysa italica*
Ninetta pallida	*Gymnocnemia variegata*

Table 30: *Neuropteroidea species whose south/north area of distribution limit is Slovenia.*

- activities affecting the riparian vegetation;
- destruction and disappearance of sand and gravel banks;
- destruction of floodplain woodlands;
- disappearance of steppe and grasslands;
- disappearance of the remains of the sub-Mediterranean forest vegetation (maquis);
- removal of old trees from forests.

Scorpion flies (*Mecoptera*)

Basic characteristics and number of species. Scorpion flies (*Mecoptera*) are among the oldest insects with complete metamorphosis. They have an elongated head with slender, chewing mouthparts near the tip of a stout beak. The distinctive appearance of male genitalia is characteristic for species of the family *Panorpidae*. The terminal segments are enlarged and held recurved over the abdomen like the tail of a scorpion. More than 500 scorpion flies, which belong to 9 families, have been identified in the world.

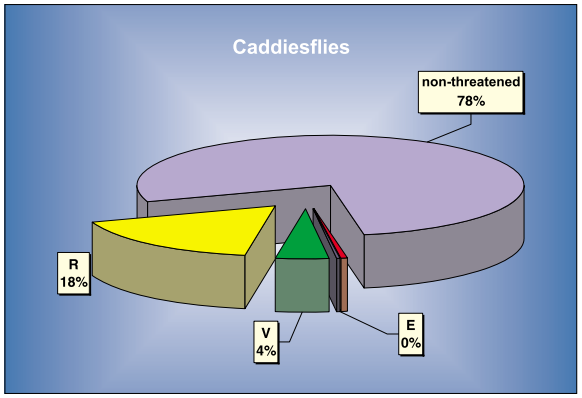
Degree of research. In Slovenia live 9 *Mecoptera* species: 5 of the common scorpion flies family (*Panorpidae*), 2 of the snow scorpion flies family (*Boreidae*), and 2 of the hanging scorpion flies family (*Bittacidae*).

Threats. There are no endemic species of scorpion flies in Slovenia. The main cause of threats is the destruction of floodplain woodlands.

Caddiesflies (*Trichoptera*)

Basic characteristics and number of species. At the global level more than 10,000 *Trichoptera* species have been identified, but according to the latest estimates the world fauna may contain up to 40,000 species. A little more than 1,100 species can be found in Europe. Caddiesflies are an order of aquatic insects with a complete metamorphosis. Larvae and pupae live in all aquatic habitats, but the richest the species diversity is at the sources, in headwater areas and smaller streams. Adults are terrestrial and live for about one month. They live off the stored food which they had accumulated in the larval stage. During the day they are found in the riparian vegetation. They become active in the evening

when the moisture in the air increases. Most caddies-flies larvae live within protective portable "cases", which are among the most technically developed insect constructions. Some species construct tunnel-like structures, others make webs used to entrap prey, but some larvae are free-living and predacious.



Graph 17: *Threatened caddiesflies according to the IUCN categories.*

Degree of research. In Slovenia caddies-flies were first studied in the 18th century, when J. A. Scopoli described new species found in the Carniola region. Research has become more systematic in the last two decades and the knowledge about the *Trichoptera* fauna has increased. Until now, 218 species of 17 families and 74 genera have been recorded. Of these, 208 species have been classified. The finds concerning the remaining ten species are old, or their identification is not reliable.

Endemic species. Endemic caddiesflies species in Slovenia are *Chaetopteryx clara, Chaetopteryx goricensis* and *Chaetopteryx irenae*, at least ten species are endemic to the Alps, and *Chaetopteryx marinkovicae* is probably endemic to Istria.

Threats. The two main causes of threats are:

- pollution of watercourses;
- activities affecting the water environment and the riverine zone.

Figure 97. *Vanessa cardui, a butterfly species occurring in Slovenia on their migratory routes from Africa to the north.*

(Photo: Marko Simić)

Butterflies and moths (*Lepidoptera*)

Basic characteristics and number of species. Until now, approximately 15,000 butterfly and moth species have been identified. Their diversity is highest in tropical areas. The Slovenian fauna of butterflies and moths is among the richest in Europe, where 8,470 species have been found (Karsholt and Razowski, 1996). In Slovenia, around 3,200 species have been identified - 1,500 large moths and butterflies (*Macrolepidoptera*) and 1,700 small moths (*Microlepidoptera*). *Macrolepidoptera* include 183 species of butterflies living in Slovenia. Within *Microlepidoptera* only the better researched groups are discussed in this overview.

Degree of research. Even though the initial studies of butterflies and moths began with J. A. Scopoli the relevant taxa are not well researched due to the constant natural fluctuation of the population. Individual foreign entomologists reported about the butterflies found on the territory of Slovenia as early as in the 18th and 19th centuries, but the general overviews of the range of butterflies were compiled in the mid-twentieth century when several entomologists conducted studies here (Rakovec, Hafner brothers, Michieli, Carnelutti and others). Of the lepidoptera, butterflies have been studied more but not enough to understand their distribution and ecology. Of moths, more is known about the large ones, while the studies of small moths have only just begun and are currently being intensified. In Slovenia nearly 50 experts and amateurs are interested in butterflies and moths. The threats to the group can only be assessed for the well researched species, while the others will have to be studied more.

Endemic species. Due to the insufficient knowledge about the species' area of distribution it is difficult to define endemism in *Lepidoptera*. Several endemic subspecies live in Slovenia but their status is constantly changing because of the taxonomic revisions. With regard to the butterfly and moth fauna, the territory is relatively small and so there are only a few real endemic species. The number significantly increases if the geographical areas - such as the Julian Alps, Karavanke, Dinaric region, which reach across the borders - are taken into account. More than 30 endemic species are found in these areas. Of the butterflies, the most known is Lorkovic's brassy ringlet (*Erebia calcaria*) which is found in the Julian Alps and west Karavanke as well as in Italy (Montaž) and Austria (Karnische Alps) and is thus the endemic species of the south-east Alps. In Slovenia, a few subspecies have been described, in particular apollo (*Parnassius apollo*)

and various species of ringlets (for instance *Erebia styx trentae, Erebia pluto triglavensis*), five-spot burnets (*Zygaena angeliceae ternovanensis*), etc.

Threats to butteflies. The main causes of threats are:

- intensive use of meadows;
- natural encroachment of vegetation;
- drainage;
- large construction works.

Species	status SI
Colias myrmidone	E (CR)
Hipparchia statilinus	E (CR)
Chazara briseis	E (CR)
Hyponephele lycaon	Ex?
Coenonympha tullia	*E* (CR)
Iolana iolas	E (CR)
Carcharodus lavatherae	E (CR)

Table 31: *Most threatened butterflies species in Slovenia.*

WETLAND HABITATS
Calamatropha aureliella
Pelosia obtusa
Phragmatiphila nexa
Archanara neurica
Ostrinia palustralis
Laelia coenosa
Phlyctaenia perlucidalis
SUBPANNONIAN AREA
Korscheltellus dacicus
SUBMEDITERRANEAN AREA
Zygaena cynarae
Malacosoma franconicum
Axia margarita
Agriopis ankeraria
HALOPHYTIC AREAS
Discestra stigmosa
OTHER
Baptria tibiale

Table 32: *Most threatened moth species (category CR) in Slovenia and their ecology.*

Threats to moths. The main causes of threats to moths are:

- increase in road traffic;
- public lighting;
- degradation of habitats;
- intensive farming;
- natural encroachment of vegetation on abandoned arable land;
- drainage of wetlands;
- urbanisation.

Bees, ants and wasps (*Hymenoptera*)

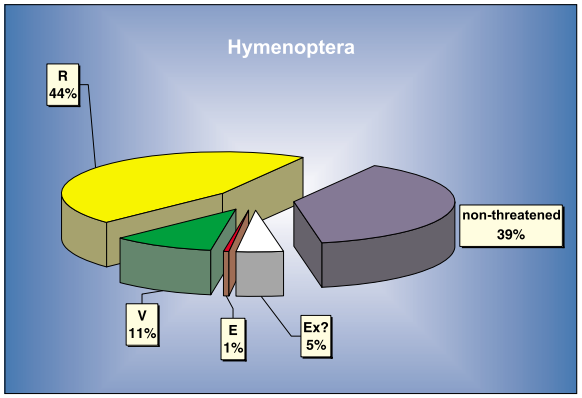
Basic characteristics and number of species. As a group, the *Hymenoptera* are among the most successful of animals. More than 100,000 species have been identified in the world. That is less than beetles but still more than all vertebrates. Bees, ants and wasps play an extremely important role in the environment and at the same time their relevance for people is notable. Ichneumon flies, whose larvae develop as parasites in other insects, destroy many plant pests, including sawflies. Bees are among the most effective pollinators, and many plants would not grow fruits and seeds without them. By digging the deep tunnels of their anthills the ants soften, mix and air the soil, transport seeds and unknowingly plant seeds and destroy many herbivorous insects.

Degree of research. The *Hymenoptera* fauna in Slovenia has not been researched in detail. The only well studied group are bees (*Apoidea*). More than 25,000 bee species have been identified in the world, and 542 in Slovenia. The number is quite high for such a small area.

Endemic species. No endemic species of bees, ants and wasps have been found. Bees are skilful fliers and their populations can not remain isolated in a small area. However, the less mobile *Hymenoptera* groups have not been studied in detail.

Country	No. of species	Surface (km²)
Spain	1,043	505,496
France	865	551,208
Czech and Slovak Republics	690	127,859
Austria	647	83,849
Switzerland	580	41,288
Germany	546	355,805
Slovenia	542	20,256
Poland	454	311,730
Belgium	376	30,507
Netherlands	328	32,450
Luxemborg	274	2,586
Great Britain	240	244,016
Finland	230	337,032
Denmark	217	43,069
Ireland	80	70,283
Iceland	1	102,828

Table 33: *Number of bee species in some European countries.*



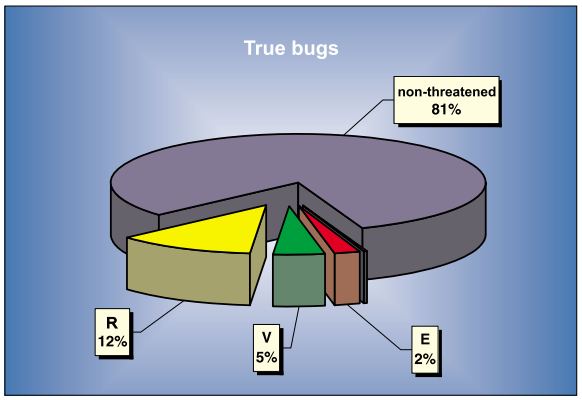
Graph 18: *Threatened Hymenoptera in Slovenia according to the IUCN categories.*

Threats. The main causes of threats to bees, ants and wasps are:

- intensive farming, monocultural production;
- urbanisation;
- cutting of hedges and shrubberies and loss of the forest edge;
- destruction of reed beds;
- destruction of sand and gravel river banks;
- natural encroachment of vegetation on or construction works (wind power plants) in karst grasslands;
- application of insecticides;
- mass breeding of domestic bee which competes for food with the wild species;
- expansion of non-indigenous species of bees, ants, wasps and plants which dangerously smother the indigenous honey bee forage plants.

True bugs (*Heteroptera*)

Basic characteristics and number of species. True bugs (*Heteroptera*) are a diverse and numerous group of insects with incomplete metamorphosis. They are predators, parasites or herbivores. Most herbivorous species are associated with specific plants and thus depend on them. True bugs inhabit the land, freshwaters and the water surface. Like cicadas (*Cicadidae*) and aphids (*Aphididae*) belonging to the order *Hemiptera*, they have elongated, piercing-sucking mouthparts which they use to squirt their digestive enzymes onto food and then suck it back in a liquefied form. More than 80,000 true bugs have been identified.



Graph 19: *Threatened true bugs according to the IUCN categories.*

Degree of research. In Slovenia, 643 true bug species have been recorded. The current data should be supplemented by the information from foreign publications, but the complete catalogue of all species living in Slovenia has not yet been compiled. The actual number of species is certainly higher than indicated.

Endemic species. Two endemic species of true bugs have been found on the territory of Slovenia. *Dimorphocoris saulii* lives only in the meadows of Vremščica, and *Halticus henschii*, whose specimens were found near Gorica, inhabit the meadows of the Čaven, Nanos mountain and the Karst. In Lipnik near Golič, the grassland plateau above Zazid in Čičarija, the third endemic true bug species of the genus *Platycranus* probably lives in the karst grasslands. The subspecies *Saldula pilosella hirsuta* is endemic to the Adriatic coast but is also found in Italy, and on Corfu in Greece.

(Photo: Marko Simič)

Figure 98. *Pyrrhocoris apterus, a fire bug.*

Table 34: *Comparison of the number of Heteroptera species in the World, Central Europe and Slovenia.*

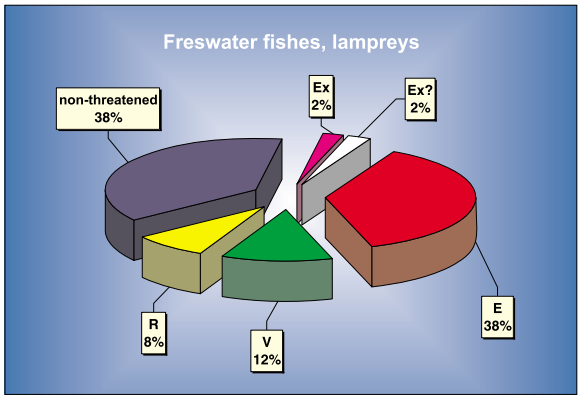
Country	No of species
World	> 80,000
Central Europe	1,088
Germany	868
Great Britain	537
Bulgaria	1,000
Greece	740
Slovenia	643

Threats. The main causes of threats are:

- land-filling, pollution and overgrowing of backwaters, puddles and Karstic ponds;
- canalisation of rivers and streams, pollution and impoundment of rivers;
- drainage and filling of wetlands;
- construction works, urbanisation;
- natural encroachment of vegetation on abandoned meadows and pastures.

Freshwater fishes, lampreys (*pisces, petromyzontidae*)

Basic characteristics and number of species. On the basis of the species distribution pattern, the Slovenian ichtyofauna belongs to the North-European and Central-European province which includes Western, Northern and Eastern Europe and small regions in the south of the continent. The ichtyofauna of the Central Europe includes the well spread European, Euro-Siberian and Palearctic species. The central area is the Danube basin where most species live. The diversity of species gradually declines towards the East and West.



There are around 20,000 fish species in the world, 5,000 of which are freshwater fish. The number is not final because several new species are discovered every year. Only 4.5 % or 227 freshwater fish species live in Europe. Merely 200 are indigenous. The other 27 originate in North America and Asia. With regard to the share of non-indigenous species, Slovenia and Hungary share the 10th place in Europe (29 %).

Degree of research. The inland waters of Slovenia, divided between the Danube and Adriatic basins, are inhabited by approximately 81 freshwater fish species (68 indigenous) and 4 lamprey species. Two fish species are already extinct. The existence of one lamprey species of the Danube basin, which has not been found in Slovenia, is threatened. The Black Sea basin is inhabited by 72 fish species, 57 of which are indigenous (including lampreys), 11 have been

ADRIATIC ENDEMIC SPECIES
Lethenteron zanandreai Vladykov, 1955
Salmo marmoratus Cuvier, 1817
Barbus caninus Valenciennes, 1842
Barbus plebejus Valenciennes, 1842
Chondrostoma soetta (Bonaparte, 1840)
Chondrostoma genei Bonaparte, 1841
A. a. alborella de Filippi, 1844
Rutilus rubilio aula (Bonaparte 1837)
Leuciscus cephalus cabeda Risso, 1826
Leuciscus cephalus albus Bonaparte, 1838
Cobitis bilineata Linnaeus, 1758
Padogobius martensi Gunther 1861
DANUBE ENDEMIC SPECIES
Hucho hucho Linnaeus, 1758
Gobio uranoscopus (Agassiz, 1828)
Gobio kessleri Dybowski, 1862
Rutilus pigus virgo (Heckel, 1852)
Cobitis elongata Heckel and Kner 1858
Umbra krameri Walbaum 1792
Gymnocephalus schraetzer (Linnaeus, 1758)
G. baloni Holčik and Hensel 1974
Zingel zingel (Linnaeus, 1766)
Zingel streber (Siebold 1863)

Table 36: *List of endemic species of freshwater fishes and lampreys in Slovenia, endemic to the Black Sea and Adriatic basins.*

Salvelinus fontinalis (Mitchill, 1815)
Salvelinus alpinus (Linnaeus, 1758)
Oncorhynchus. mykiss (Walbaum, 1792)
Hypophthalmychthys molitrix (Valencinnes, 1844)
Aristichthys nobilis (Richardson, 1844)
Carassius a. auratus (Linnaeus, 1758)
Carassius gibelio (Bloch, 1783)
Ctenopharyngodon idella (Valenciennes, 1844)
Pseudorasbora parva (Schlegel, 1842)
Ictalurus nebulosus (Le Sueur, 1890)
Gambusia affinis Baird in Girard, 1853
Micropterus salmoides Lacpede, 1802
Lepomis gibbosus Linnaeus, 1758

Table 37: *List of introduced fish species of fishes in Slovenia.*

Graph 20: *Threatened fishes (freshwater and marine species) according to the IUCN categories.*

Figure 99. *Salmo trutta m. fario, is an indigenous species threatened by the introduced American trout (Salmo gairdneri).*

(Photo: Jana Vidic)

Table 35: *Red Data List of threatened freshwater fishes and lamprey species in Slovenia according to IUCN categories.*

IUCN category	Ex	Ex?	E	V	R
Lampreys			3		1
Fishes	2	2	29	9	6

brought from other continents and 4 originate in the Adriatic basin. The latter is populated with 40 fish and lamprey species, 24 are indigenous, 9 introduced and 7 translocated.

Endemic species. In the Black Sea basin, 10 endemic species live and in the Adriatic basin 12. None are found only in Slovenia.

Threats. The main causes of threats are:

- overcatch (lake trout *Salmo trutta m. lacustris*, Danube roach *Rutilus pigus virgo*, sneep *Chondrostoma nasus*);
- illegal angling (marble trout *Salmo trutta marmoratus* and huchen *Hucho hucho*);
- introduction and translocation of fish (trout *Salmo trutta*, pumpkinseed *Lepomis gibbosus*, Poeciliidae, Cypriniformes);
- genetic pollution (marble trout *Salmo trutta marmoratus*);
- pollution of waters and canalisation of rivers and streams.

Figure 100 (below). *Hyla arborea, adhesive pads on tips of toes enable the frog to move easily on slippery surfaces. It stays in water only during mating.*

(Photo: Marko Simić)

Figure 101 (bottom). *The yellow freckles typical of the common salamander (Salamandra salamandra) contain poison and warn any possible predator that the animal is not edible.*

(Photo: Matjaž Bedjanič)

Amphibians (*Amphibia*)

Basic characteristics and number of species. Amphibians occupy a special position among vertebrates because they live both on land and in water. Most amphibians have thin, moist skin and are tetrapods. Their body temperature depends on the temperature of their surrounding. Females lay eggs (usually in water) from which tadpoles develop. These live in water and after the metamorphosis they move to the land. The adult amphibians are carnivorous. They feed on insects, snails, 'worms' and other aquatic animals.

More than 4,800 amphibian species are found in the world and new ones are discovered every day, mostly in the less researched tropical areas. In the *Atlas of Amphibians and Reptiles of Europe*, 62 amphibian species are discussed. There are 19 species found in Slovenia and 4 of them have 2 subspecies each. Overall, 23 amphibian taxa live on Slovenian territory.

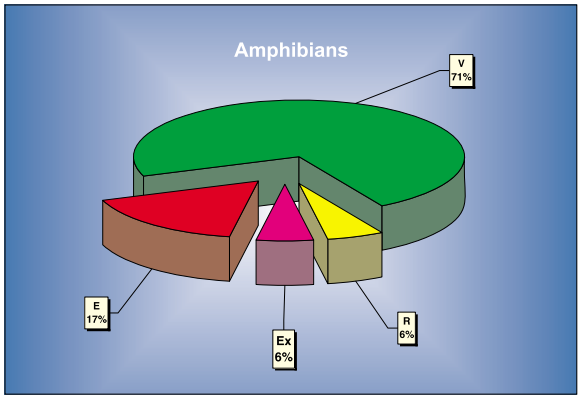
Degree of research. Not much has been written about amphibians, and most work has been published in scientific literature. The first complete list of amphibians in Slovenia was compiled by B. Sket (1967). In the last decade the experts interested in amphibians united in the Society for the study of amphibians and reptiles. Most collected data concern the olm (*Proteus anguinus*) which was first described in *Glory of the Carniola Duchy* by Janez Vajkard Valvasor (*Slava Vojvodine Kranjske*, 1689). After the second World War, numerous studies of the olm were carried out at the Department of Biology of the Slovenian Museum of Natural History. In 1986, a black olm specimen was found in Dobličica spoting in Bela krajina. Later on even more black specimens were found and identified as the subspecies *Proteus anguinus* ssp. parkelj.

In Slovenia, the knowledge about the amphibian species' area of distribution has improved substantially in the last decade. Nevertheless, many 'blank spots' still remain on the map. Detailed research on the populations and the ecology of species is needed as well as their long-term monitoring.

Endemic species. The black olm is an endemic species which has been found in only two sites in less than 100 km^2 of the karst area of Bela krajina.

Threats. Causes of threats are:

- uncontrolled urbanisation, in particular dispersed settlements;
- changes in agricultural production (introduction of new technologies, intensification of production, pesticides and fertilizes in the water and soil, agricultural improvements, land consilidation and similar activities);
- development of infrastructure (roads, railways, power lines) and transport;
- canalisation of rivers and streams and flood protection, removal of vegetation on river banks and in the buffer zone;
- changes in land use of restored gravel and clay pits important for nature conservation, in particular in the north-east of Slovenia (intensive fish farming, sport angling, recreation);
- removal of hedges and similar natural structures which function as migratory corridors;
- filling and drainage of wetlands (changes in the land use categories for economic development and agriculture);
- non-maintenance, overgrowing and destruction of puddles and karstic ponds, in particular in karst areas where they are no longer used in a traditional way;
- introduction of non-indigenous and invasive animal and plant species, introduction of fish into standing water (in particular karstic ponds and puddles, gravel pits and mountain lakes) and streams in the headwaters where there are no fish (impoundment of headwaters of streams facilitates the planned or spontaneous introduction of fish and fingerlings);
- water pollution.



Reptiles (*Reptilia*)

Basic characteristics and number of species. In the Mezozoic Era the reptiles were the largest and the most numerous group of vertebrates. Of 23 orders of that time most are extinct. Only four have survived: turtles and tortoises (*Testudines*), crocodilians (*Crocodylia*), tuataras (*Rhynchocephalia*), lizards and snakes (*Squamata*). In Slovenia, there are 24 reptile species belonging to two orders (*Testudines, Squamata*).

The body temperature of these animals depends on the temperature of their surroundings (ectotherms); the diversity and abundance of the species is highest in tropical regions and decreases towards high latitudes. In Europe, the diversity is highest in the Mediterranean (Gasc *et al.*, 1999). It is a little lower in Slovenia but still higher than in the countries with a distinct continental climate. The main reason for the rich species diversity of reptiles in Slovenia is its geographical position. The areas of distribution of species, which are characteristic for different regions, converge in Slovenia.

For the Alpine region the European asp (*Vipera aspis*) is characteristic. An endemic species of the Alpine-Dinaric mountain range is the Horvath wall lizard (*Lacerta horvathi*). The Eu-

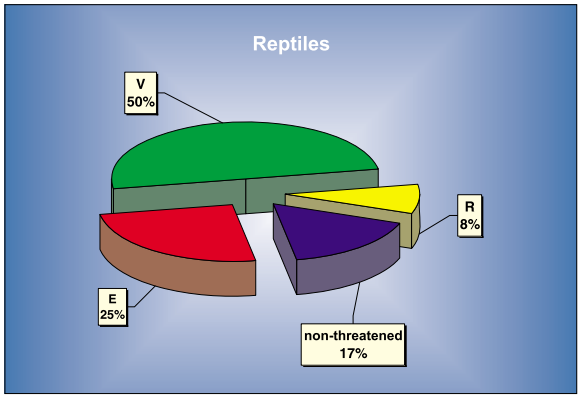
(Photo: Matjaž Bedjanič)

(Photo: Matjaž Bedjanič)

Figure 102 (top). *Zoothoca vivipara, is rare in Slovenia and therefore listed as an endangered reptile species. Research has proved that some females of lowland populations of "live-bearing" reptiles do not give birth to live offspring, but that they are actually "egg-hatched".*

Figure 103 (above). *Emys orbicularis, the only freshwater turtle in Slovenia is seriously endangered. One of the main threats is an introduced species, Trachemys script, which the "nature lovers" release in ponds and puddles all over Slovenia.*

Graph 21 (left): *Threatened amphibians in Slovenia according to the IUCN categories.*



Graph 22: *Threatened reptiles in Slovenia according to the IUCN categories.*

ropean adder (*Vipera berus*) mainly occurs in the Alpine region. In lowlands they are rarely found, mostly in humid areas.

The impact of the Pannonian region on the Slovenian reptile fauna is not as evident as in the case of other animals. It is reflected in the abundance of sand lizards (*Lacerta agilis*) in the eastern parts of the country, even though this is not a characteristically Pannonian species. The sand lizard used to be the most frequent lizard species but it has almost disappeared from the major part of Slovenia. The main causes for threatening to species in Europe are the degradation of habitats and the application of pesticides (Gasc *et al.*, 1997). No extensive studies of sand lizards have been conducted but it is evident that, despite the intensive agriculture, the species has found enough suitable habitats for its survival in the east. However, it is presumed that the retreat of the area of distribution towards the east is the consequence of the climate change.

The species diversity of reptiles is highest in the west of Slovenia (Primorje region and Istria) and lowest in the eastern, sub-Pannonian region (Tome, 1996). There are no endemic reptile species in Slovenia.

Figure 104. *Natrix natrix, feeding on a toad. The picture was taken on the banks of the Soča river.*

(Photo: Marko Simič)

Degree of research. In the past, the research on reptiles lagged considerably behind. Other, more economically interesting species, were given priority. Only recently has the systematic collection of data begun (Tome, 1996), bringing new discoveries. Unfortunately, no measurable and comparable data on the size and dynamics of populations are available. Nevertheless reptiles are among the most threatened animals in Slovenia.

Threats. All reptile species are threatened due to rapid and intensive urbanisation. The causes are numerous and their effects interact. An important role is played by the degradation of reptile habitats. Since reptiles are at the top of the food chain they are affected by the reduced abundance of insects, fish, amphibians and small mammals which they feed on. One of the reasons for such a reduction in the number of the reptile prey is the excessive application of pesticides. However, this cause of the decline of the species has not yet been studied. The pollution of watercourses and wetlands affects the species which feed on fish and amphibians. Recently, an additional cause of threats is the introduction of a non-indigenous species (Red-Eared Slider *Trachemys scripta*) which are released into the wild by irresponsible pet lovers. The killing of snakes out of fear or prejudices could seriously threaten the already endangered populations and the populations which are scarce because they inhabit the border areas of their distribution range.

Birds (*Aves*)

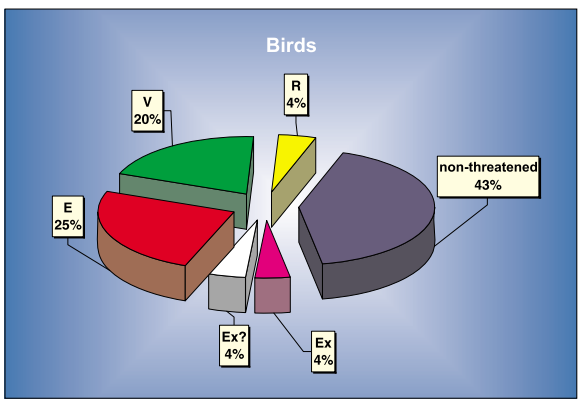
Basic characteristics and number of species. Birds are an important ecosystem component. They are mostly carnivorous (insectivorous) and are at the top of the food pyramid. They are important regulators of ecological balance. Birds inhabit all surface habitats, such as marshes, meadows, forests and tops of the mountains. There are approximately 9,700 bird species found in the world. Of these, 513 birds regularly or periodically nest in Europe. In total, 365 species have been found in Slovenia. Over 200 are nesting birds, including those which nest periodically or irregularly.

Degree of research. The founder of Slovenian ornithology was the famous nature scientist J. A. Scopoli (1723-1788). At the end of the 19th and at the beginning of the 20th centuries, Slovenian ornithology developed rapidly with the establishment of the Ornithological Observatory and the publication of several basic ornithological works (Bevk, Ponebšek, Reiser, J. Hadži). The mentioned observatory is still in operation as an Ornithology Department at the

Slovenian Museum of Natural History. Gradually the number of ornithologists and bird lovers increased, and the DOPPS-BirdLife Slovenia was established in 1979. Several, mostly popular, ornithological publications were issued (I. Geister, J. Gregori, F. Šušteršič, Krečič, L. Božič) and the interest in ornithology was aroused among the amateur bird watchers. In the last decade of the 20th century three basic works of modern Slovenian ornithology were published: Ornithological Atlas of Wintering Birds of Slovenia (*Zimski ornitološki atlas Slovenije*; 1994, A. Sovinc), Ornithological Atlas of Slovenia (*Ornitološki atlas Slovenije*; 1995, I. Geister) and Internationally Important Bird Areas in Slovenia (*Mednarodno pomembna območja za ptice v Sloveniji*; 2000, S. Polak). Many local ornithological atlases and organised inventories made it possible to evaluate the abundance and population density of birds, in particular of the threatened and rare species. The data on population trends are obtained through the monitoring of specific endangered species (water-birds, Corn Crake, White Stork, Common Tern). Beside certain bat species, birds are the only vertebrates for which the size of populations and the relevant trends have been evaluated. The latest data for all bird species will be gathered in the new atlas of nesting birds of Slovenia published by DOPPS - BirdLife Slovenia.

Threats. There are no endemic bird species in Slovenia. The most important causes of threats are (Polak, 2000):

- intensification of agriculture;
- drainage of wetlands;
- construction of dikes and dams;
- expansion of tourism and outdoor recreation;
- construction of infrastructure facilities;
- abandonment of agricultural land;
- filling of marshes;
- direct disturbing of birds;
- natural encroachment of vegetation on grasslands;
- construction and maintenance of canals;



(Photo: Andrej Hudoklin)

- expansion of industry and urbanisation;
- fish farms and mariculture;
- selective cutting of forest trees.

Figure 105. *Bubo bubo, the biggest European owl has declined in numbers since the beginning of the last century.*

Mammals (*Mammalia*)

Species	Year
Rhinolophus blasii	? first half of 20th century
Castor fiber	approx. 1750
Dinaromys bogdanovi	boreal
Lynx lynx	second half of 19th century
Monachus monachus	? 19th century
Sus scrofa	? 18th century
Cervus elaphus	? 19 th century
Alces alces	? medieval times
Bos primigenius	up to the arrival of the Slavs
Bison bonasus	? 6th century

Table 38: *List of mammal species exterminated on the Slovenian territory (Kryštufek, 2001)*

Basic characteristics and number of species. Slovenian mammal fauna is entirely palearctic. Species which are characteristic for deciduous forests dominate. Two species (Arctic hare and northern bat) are boreal species and belong to the isolated Alpine population. In Slovenia, there are no relict species, which developed in the Balkan ice age refuge. In total 32.5 % of the European mammal species are found in Slovenia. On the global scale only 1.8 % of mammal species live in this area. However, taking into account the size of the territory and its geographical position, the mammal fauna in Slovenia is relatively rich.

Graph 23: *Threatened birds according to the IUCN categories.*

Degree of research. At the end of the 20th century, 83 species were identified in Slovenia. At least 8 species were non-indigenous (5 rodent and 3 ungulate species). In the last decade, 11 more species occurred occasionally - carnivores (4 species) and whales (3 species). Most of the

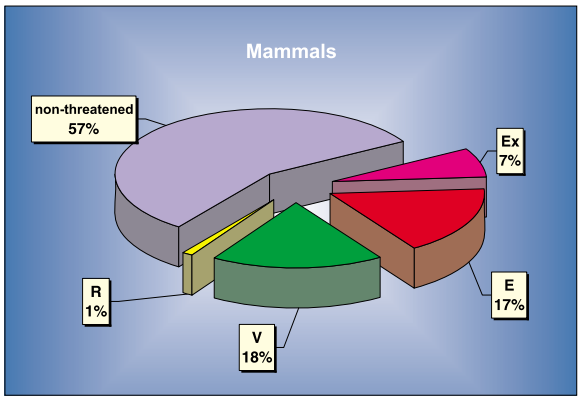
(Photo: Marko Simić)

(Photo: Andrej Hudoklin)

Figure 106 (top). *Erinaceus europaeus, the hedgehog is a frequent victim on the Slovenian roads.*

Figure 107 (above). *Felis silvestris, is becoming rare in Europe yet still well represented in Slovenia. Its existence, however, is threatened mainly by interbreeding with the domestic cat.*

occasionally occurring species have been introduced by humans. Historic data document the extinction of 10 mammal species. Two of these species have been repopulated: European lynx and beaver (spontaneous introduction from Croatia). In Slovenia, there is no tradition of monitoring animal populations and it is therefore difficult to evaluate the possible trends in the abundance of mammal populations. The only exception is that of the hunting statistics, for some areas reaching back to the 19th century. The knowledge about the mammal fauna in Slovenia is so lacking that even the actual area of distribution of many species is not known.



Graf 24: *Threatened mammals in Slovenia according to the IUCN categories.*

Bats are the species which is relatively well studied. Of 31 European species, 28 live in Slovenia (Presetnik *et al*., 2000). The basic work in that field was carried out by B. Kryštufek (1991, 1999).

Threats. There are no endemic mammals in Slovenia. The main causes of threats are:

- extensive pollution of waters (otter);
- draining and land reclamation for agriculture (ferret);
- intensive agriculture (brown hare, bats);
- transport (brown bear, deer);
- genetic pollution (European wildcat, brown hare);
- introduction of non-indigenous species (hoofed animals);
- destruction of suitable bat habitats (felling of old trees, restoration or demolition of old buildings);
- uncontrolled cave tourism and unsuitable cave closures (bats).

Subterranean animals

Basic characteristics and number of species. Subterranean habitats are mainly karst caves and interstitial waters which are low in energy and more or less closed spaces. The available data show that the subterranean fauna of Slovenia, in particular aquatic (stygobiontic), is among the richest in the world. Of 20 world cave systems with the most animal taxa, 5 are found in Slovenia. The cave system between Postojna and Planina leads in number of stygobionts and troglobionts, but the proportion of more tolerant immigrant flora is also high. Other cave systems rich in fauna are: Križna jama, Logarček, system of the underground river Šica-Krka and the cave Grad near Osp.

In the south and west of Slovenia, 169 stygobiontic species have been identified. Many of them are endemic species and their areas of distribution are small. Some of these species have only been found in typical sites. It is estimated that in Slovenia's underground around 200 stygobiontic species will eventually be identified.

The taxonomic composition of the subterranean fauna (at the level of order) is similar to the Dinaric. Special features include the only cave vertebrate in Europe (olm *Proteus anguinus*), the only cave tube-worm (*Marifugia cavatica*), the only cave mollusc (*Kerkia kusceri*), the only cave cnidarian (*Velkovrhia enigmatica*), the only cave water fleas (*Alona sketi and Alona stochi*), many

SYSTEM GROUP	Ex	Ex?	E	V	R	O	I	K	Total (Ex, Ex?, E, V, R)
Protozoa					2				2
Porifera								1	-
Turbellaria					14				14
Hydrozoa					1				1
Nematoda								8	-
Bivalvia					1				1
Gastropoda					26				26
Serpulidae					1				1
Oligochaeta					12				12
Hirudinea					1?				1?
Crustacea			1	7	20			2	28
Trichoptera					1				1
Amphibia				1	1				2
TOTAL			**1**	**8**	**80**	**-**	**-**	**11**	**89**

Table 40: *Specific taxa of subterranean animals and the number of threatened species according to the IUCN categories*

stygobiontic snail species (*Gastropoda*) and numerous epizoic turbellarians (*Temnocephalida*). The European and Slovenian subterranean fauna are characterised by the absence of stygobiontic fish.

In other respects the composition of the stygobiontic fauna is similar to that of the rest of the world. While there are no stygobiontic insects in Slovenia (rare in other parts), the fauna of crustaceans, in particular amphipods (*Amphipoda*), copepods (*Copepoda*) and isopods (*Isopoda*) is extremely rich.

Threats. Main causes threatening the subterranean fauna are:

- pollution of surface waters flowing into the underground;
- individual discharges of toxic substances on the karst surface or layers over the interstitial water;
- organic pollution of sinking rivers.


ŽIVI SVET BUKOVO-JELOVEGA GOZDA
BOGASTVO JE V RAZNOLIKOSTI

GENETIC DIVERSITY

The genetic diversity of organisms is a foundation of diversity within one species and among various species. Further evolution of species and their capability to adapt to the ever changing conditions in the environment are based on this diversity. It conserves the existing ecosystems and is a prerequisite for the existence of the species. For most species the genetic diversity has not yet been studied, and a lot of work remains to be done in this field. The results of genetic diversity are the regional and local differences in the morphology and ecology of species. These differences have not yet been examined in detail. Many species living in Slovenia are endemic and they contribute to the genetic diversity at the European and global levels.

CROPS AND DOMESTIC ANIMAL BREEDS

Biodiversity is represented not only by wild plant and animal species and ecosystems but also by nature which humankind in the course of its existence has changed, created and, through selection, adapted to its needs. In the last decades, global agriculture has been oriented towards intensive production which gives priority to a few profitable varieties and breeds whose emphasised properties are important for higher production. Such production is not natural, and consequently the varieties and breeds, which have not been adapted to the local conditions, have become weak. More pesticides, artificial fertilizes as well as chemical additives in fodder, have been applied and the impacts of agricultural production on nature and human health have become increasingly detrimental.

Over the centuries, many domesticated varieties and breeds adapted to the environment created by humans. Local varieties of cultivated hybrids and ecotypes of domestic animals developed. The biodiversity conservation therefore includes the inventory and conservation of old varieties and breeds which are resistant to diseases and do not disturb the natural environment and its landscape.

Crops

In the centuries of the development of agricultural production many plant species and their varieties have been selected and adapted to the growing conditions and local environment. Systematic study of the diversity of plant species began after the First World War, when the Russian scientist N. I. Vavilov identified eight centres of origin of all cultivated plants. Slovenia is located in the Mediterranean gene centre, which follows China as the richest in the world with regard to the number of plant species, and also belong to the Europe-Siberia centre. These regions are the centres of origin of cole crops, salad crops, hops, root crops, grain legumes and forages. Indigenous cultivars and populations named after Slovenian settlements and regions are evidence that our ancestors had been breeding these plants for centuries. Varieties of some of the indigenous cultivars have been selected and entered in the list of varieties, such as: *salad*

(Photo: Peter Skoberne)

Figure 108. *Genetic diversity includes autochthonous cultivars. Old, traditionally managed orchards are important habitat types.*

Ljubljanska ledenka (included in the European list as Laibacher Eis), cabbage Ljubljansko zelje, rampion Ljubljanski motovilec, carrot Ljubljansko korenje, onion Ptujska rdeča čebula, garlic Ptujski spomladanski česen, Ptujski jesenski česen, chicory Goriški radič, beans Ribničan, Jeruzalemski fižol, hop Savinjski golding, stubble turnip Kranjska okrogla repa, Kranjska podolgovata repa, olive tree Istrska belica, apple trees Dolenjska voščenka, Gorenjska voščenka, Goriška sevka, Štajerski mošancelj, apricot tree Pišeška marelica, cherry tree Vipavska češnja, pear tree Tepka and vine Bela glera, Briška glera, Cundra, Danijela, Dišečka, Dolga petlja, Klarnica, Osipka, Pinela, Pergolin, Planinka, Poljšakica, Racug, Radgonska ranina, Ranfol or Štajerska belina, Rečigla, Rožica, Sladkočica ali Sladkočrn, Verbena, Volovnik, Vrtovka, Zelen, Zelenika, Zunek - durelo, Žametovka.

In the 1980s, Ph. D. Jože Spanring conducted a study on the functioning of the Yugoslav gene bank. Within the project, the indigenous plant species were systematically collected in Slovenia for the purposes of the gene bank. In 1995, the minister responsible for agriculture, forestry and food designated the Commission for the preparation and implementation of the National programme on the *Slovenian plant gene bank*. In the programme, all Slovenian cultivars are included which used to be entered in the list of varieties, the Slovenian indigenous populations and old cultivars, lines and clones, bred from the indigenous plants or those which are important for the varieties' selection, ecotypes, meadow plants and wild relatives of crops found in natural sites. These data can be used for the study of species and gene diversity, the genetic erosion, and in the monitoring of the loss of old varieties and species of crops.

Threats. The main causes of threat are:

- alterations in agricultural practices;
- insufficient awareness of the public about the importance of domestic varieties of crops;
- introduction of new, highly productive varieties;
- reduced rotation of crops;
- globalisation of the agricultural market;
- deagrarisation of the countryside,
- increased burdening of the environment;
- lack of legislation concerning agriculture.

Domestic animal breeds

Domestic animals are a traditional cultural value of humanity. For centuries they have been used for the production of food and raw materials, for work or as domesticated animals. It is considered that domestic animals are animals bred by humans for their benefit, living under their protection and care. In the hundreds and thousands of years of development since domestication began, the geographically isolated species evolved into subspecies and types, adapted to the conditions of a specific environment and climate. Numerous indigenous breeds of domestic animals developed and thus biodiversity (genetic diversity) became richer. Domestic animals represent 30-40 % of agricultural economic value. The sustenance of approximately 2 billion people depends, at least in part, on domestic animals. Due to the growth of population, the production of meat, milk and eggs should double in the next 20 years.

According to the December 2000 data of the Food and Agriculture Organisation (FAO), two breeds of diverse domestic animals are lost every week. In the last 100 years around 1,000 breeds were lost, and currently one third of the breeds is facing extinction.

In the absence of effective measures it can be expected that in the next twenty years more than 2,000 breeds of domestic animals will be lost. Biodiversity of domestic animals is unique and can not be replaced. Breeds are permanently lost. The utilisation of breeds is the cheapest method of conservation of animal genes for the future. Sustainable development and conservation are the most important bases of the FAO global management strategy of biodiversity of domestic animals.

In Slovenia the breeding of domestic animals was already well developed in the Middle Ages. At the beginning of the 20th century the number of domestic animals was higher than today; indigenous breeds used to be a main source of income for many farms in Slovenia. Nowadays, many breeds are lost or hybridised and others are only preserved in extremely low numbers. Slovenian indigenous breeds of domestic animals are an important part of our heritage. They are a source of genes which will contribute to conserving the biodi-versity of domestic animals.

(Photo: Peter Skoberne)

Figure 109. *A local cow breed (Bohinjska cika) has been well adapted to the alpine conditions. Yet introduction of new more productive breeds is one of the threats to the autochthonous domestic animal breeds.*

Breed	Year	Estimated number	Degree of threat
Lipicanec - horse	1999	600	Endangered population
Cika - cattle	2000	400	Endangered population
Jezersko-Solčavska ovca - sheep	2000	4,500	Vulnerable population
Bovška ovca - sheep	2000	1,500	Vulnerable population
Istrska pramenka - sheep	2000	600	Endangered population
Belokranjska pramenka - sheep	2000	250	Endangered population
Krškopoljski prašič - pig	2000	300	Endangered population
Štajerska grahasta kokoš - hen	2000	1,000	Vulnerable population
Kraški ovčar - dog	2000	950	Endangered population
Slovenski planinski gonič - dog	2000	35	Critical situation
Posavski gonič - dog	2000	470	Endangered population
Resasti istrski gonič - dog	2000	460	Endangered population
Kratkodlaki istrski gonič - dog	2000	1,020	Vulnerable population
Kranjska čebela Carniolan honeybee (*Apis mellifera Carnica*)	1999	162,000 beehives	Stable situation

Table 41: *Number and degree of threat of specific Slovenian indigenous domestic animals in 2000 (Source: BF Oddelek za zootehniko).*

Through out the centuries these breeds were adopted to the Slovenian environment and bred by the Slovene farmer.

The status of indigenous breeds of domestic animals in conservation programmes. The data on number, spatial distribution, method and purpose of breeding, production utilisation, etc. are continuously maintaned for Slovenian indigenous breeds.

Threats. The main causes of threats are economic:

- abandonment of agricultural production and deagrarisation of areas;
- introduction of new, highly selected, specialised and productive breeds and the intensification of agriculture.

Artificial insemination in cattle breeding has resulted in higher productivity of specific breeds, and three or four highly productive breeds are found all over the world. Numerous local breeds have disappeared or are very rare and their existence is threatened. The same applies to other livestock breeding sectors, such as poultry and pig production. Indigenous breeds from a hundred of years ago have been replaced by modern and globally spread breeds and lines.

As a rule, indigenous breeds are not highly productive and are therefore not economically interesting. Usually they are not even included in the regular selection procedures. However, some of their traits have been neglected, such as adaptation to the environmental conditions, specificity of their products, resistance to diseases etc. In particular these breeds could facilitate the development of new breeds, adapted to the breeding conditions. Biodiversity of domestic animals is particularly threatened by the export of pure bred animals from developed countries, which leads to cross-breeding and even replacement of local breeds. Breeds from developed countries are more productive but they are not adapted to demanding breeding conditions.

FOREST WOODY PLANTS

It is generally believed that the established concept of sustainable management in Slovenian forestry ensures the genetic diversity of the complex of biological components in forest ecosystems. This belief arises from ignorance of the actual genetic diversity, affected by the introduc-

(Photo: Peter Skoberne)

Figure 110. *Trees can host a variety of animal species, an example is the larva of Cynips quercusfolii.*

(Photo: Marko Simić)

Figure 111. *Due to uncontrolled distribution of spruce in Europe the source of seed in the seed bank can be questionable.*

tion and promotion of spruce in the past, the selective forest cultivation measures, supporting only individual tree species, the introduction and uncontrolled transfer of propagating material, the selective human impacts on forests - in particular the pollution of environmental media and climate change - the ignorance of the biocomponents of the forest soil, the biology of symbionts and pathogens of the forest trees, etc.

Despite the traditionally sustainable forest management and the long-lasting expert work on the forest gene bank **the origin of some of the prevailing tree species found in Slovenian forests is not known**. Problematic species are in particular:

- **spruce**, which was uncontrollably transferred across Central Europe; even the origin of seed in the seed bank is doubtful;
- **oak**, in particular English oak and sessile oak, whose origin is not clear; oak species are also a taxonomic problem because the species are cross-breeding; the data provided in the Forest inventory issued by the Slovenian Forest Service do not reflect the actual status;
- **fir**, whose natural rejuvenation is hindered by the abundant game.

Rare and endangered species or species, whose distribution boundary is in Slovenia, are *Taxus baccata, Sorbus domestica* and *Sorbus torminalis, Ulmus glabra, Ulmus minor, Ulmus laevis, Castanea sativa*, partly endangered species like *Pyrus pyraster, Malus sylvestris* and *Juglans regia*. In addition to the mentioned, other rare, mostly sub-Mediterranean, species of Slovenian forests are also endangered. Amongst them are: *Laurus nobilis, Mespilus germanica, Pyrus amygdaliformis, Cercis siliquastrum, Pistacia terebinthus, Acer obtusatum, Acer tataricum, Ilex aquifolium, Quercus crenata, Quercus ilex, Celtis australis* and *Phillyrea latifolia*.

Seed bank. Due to the easy storage and historical need for seed, most seed bank units in the Slovenian forest bank are spruce seed. Germinability of seed in the seed bank is tested annually, in comparison to the year of yield for individual seed stands. In 1998 the germinability of seed from 1988 yield was satisfactory while older seed (from 1971, 1977, 1980 (partial yield) in 1982) and seed from 1992 was of lower quality. Spruce seed in seed bank should be gradually supplemented by new supplies, provided that the yield is good. Simultaneously, a new data bank should be established, based on the genetic analyses for controlling the origin of spruce seed from individual seed stands.

(Photo: Peter Skoberne)

Figure 112. *Taxus baccata, the yew tree protected in Slovenia since 1976 is mainly threatened due to the good quality of its wood.*

A special problem is the **recalcitrant seed of deciduous trees**, such as oak, for which special storage procedures are needed due to the high moisture content of the seed. No such seed is currently stored in the Slovenian seed bank. The procedures for the storage of deciduous trees should be further developed because these species are becoming more important with regard to promotion of the species diversity of Slovenian forests.

Not only the genetic variability of the forest trees' populations should be inventoried. The physiological properties of these populations, and of other biotic co-creators of forest ecosystems, should also be established. Particularly long-lasting are the provenience studies of successful growth and the survival of forest trees in different ecological conditions. Very important are also the studies concerning the resistance to pathogens and efficient symbiosis with other organisms in the mycorrhizosphere.

LANDSCAPE DIVERSITY

CHARACTERISTICS AND STATUS

One of the principal characteristics of Slovenia is the diverse and mosaic structure of its landscapes[1], denoted by a small scale and minute division of landscape components (ecosystems). Landscape upgrades biodiversity and is very important from the point of view of its enjoyment[2].

The high landscape diversity is the result of the diverse geology, relief and climate factors (Alpine, continental and Mediterranean) of the area. On such a basis, diverse and heterogeneous ecosystems have evolved. In addition, the landscape is influenced by human activities, in particular agriculture and forestry, which have developed in accordance with the natural conditions. The traditional settlement patterns, and lately the intensive urbanisation and construction of infrastructure, affect the land-scape. The structure of the predominant cultural landscape is most favourable when its productive, settlement, ecological and cultural aspects are balanced. Such landscape is eco-nomically effective, is imbued with natural elements and shows a harmonised image.

Landscapes have been classified by many authors. However, the classifications depend on how a specific science regards landscape issues. Forman (1990) classifies landscapes as natural, partly managed, managed and urbanised. According to Anko (1998), landscapes may be natural or cultural. Cultural landscape is further divided into forest, rural and urban-industrial landscape.

The principal characteristic of landscape diversity of Slovenia is the mosaic structure and the diversity of its units which are a result of natural attributes and the long-lasting presence of humans who continuously changed the manner of land use. The geology of the area, its geomorphological diversity, soil, climate conditions and biogeographical regions are reflected in the diversity of landscapes. In Slovenia this diversity is high. In its territory the natural, partly managed and urbanised landscapes (Forman, 1990) are found. From the ecological point of view, the landscape components are patches, corridors and the surrounding matrix which determine the small- and large-scale biological and landscape diversity.

The agricultural and forest ecosystems dominate in the managed, cultural landscape. However, minor ecosystems, such as forest clearings, tree groups on farmland, and wetlands, are of extreme importance for its diversity.

THREATS

It is difficult to say that a landscape is directly threatened because its main characteristic is change itself. These changes are caused by humans and their activities, or lack of them, and natural processes because nature is capable of reclaiming the land 'lost' in the past.

Causes of changes and threats to inter-landscape and intra-landscape diversity are:

- Unplanned and increasing settlement of the countryside, including the construction works on arable land and the decline of traditional urbanisation patterns with preserved natural features;
- Inappropriate urbanisation of the city suburbs and open landscape when the characteristic landscape patterns are altered;
- "Illegal building" - activities affecting the environment which have not been permitted and are not controlled; the most exposed and sensitive landscapes are affected, such as floodplains, riverine areas, elevated and exposed slopes and ridges;

[1] The term landscape is multilayered. The definitions of landscape may be very simple - such as found in dictionaries - that landscape is an expanse of scenery that can be seen in a single view, or the more complex landscape ecology definition by Forman (1990) that landscape is a system of ecosystems with specific structures, functions and changes. Landscape could be defined according to the English geographer Meinig (Ogrin, 1986) who described landscape as nature, dwelling, artificial formation, system, problem, property, ideology, history, place and aesthetics.

[2] Landscape is a complex system, experienced by humans. Therefore, it should express the considerate attitude of humans toward nature, be visually attractive and it should be possible to identify landscape at the local and national levels. The landscape is visually attractive if it is complex, if its components are contrasting and if its spatial order is ensured.

(Photo: Marko Simič)

Figure 113. *Terrace walls built of limestone are an important element of the cultural landscape on Banščice plateau, and at the same time contribute to its rich habitat diversity.*

- Construction of flats and residential houses, secondary homes and tourist facilities which stand out in the landscape of a protected area;
- Construction of large infrastructure facilities, for example the highway system, railway towards Hungary and the coast, causes the fragmentation of habitats and divides landscape units;
- Construction of new hydro electric power plants and power lines modifies the water and riverine landscape;
- Numerous excavation sites, such as quarries, gravel pits, clay pits and sand pits, degrade landscape because of the size of the activity and its dominant appearance in the landscape; the renaturation of these excavation sites is rarely carried out, but its purpose is to conserve the new habitats of rare and endangered species (European bee-eater *Merops apiaster*);
- Tailings disposal sites and waste disposal sites (many are illegal and uncontrolled) in environmentally valuable areas and landscapes (by rivers, karst sinkholes, ravines);
- Activities affecting watercourses and water areas are the result of other activities affecting the environment by which the building sites, infrastructure and agricultural land are protected from floods. The canalisation of streams and rivers and the filling of wetlands, if the activities are not adapted to the ecology of the area, can cause intensive alterations in the landscape.
- Construction of tourist facilities (beaches, marinas) and expansion of industry (port) on the Slovenian coast affects the coastal zone and alters the current coastline;
- Landscape is profoundly affected by agriculture which is the main factor in the creation of cultural landscape. The agri-cultural production is intensifying but at the same time, the relevant surface area is becoming smaller. The modernisation of agriculture results in homogenous land use categories. The natural components of landscape slowly disappear, such as individual trees and tree and shrub hedges. Micro-relief formations are being levelled and the rivers and streams canalised, which makes the landscape uniforms and reduces its diversity.
- The opposite to the intensification of the cultivation of land is the abandonment of agricultural land and its natural enchroachment by scrubs and trees. In Slovenia the process began at the end of the 19th century but it intensified after the Second World War. Forests have become the prevailing landscape feature since they cover more than a half of the territory of the country. In addition, the rate of forestation is still increasing. Extensive areas of newly forested land and their intended use remain an open issue of the spatial planning policy as well as agriculture and forestry.

DEGREE OF RESEARCH

Experts in different fields are occupied with the issues concerning landscape: landscape architects, landscape ecologists, geographers, foresters, ecologists, archaeologists and art historians. Most research in this field has been conducted by the landscape architects at the Department of Landscape Architecture at the Biotechnical Faculty (*Strategija varstva krajine* - Landscape Conservation Strategy, Ogrin, 1996; *Izjemne krajine v Sloveniji* - Exceptional Landscapes of Slovenia, Ogrin, 1999) and by landscape ecologists at the Department of Forestry and Renewable Forest Resources at the same faculty (*Vrednotenje krajin z vidika biotske raznovrstnosti ter izhodišča za njihovo varstvo* - Assessment of Landscapes with regard to Biodiversity and the Grounds for their Conservation, Anko, 2000; *Vidiki krajinske pestrosti na primeru pestrosti ornitofavne Ljubljanskega barja* - Aspects of Landscape Diversity in view of the Diversity of Ornithofauna of Ljubljansko barje, Groznik Zeiler, 2000).

The main deficiency is the insufficient research on the landscape diversity factors, the structural diversity of landscapes, the processes which cause its transformation and the correlation between the structure of landscapes and the social aspects of its diversity. So far, no models concerning the design of cultural landscapes in the future have been developed.

Simultaneously, no close relation to the research on cultural landscape from the point of view of cultural heritage has been established.

PRESENTATION OF LANDSCAPE TYPES

The reference for the presentation of the diversity of Slovenian landscapes is the study by Marušič Regional Distribution of Landscape Types in Slovenia (*Regionalna razdelitev krajinskih tipov*, 1996) which was part of the material collected during the drawing up of the spatial plan of Slovenia. Its purpose was to inventory the landscapes in Slovenia, to present them to the public and to draw up guidelines for the activities affecting the landscapes and their conservation.

The landscapes are presented hierarchically. There are 5 basic regions at level 1: Alpine, sub-Alpine, sub-Pannonian, Karst and coastal landscapes. They comply with the geographical regionalisation of Slovenia by Gams (1979) which has been determined on the basis of the climate and geology of the territory. These regions are further divided into 18 landscape units defined by the relief features, hydrology and vegetation cover. At level 3, there are 67 units, 233 subunits at level 4, followed by 357 landscape patterns. The list of exceptional landscapes referred to in the study by Ogrin, Exceptional landscapes of Slovenia (1999)[3], is added to the description of each region. The selection is not complete and the list of landscape patterns will have to be supplemented by Ljubljansko barje, Strunjan cliffs and specific forest landscapes which are, despite their homogeneity, important from the point of view of landscape diversity (*Abieti-Fagetum dinaricum* forests in Kočevje region).

(Photo: Peter Skoberne)

Figure 114.
Zajamniki, a typical alpine pasture in the Triglav National Park.

Landscapes of the Alpine region

These landscapes occupy the north-west part of Slovenia with the highest mountain ranges of the Julian Alps, Karavanke and Kamnik and Savinja Alps in the East-West direction. The prevailing limestone and dolomite, uplifted during the last orogeny processes, define the varied relief with substantial elevation difference between the highest mountain peaks and glacial Alpine valleys. The climate is harsh, Alpine, which is evident from the vegetation cover adapted to such conditions. At the bottom of the valleys, the remains of uneven meadows can be found. As the elevation increases the deciduous forest is slowly replaced by spruce stands, followed by dwarf pine communities with an occasional larch. At the top of the mountains, grasses and diverse Alpine flora grow. The population density in the Alps is low. The villages are clustered and situated on high, sunny terraces. In the highlands, 'solitary' farms mainly replace the already rare villages. The lack of arable land in the valleys forced the farmers to fell forests and turn them into pastures for grazing livestock. Mountain pastures with herdsmen cottages are one of the characteristic elements of the area.

Suggested outstanding landscapes of the Alpine region are: Bohinj, Bohinjska Češnjica, Drežnica, Jezersko, Koprivna, Logarska dolina z Matkovim in Robanovim kotom, Log pod Mangrtom, pastures Javornik na Pokljuki, Uskovnica, Voje and Zajamniki, Podolševa, including the farms Klemenšek and Macesnik, Studor, Topla, Trenta and Velika planina.

Landscapes of the sub-Alpine region

This type cover Slovenia's territory from the Italian border along the river Nadiža, across the west sub-Alpine highlands, the central lowlands of Ljubljana basin, East sub-Alpine highlands

[3] *The most important criteria for the selection of exceptional landscapes are:*
- complete and unique, visually interesting landscape pattern,
- sensible adaptation of land use categories to the natural features of the area,
- suitable relation between the economic, ecological and cultural aspects,
- high expression value of the landscape due to its structural authenticity with traditional field pattern,
- presence of historic, monumental, archeological and other similar features,
- exceptionality of natural features and cultural heritage,
- landscape pattern complies with the settlement pattern,
- exceptionality of the settlement pattern and its spatial position,
- complexity of the landscape structure,
- complexity as a result of diversity within the same structural unit,
- symbolic value, representativeness for a specific region.

(Photo: Marko Simič)

Figure 116. *Banjščice plateau is sufficiently open to the Mediterranean to reflect its influence on the picturesque cultural landscape. The dry karst bedrock does not support intensive agricultural development.*

along the river Sava to Pohorje and Kozjak by the Austrian border. The geology of the area is characterised by dolomite and limestone as well as magmatic and metamorphic rocks in the east and extensive alluvial deposits in the Ljubljana and Celje basins. The diverse geology of the area determines the relief and the appearance of landscapes. Rounded hills formed of softer bedrock interchange with steep limestone and dolomite peaks which do not exceed the altitude of 1000 m. The west part of the region (the hills of Cerklje, Idrija and Škofja loka) is extremely variegated. On the other hand, the east of the region is defined by lower altitudes with moderate passes and several high tops and ridges: Paški Kozjak, Kum, Lisca, Boč. Villages with fields are often located on the slopes and soft ridges. Livestock breeding is well developed and the main land use category is meadows. In the valleys, the reclaimed land is used for various agricultural purposes. The evidently degraded areas are the reflection of mining activities. In the area, the clustered villages, hamlets and 'solitary' farms prevail but large settlements in lowlands are growing fast.

(Photo: Marko Simič)

Figure 115. *Ponor Šice on Radensko polje south of Ljubljana nearby Grosuplje. Radensko polje is a karst polje threatened by stream canalisation and land reclamation.*

Suggested outstanding landscapes of the sub-Alpine region: Adergas, Brunk - Osredek, Bitnje, Spodnje and Zgornje Danje, Dobrave pri Lescah, Bled, Črni vrh, Jamnik nad Kropo, Jekl, Koreno pri Horjulu, Labinje, Pik na Koroškem, Podsreda s Starimi gorami, Prtovč, Rovtarjev vrh - Vojsko, Pohorja, Radensko polje, Razbor pod Lisco, Resnik - Skomarje, Rovte, Rut - Grant - Stržišče, Sorica, Strojna, Svibno, Širje nad Zidanim mostom, Velika Slevica, Zali Log and Žirovnica nad Radečami.

Landscapes of the sub-Pannonian region

These landscapes occupy the entire eastern part of Slovenia and a 'detached' region in the south comprising the hills of Posavje and Obsotelje as well as Krško-Brežiško polje and the valley of the river Krka and its skirts. In the lowlands, the geology of the area is defined by the sand and gravel or clay deposits, the hills consist of tertiary sediments mixed with clastic rocks and carbonates. The Pannonian region is characterised by vast lowlands and low gentle hills covered by vineyards. The region has a moderate continental climate which is extremely suitable for viticulture. Two distinctive patterns dominate the agricultural landscape in the lowlands: large-scale homogenous landscape where the land has been reclaimed for agricultural purposes and the traditional narrow fields separated by hedges. The relics of lowland forests and floodplain woodlands can be found along the lower courses of the rivers. The structure of the landscape in the hills is mosaic. The forests cover the shady, steep slopes and ravines between vineyards. The fields, meadows and orchards are located on the sunny and gentle slopes. The proportion between the arable land and forests has been changing and currently most vineyards are found in the vicinity of large settlements, and the less accessible parts of the region have become forests. In the lowlands, people live in clustered villages flanking the road, and in the hills in dispersed villages and hamlets. Small vineyard cottages situated on the hills' ridges are characteristic of the vinegrowing areas.

Suggested outstanding landscapes of the sub-Pannonian region: Bukovnica, Dolinsko pri Polani, Donačka gora, Gradišče v Slovenskih Goricah, Haloze, Jeruzalem v Slovenskih Goricah, Jovsi pri Brežicah, Kalvarija - Piramida v Mariboru, Kobilje, Mura between Dolnja Bistrica and Hotiza, Lendavske gorice, Otočec, Radulja pri Klevevžu and the region between Tinska and Babna gora.

Karst landscapes of inner Slovenia

Karst landscapes occupy the south central part of Slovenia with Gorjanci in the east and the plateau of Trnovski gozd and Banjščica in the west. The bedrock of the area is limestone and

dolomite. They form a karst relief with all the diversity of karst forms, from karst poljes and underground streams to sinkholes and caves. The climate in the area is continental. Altitudes, which exceed 500 m, contribute to its sharpness. The region is characterised by vast and preserved fir-beech (*Abieti-Fagetum dinaricum*) forests and karst poljes which extend in the direction of the Dinaric mountains (NW-SE). Agricultural production, which is concentrated on karst poljes and large flatlands, is mainly extensive. The settlement pattern in the landscape is clustered villages surrounded by arable land and mown grasslands which are gradually turning into forests.

Suggested outstanding Karst landscapes of inner Slovenia: Bočje - Gadova peč, Cerkniško jezero, Zelše, upper valley of river Kolpe, Drašički ali Marindolski steljniki, Dvor pri Soteski, Globodol, Hotedršica, source of the Krka near Trebnja Gorica, Loški potok, Otlica - Predmeja, Planinsko polje, Strmca pri Postojni, Suhor v Beli krajini and Šmihel ob Krki.

Landscapes of the Primorje region

The landscapes include the south west part of Slovenia, from the sea to Matarsko podolje, Vipavska dolina, Karst and the Soča valley. The region is characterised by the sub-Mediterranean climate. The bedrock of the area is hard limestone with patches of flysch which is a suitable ground for agricultural production. The uniformity of the region is expressed through the characteristic sub-Mediterranean vegetation and ecosystems, such as natural uncultivated and overgrown karst areas and forests of European black pine (*Pinus nigra*). The traditional and picturesque barren karst has almost disappeared. The Primorje region is characterised by intensive land use (horticulture, vineyards, orchards, olive tree plantations). In the past, the less productive land in the Karst was intensively exploited but nowadays this land is being overgrown. Traditionally, the climate conditions were taken into account in the location of settlements which were thus situated in the leeward areas and on sunny gentle ridges of Slovenska Istra and Goriška Brda. The traditionally clustered settlement pattern is slowly turning into a dispersed one. The vertical component of the coastal landscape is formed by the cypresses (*Cupressus*).

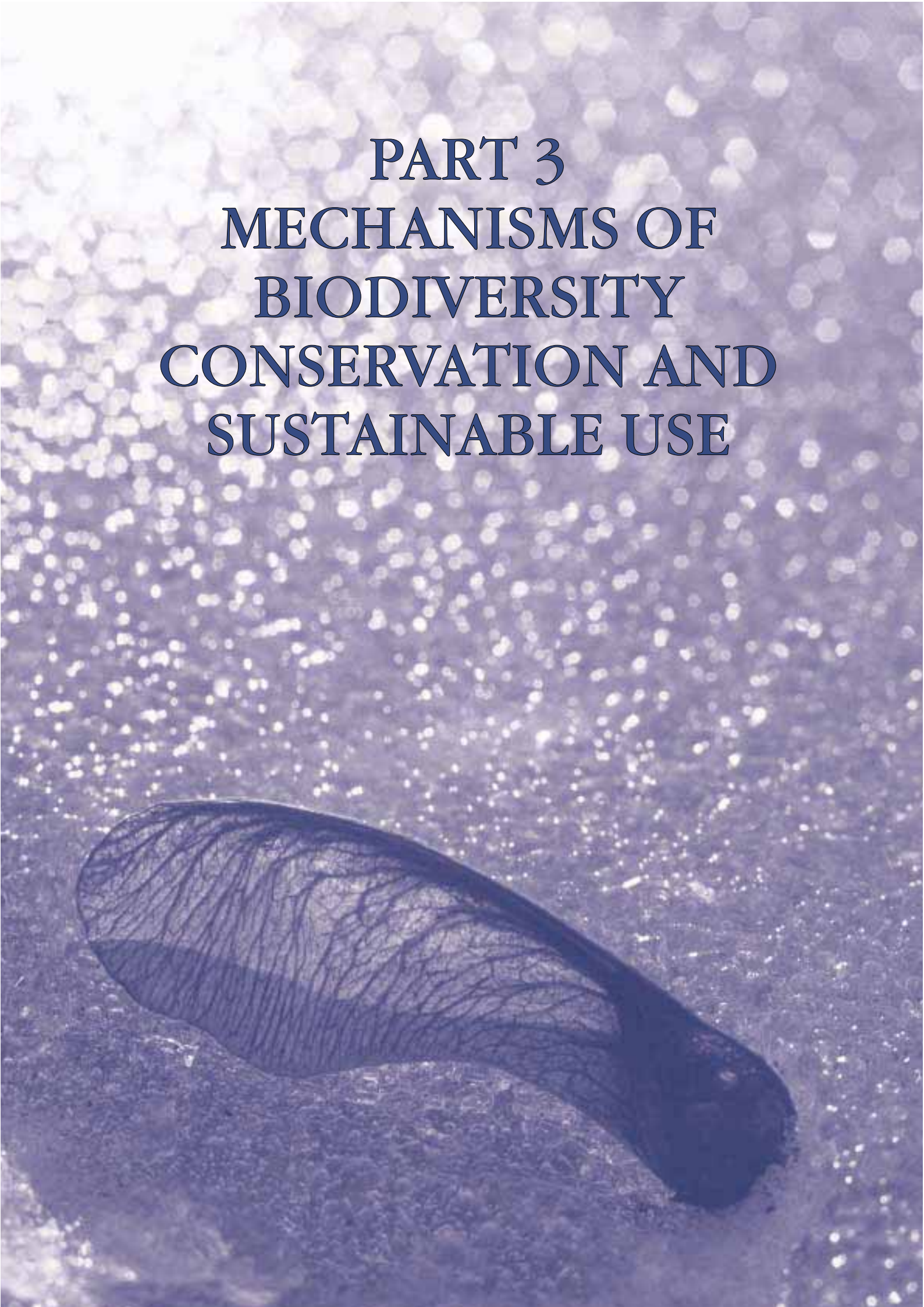
(Photo: Marko Simić)

Figure 117. *The largest collapse doline in the Slovenian Istra is above the village Osp. Its biodiversity value is in floristic, vegetation and faunistic particularities.*

Suggested outstanding landscapes of the Primorje region: Črni Kal, the region of Dutovlje - Tomaj, Izola, ridge settlements: Koštabona, Padna, Šmartno in Krkavče, Lipica, Podgorski kras z Marijo Snežno, Marija Snežna pri Gočah, Rožar pri Tinjanu, Sečoveljske soline, Strunjanske soline, Sveto pri Komnu, Škocjanske jame, Šmartno v Goriških Brdih in Vrtača pod Čebulovico.


GORSKI SVET
BOGASTVO JE V RAZNOLIKOSTI

PART 3
MECHANISMS OF BIODIVERSITY CONSERVATION AND SUSTAINABLE USE



BACKGROUND

Since 1991 Slovenia has been undergoing a number of political, juridical and economic changes. Together with the creation of a new democratic state and its decentralisation, the economic system is being transformed from a self-management into a market economy. When Slovenia gained its independence, it was faced with many demanding tasks related to the construction of a new legal and economic system. The changes inevitably result in modified social values, and the whole society suffers from shocks caused by new values and the inability of certain social groups to adapt to the current situation. In such a climate, it is important to focus on the guided raising of social awareness about the importance of biodiversity conservation and about the corresponding need to act. This aim could only be achieved by the appropriate education and raising of public awareness as well as by the integration of the civil society institutions into the process of biodiversity conservation. However, the awareness about the complexity of the issues related to the conservation and sustainable use of biodiversity is currently still unsatisfactory.

The legal order of a certain State reflects the values which are guaranteed and protected within it. Through legislation the basis for the attainment of these values is established, together with the inclusion of the prescribed procedures and the competent organisations. The legal order presents an integral legal system, materially and officially harmonised, which ensures the rule of law. The ratification of the Convention on Biological Diversity reflected the conviction of the country that biodiversity conservation is necessary and that the relevant components have to be used in a sustainable manner. However, for the implementation of this Convention a certain legal framework which determines the programme structure and the economic measures for the biodiversity conservation components has to be set up.

(Photo: Marko Simić)

Figure 118. *Coronella austriaca, is often mistaken for the poisonous Vipera berus.*

The sectors whose impact on the state of biodiversity and its trends is substantial are: agriculture, forestry, fisheries, tourism, transport, the energy sector, water management, spatial planning, regional development, the banking sector and others. Integration is therefore the main challenge which Slovenia faces in the field of biodiversity conservation and sustainable use of its components, in particular while taking into account that in the past the isolated sectoral approach towards the exploitation and management of natural resources prevailed.

Until now, the value of biodiversity has not been accounted for in the national economic calculations. The main reasons are of a methodological nature and are mainly based on underestimation of the potential value the biodiversity has for the national economy.

The state of the genetic resources, except in the agricultural and food processing sectors, has not yet been adequately discussed. Only the Convention has brought them to the attention.

The denationalisation and privatisation altered the ownership structure, and thus the *in*

situ conservation is faced with new challenges. Nowadays the fact that Slovenia has not developed a system of financial support and compensations makes it difficult to carry out the *in situ* conservation. Beside that, one of the major problems is the lack of communication with other sectors. Many national programmes and strategies have been drawn up but the actual support for their implementation is still weak.

The responsibilities and competencies of the public institutions have not been clearly defined, since the division of powers and responsibilities has not yet been completed. In particular in the field of nature conservation, including biodiversity, the transparency of the organisational scheme and human resource capability is extremely weak, which lessens the efficiency of the sector. The institutions responsible for the implementation of the already assumed international and national obligations often lack the qualified staff and strength needed to enforce the relevant instruments, or else their infrastructure is inadequate. Among the most deficient task-areas are the identification, preparation, financing and implementation of the nature conservation projects. The consultants are rarely hired to solve specific problems. On the market, there are not enough funds to implement these programmes because the banking sector is not yet prepared to invest in the nature conservation and environmental projects.

The general level of knowledge and the technical qualifications of decision-makers is quite satisfactory, but those people are not qualified to analyse alternatives closely related to the key issues of sustainable development.

The management and communication skills are unsatisfactory at all administrative levels. The shortage of experts in certain fields, e.g. environmental economists, environmental lawyers and communication experts is critical.

In 2000, the needs and priorities for the implementation of the biodiversity conservation activities were evaluated by the GEF and UNDP.

(Photo: Peter Skoberne)

Figure 119 (right). *Nigritella rubra, is among the rarest orchids in Slovenia and can be found on Mt. Snežnik.*

(foto: Peter Skoberne)

Figure 120. *The edges of karst plateaux in the western part of Slovenia (Trnovski gozd is in the photograph) are constantly exposed to the strong easterly winds 'burja'. The dry karst meadows typical of these areas have a high botanical value. The edges are also of interest for the use of wind energy.*

LEGAL FRAMEWORK FOR THE CONSERVATION AND SUSTAINABLE USE OF BIODIVERSITY

Biodiversity conservation has been included in the Constitution of the Republic of Slovenia. Although its inclusion in this fundamental legal act is not explicit, it is nevertheless notable.

Biodiversity conservation and sustainable use of its components are regulated by several acts. Some merely regulate the protection and conservation of biodiversity, and others its sustainable use, all within the framework of the management of particular components of biodiversity. A summary of acts regulating specific fields of protection and conservation of biodiversity and the use of its components is given below.

Beside the *Environmental Protection Act*, the fundamental regulation in the field of the environmental protection, the overview also includes the *Nature Conservation Act* with a number of implementing mechanisms for the direct and indirect conservation of biodiversity and the *Animal Protection Act*. In the second part, all the acts regulating the use of individual components of biodiversity are included. The Slovenian legislation considers these components as natural resources which include forests, agricultural land, waters, wild plants and animals. In this part the *Spatial Planning Act* is also discussed. This is extremely important for the biodiversity conservation, because in particular spacial use should take into account nature and biodiversity. In the procedures concerning the spatial planning and the activities affecting the environment the conflict between conservation and development is reflected. Space is a limited asset and it is important in what way and how carefully the decisions concerning its use are taken when the development and conservation interests meet. The legislation concerning space is now obsolete but a new one is being drawn up. Certain instrumental measures have been enforced by the Environmental Protection Act and the Nature Conservation Act (environmental vulnerability study, environmental impact assessment, etc.).

LEGAL FRAMEWORK FOR THE CONSERVATION OF BIOLOGICAL AND LANDSCAPE DIVERSITY

Constitution

The grounds for regulation environmental protection and nature conservation lie in the Constitution of the Republic of Slovenia. In its general provisions it is laid down that the State provides for the preservation of the natural wealth and creates opportunities for the harmonious development of society and culture in Slovenia. The Constitution stipulates that the acts and other regulations have to comply with the principles of international law and the international treaties which oblige our country. This provision is of great importance for the nature conservation and the protection of the environment because the relevant conventions form a constituent part of Slovenia's legislation. With regard to the hierarchy of legal acts, the laws and executive regulations which have not been harmonised or are in contradiction with the mentioned conventions and international treaties may not be applied pursuant to these provisions.

In the chapter on Economic and Social Relations, it lays down that pursuant to the law the property is acquired and enjoyed so as to ensure its economic, social and environmental function. Pursuant to the Constitution, the ownership rights to real estate may be revoked or limited in the public interest if the conditions stipulated by the law are met. The natural wealth may be exploited if the conditions stipulated by the law are met, and the Constitution further defines the legal order regarding special conditions for land utilisation and special protection of agricultural land. The State is obliged to provide a healthy living environment and establish by law the conditions and manner in which economic and other

activities are pursued. It stipulates that everyone is obliged in accordance with the law to protect natural sites of special interest and rarities and that the State and local communities have to promote the conservation of the natural and cultural heritage.

A special provision included in the Constitution is that the cruelty to animals is regulated by the law. That provision can not be found in the constitutions of other countries.

International legislation on nature conservation

International conventions

By notifying the conventions ratified by the Socialist Federal Republic of Yugoslavia, Slovenia has taken over the obligations of the Ramsar Convention, the Barcelona Convention and the Convention Concerning the Protection of the World's

Table 42: *International biodiversity relaterd conventions ratified by Slovenia*

SHORT NAME	TITLE	PLACE AND YEAR OF ADOPTION	YEAR OF ENFORCEMENT/ NUMBER OF PARTIES	STATUS IN SLOVENIA
GLOBAL CONVENTIONS				
Ramsar Conven.	Convention on Wetlands of International Importance especially as Waterfowl Habitat	Ramsar, 1971	1975 123 (2001)	notification in 1992 (Ur. l. RS, 15/92)
World Heritage Convention	The Convention Concerning the Protection of the World Cultural and Natural Heritage	Paris, 1972	1976 161 (2001)	notification in 1992 (Ur. l. RS, 15/92)
Washington Convention or CITES	The Convention on International Trade in Endangered Species of Wild Fauna and Flora	Washington, 1973	1975 150 (2000)	ratified in 1999 (Ur. l. RS, MP* 31/99)
Bonn Convention	The Convention on the Conservation of Migratory Species of Wild Animals	Bonn, 1979	1983 70 (2000)	ratified in 1998 (Ur. l. RS, 72/98, MP 18)
The Conven. on Biological Diversity	The Convention on Biological Diversity	Rio de Janeiro, 1992	1993 178 (2000)	ratified in 1996 (Ur. l. RS, 30/96, MP 7)
REGIONAL CONVENTIONS				
Bern Convention	The Convention on the Conservation of European Wildlife and Natural Habitats	Bern, 1979	1982 40 (2000)	ratified in 1999 (Ur. l. RS, 55/99, MP 17)
The European Landscape	The European Landscape Convention Convention	Florence, 2000	-	signature and ratification under way
Aarhus Convention	Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters	Aarhus, 1998	-	signed in 1998; ratification under way
Alpine Convention	Convention on the Protection of the Alps	Salzburg, 1991	1995 9 (1999)	ratified in 1995 (Ur. l. RS, 19/95, MP 5)
Barcelona Convention	Convention for the Protection of the Marine Environment and the Coastal Region of the Mediterranean	Barcelona, 1976	? 21 (2000)	notification in 1992 (Ur. l. RS, 15/92)

* international treaties

Cultural and Natural Heritage. As an independent state, Slovenia has signed and ratified the following conventions: the Convention on Biological Diversity, the Alpine Convention, the Washington biodiversity related Convention, the Bonn Convention, the Bern Convention and the Danube Convention. It has signed, but not yet ratified, the Aarhus Convention.

Nature conservation regulations issued by the European Community

The objectives of the Fifth Environmental Action Programme in the field of nature conservation are:

- conservation or restoration of natural habitats and wild plant and animal species with a favourable conservation status;
- establishment of an integral European Ecological Network of Special Areas of Conservation - Natura 2000,
- stringent control of the trade in endangered wild plant and animal species and the prevention of their misuse.

In order to implement the international obligations in the field of biodiversity conservation and the objectives of the environmental programme the following regulations are listed in the European Union Table 43.

The Birds Directive and the Habitats Directive are the key instruments for the conservation of plant and animal species and habitats of Community importance at a favourable status, the objective of which is to ensure the protection of species and the designation of special protected areas included in the ecological network NATURA 2000.

Other environmental legislation important for the conservation of biodiversity are: the environmental impact assessment directive, the regulation concerning enhancement of the efficiency of agriculture and, in particular, the agri-environmental regulation which stipulates the agricultural production methods compatible with the requirements of the protection of the environment and the maintenance of the countryside, and also enables the environmental standards to be integrated in the Common Agriculture Policy of the European Union.

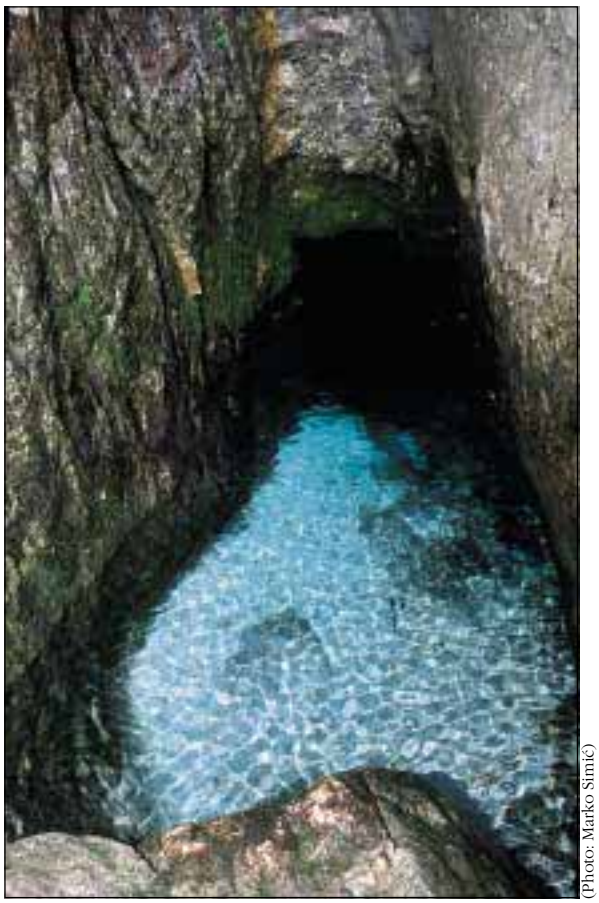
Title
Protection of species and habitats
The Wild Birds Directive:
Council Directive 79/409/EEC of 2 April 1979 on the conservation of wild birds (OJ L 103, 25. 4. 1979)
The Habitats Directive:
Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora (OJ L 206, 22. 7. 1992)
International trade
The Endangered Species Regulation:
Council Regulation (EC) No 338/97 of 9 December 1996 on the protection of species of wild fauna and flora by regulating trade therein (OJ L 61, 3. 3. 1997)
The Skins of Seal Pups Directive:
Council Directive 83/129/EEC of 28 March 1983 concerning the importation into Member States of skins of certain seal pups and products derived therefrom (OJ L 91, 9. 4. 1983)
The Regulation on Imports of Cetacean Products:
Council Regulation (EEC) No 348/81 of 20 January 1981 on common rules for imports of whales or other cetacean products (OJ L 39, 12. 2. 1981)
Commission Regulation (EC) No 1968/1999 of 10 September 1999 suspending the introduction into the Community of specimens of certain species of wild fauna and flora (OJ L 244, 16. 9. 1999)
Other legal acts
The Regulation on Leghold Traps:
Council Regulation (EEC) No 3254/91 of 4 November 1991 prohibiting the use of leghold traps in the Community and the introduction into the Community of pelts and manufactured goods of certain wild animal species originating in countries which catch them by means of leghold traps or trap ping methods which do not meet international humane trapping standards (OJ L 308, 9. 11. 1991)
Council Directive 1999/22/EC of 29 March 1999 relating to the keeping of wild animals in zoos (OJ L 94, 9. 4. 1999)

Table 43: *European Union legislation related to the nature conservation.*

Protection and conservation of Biological and landscape diversity

Environmental Protection Act

The Environmental Protection Act (hereinafter referred to as the ZVO) is a fundamental act regulating the objectives and principles of environmental protection. With this Act the foundations of the new legislation on environmental protection were established. The purpose of the legislation is to protect the closely connected living and natural environment and to direct the developmental processes and activities affecting the environment based on the balanced developmental and environmental needs arising from the obligation that - together with meeting the requirements of the current generations - the equal opportunities of the future generations should also be taken into account. Therefore, the natural resources should be used in a controlled way. The provisions concerning the nature conservation, including the protection of valuable natural features and biodiversity conservation, are the general provisions forming a legal framework for the adoption of other nature conservation regulations. The ZVO provides the principles, the basic instruments and the institutes for the regulation of the legal protection of the environment which form a framework for the preparation of all other acts regulating the specific environmental protection fields. They are a mandatory component of other provisions which regulate the areas having an indirect impact on nature.



(Photo: Marko Simić)

Figure 121. *Spring of the Soča River, it is a karst cave formed at a tectonic fault and filled with water from the alpine karst under Mojstrovka. Since no human influence intervenes, the water is of very good quality.*

One of the provisions necessary for the legal regulation of biodiversity conservation lays down that the purpose of environmental protection is the preservation, improvement and development of the integrity, diversity and quality of the natural features, natural communities, natural assets, and the natural wealth contained therein. Beside regulating in principle the actions of the public entities and public law, the ZVO prescribes that the needs of all living organisms should be considered. The basic objectives of the ZVO include: the conservation of the vitality of nature, biodiversity and indigenous species, their habitats and ecological balance, the conservation of diversity and quality of the natural assets and the natural gene pool, as well as reduced consumption of the natural resources.

With regard to the natural assets (natural public good, natural resources, valuable natural features, natural wealth) the ZVO sets only the general directions that have to be taken into account and discussed in sectoral acts (Agricultural Land Act, Waters Act, Forests Act, Nature Conservation Act, the regulations concerning mineral raw materials, game, fish, air, etc.). The public good - a constituent part of the ecosystems of agricultural land, forests, underground world, karst, waters, sea and infertile land - may only be exploited in such a way that its substance is not threatened and its natural role is not neglected. All these principles have to be taken into consideration when the regulations concerning forestry, fisheries, agriculture, hunting and spatial planning are adopted. Pursuant to these regulations the ecological functions of the environment have to be conserved and ensured. The same applies to the natural resources and valuable natural features.

PLANNING AND PROGRAMMING

Pursuant to the Environmental Protection Act, the Government had drawn up the National Environmental Action Programme which has been adopted by the National Assembly. In the programme the objectives, directions and strategies for the protection of the environment and the use of natural assets have been defined for the next ten years. Within the National Environmental Action Programme a framework programme for the biodiveristy conservation until 2008 and the programme of measures until 2003 are included. Its basic objectives in the field of the biodiversity conservation are:

- BIO 1: to prevent the reduction of biological diversity at the ecosystem, species and genome levels;

- BIO 2: to prevent further threats to natural equilibrium of ecosystems caused by inappropriate exploitation of animal and plant species.

ENVIRONMENTAL PROTECTION MEASURES

The ZVO provides measures and procedures important also for biodiversity conservation:

- **Protection and temporary protection of natural wealth**, e.g. rare, precious or valuable natural assets.
- **Designation of the status of endangered environment** in order to rehabilitate, establish the new, and restore the previous status of a certain area, a specific natural community or any other part of a natural asset.
- **Pre-emptive right and expropriation** for a real estate located in the area of a protected natural wealth in order to prevent the exploitation of the especially rare natural resources and those which are difficult to renew, or to ensure the ecological, protective and other public functions of natural resources stipulated by the law.
- **Concession** for the exploitation of natural assets. Currently, the regulations on the criteria for determining payment rates are not available, but the executive acts are in force on the emission limit values and the input of energy into the soil, water and air, on the corresponding concentrations and on other mandatory measures.
- **Environment vulnerability study** has to be considered in the planning, programming and designing of activities affecting the environment and in planning spatial development. The regulation on determining the principles of the ecosystem classification and methodology for implementation of the environmental vulnerability studies has not yet been drawn up.
- **Comprehensive environmental impact assessment** evaluates the impacts of the planned activities on the environment and the inter-related impacts of individual human activities. The regulation laying down in detail the scope of the comprehensive assessment and the relevant methodology has not yet been adopted.
- **Environmental impact assessment** determines the acceptability of the intended activity affecting the environment with respect to its long- and short-term, and direct and indirect impacts on the environment in the light of the minimum possible change in the natural environmental conditions and the maximum required environmental protection levels. With regard to the implementation of the provisions concerning the environmental impact assessment the relevant regulations have been issued. After implementation of the environmental impact assessment, the procedure concerning the issuance of the environmental protection consent follows.

Nature Conservation Act

The Nature Conservation Act (the ZON) is the fundamental regulation in the field of the conservation of biodiversity of wild plant and animal species. The conservation of biodiversity in nature is closely linked to the maintenance of the natural equilibrium. In order to protect the environment, the measures for the biodiversity conservation have been determined and the system for the protection of valuable natural features established. The biodiversity conservation measures regulate the protection of wild plant and animal species, including their genetic material, habitats and ecosystems. The system for the protection of the valuable natural features lays down the procedures and methods for the designation of the status of a valuable natural feature and for their protection. Both systems are combined and complemented to ensure the effective nature conservation.

The ZON establishes a general conservation regime for all wild plant and animal species. The regime is based on the fundamental limitations and prohibitions and on the detailed rules of conduct stipulated by the Government. The general conservation of plant and animal species stipulates the minimum rules of conduct which have to be respected by all the entities involved and which apply to all human activities. In compliance with the environment conservation development, only those human activities are permitted which meet human needs in a reasonable manner. Pursuant to the ZON, the nature conservation measures and the system for the protection of valuable natural features are taken into account in the spatial planning and in the use and exploitation of natural assets in a way stipulated by the law.

PLANNING AND PROGRAMMING

Pursuant to the Nature Conservation Act the National Assembly must adopt the Nature Conservation Programme which covers biodiversity conservation and the protection of valuable natural features. The programme has to define the public interest in biodiversity conservation and the protection of valuable natural features for at least the following 10 years. It is implemented by

the adoption of operational plans approved by the Government for maximum 4 years. In addition, the programmes for the protection of valuable natural features of local importance have to be adopted by the local communities.

BIODIVERSITY CONSERVATION MEASURES

In the ZON, the biodiversity conservation measures are divided into different groups, i.e. the conservation of diversity at the genetic, species and ecosystem levels.

PLANT AND ANIMAL SPECIES

Measures for the conservation of plant and animal species are the following:

- The **general conservation regime** is stipulated by the law. In compliance with this regime it is prohibited to exterminate a plant or animal species, reduce the number of plants and animals, reduce their habitats or worsen their living conditions to such an extent that the species becomes endangered. It is also prohibited intentionally to destroy or damage habitats of plant or animal species populations, without a justifiable reason. Pursuant to the Nature Conservation Act the reason is justifiable when the action has a beneficial result and is socially acceptable.
- **Mandatory application of techniques, methods and technical devices** which contribute to the conservation of the favourable status of a species during the carrying out of the activities affecting nature or habitats. The regulation concerning the least disturbing manner of and conditions for the carrying out of the activities affecting nature has not yet been issued.
- **Conditions for use of plants or animals** - the ecosystem and biogeographical characteristics of species or populations which are important for the maintenance of species at a favourable status are included into plans within the framework of the sustainable management. So far, no regulations on the conditions for the use of plant and animal species have been issued.
- **Prohibition of introduction of non-indigenous plant or animal species**, unless it had been determined during the assessment of risk to nature that the introduction will not threaten the natural balance or the biodiversity components. Biotechnologically modified plants and animals are considered to be plants or animals of non-indigenous species.
- **Control of reintroduction of non-indigenous species** - a consent is mandatory (except for plants used in agriculture and forestry).
- **Prohibition on keeping indigenous and non-indigenous species in captivity** in unsuitable living conditions and without proper care, and the obligation of natural and legal persons to inform the Ministry about the species which had been obtained for keeping in captivity. The regulation concerning the living conditions of and care for the species for which the notification is obligatory has not been adopted.
- **Permit for the breeding of animals of indigenous or non-indigenous species and the obligation to isolate the area** intended for animal breeding from the adjacent ecosystem. The relevant regulations have not yet been issued.
- **Records on trade** in live animals of indigenous and non-indigenous species. The regulation concerning the species for which the records on trade are not necessary and on the detailed contents of these records have not yet been issued.
- **Rules of conduct** for the taking of animals from the wild, their breeding and transporting; introducing and keeping of animals in captivity, the trade, import, export or transit

Figure 122 (below). *Lynx lynx, once extinct in Slovenia, was successfully reintroduced in 1973.*

Figure 123 (bottom). *Cub of a brown bear at one of the farms on Mt. Nanos. The cage was far too small for the animal.*

(Photo: Andrej Hudoklin)

(Photo: Branka Hlad)

and other handling. The regulations on the detailed techniques for the protection of plant or animal species and the protection of other types of living organisms have not yet been adopted.

- **Protection of internationally protected species** (pursuant to the ratified international treaties) is guaranteed through the protection of their habitats and through the protection regimes for protected species. The regulation on the guidelines for maintaining a favourable status of the species' habitats, which have to be taken into account in spatial planning and the use of natural assets, has not yet been issued.
- **Assessment of risk to nature** concerning the biotechnologically modified plants or animals, the repopulation or the introduction of non-indigenous species and the breeding of animals is carried out before the permit for an activity affecting nature is issued providing that it has been determined during the procedure that the activity cannot threaten the natural balance or biodiversity components. The regulation concerning the conditions for and methods of the implementation of assessment has not yet been issued.

GENETIC DIVERSITY

The measures concerning biodiversity conservation at the genome level are as follows:

- Establishment of a gene bank (*ex situ* protection measure) - gene banks are controlled or cultured populations or parts of animals and plants, in particular seeds, spores, reproductive cells and other biological material which are managed for the purposes of the conservation of species or their gene pools. The regulation on the technical qualifications and on the rules of conduct for the taking of biological material from nature for the needs of gene banks and on the proper procedures for their management has not yet been adopted.
- **Rules on the use of genetic material** - genetic material is part of a plant, animal or micro-organism which contains units of heredity to be used in compliance with the regulations concerning the use of natural assets unless specified otherwise by the law. The regulation on the rules of conduct in the taking of genetic material from nature has not yet been adopted.

ECOSYSTEM DIVERSITY

The ZON stipulates the **obligation to conserve** habitats, establish ecologically important areas and special protected areas, and to protect landscape and nature in urban areas. The relevant measures are:

- **Guidelines for the conservation of habitats** as spatially explicit ecosystem units distinguished by biotope or biotic characteristics. The regulation on habitats and the guidelines for the maintenance of habitats at a favourable status has not yet been adopted.
- **Designation of ecologically important areas** (EPO) as areas of a specific habitat, its part, or a large ecosystem unit which significantly contributes to biodiversity conservation and **the establishment of an ecological network** as a system of interconnected ecologically important areas or areas close to one another which, through an even biogeographical distribution, significantly contribute to the maintenance of natural balance and consequently to biodiversity conservation. The regulation on the designation of ecologically important areas and on their protection has not yet been adopted. The rules of conduct, the protection regimes or the development directions will form mandatory grounds for spatial planning and the exploitation of natural assets. When Slovenia becomes a full member of the EU, the provisions of the ZON will start to apply on special protected areas (SPA) as ecologically important areas which, within the European Union, are important for the maintenance or attainment of a favourable status of species and their habitats. The regulation on the Special Protected Areas and on their protection has not yet been adopted. The protection of all protected areas will be ensured through the measures for the protection of valuable natural features, including the establishment of protected areas run by their own manager.

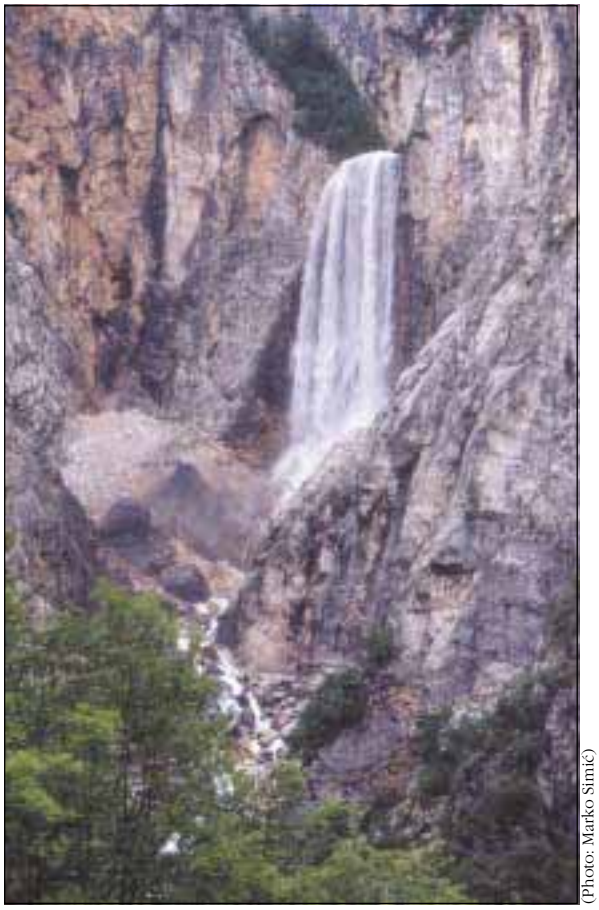
(Photo: Marko Simić)

Figure 124. *Nature conservation also needs to be considered in urban areas.*

- **Designation of landscape features and landscape diversity** important for biodiversity conservation and the **guidelines for the conservation of biodiversity in a landscape**. The relevant regulation has not yet been adopted.
- **Methods of and conditions for the conservation of biodiversity in urban areas**. The regulation on the protection of plant or animal species, or habitats of their populations in urban areas, and on the way of and conditions for an activity affecting nature has not yet been adopted.

SYSTEM AND MEASURES FOR THE PROTECTION OF VALUABLE NATURAL FEATURES

The system for the protection of valuable natural features ensures the fulfilment of the conditions for the **preservation of the characteristics of valuable natural features and natural processes** which generate and preserve these characteristics and of the conditions for the restoration of valuable natural features. In the ZON a natural valuable feature is defined as a rare, valuable or well-known natural phenomenon and any other valuable phenomenon, a component or part of the living or non-living nature, a nature area or part thereof, an ecosystem, landscape or designed landscape. According to the form in which a natural valuable feature appears in nature, the Act lists in particular: the geological phenomena, the minerals and fossils and mineral and fossil sites, the surface and subsurface karst features, the caves, gorges and other geomorphological phenomena, the glaciers and glacial forms, springs, waterfalls, rapids, lakes, bogs and fens, brooks and rivers with their banks, sea-shore, plant and animal species and exceptional specimens and habitats thereof, ecosystems, landscape, and designed landscape. Valuable natural features may be the property of natural or legal persons and of the State or local community, but no one is allowed to treat them in such a way that their existence would be threatened. The regulation concerning the detailed conditions for and methods of the management of valuable natural features for viewing or visiting has not yet been adopted. A concession may be granted for the use of a valuable natural feature which is the property of the state or local community. The valuable natural features are of national or local importance, and the regulation concerning their classification will have been adopted in 2002.



(Photo: Marko Simič)

Figure 125. *The waterfall Boka is the second highest in Slovenia, but with the largest amount of water. In spring, the melting snow on the Mt. Kanin in the hinterland can contribute to the waterfall's discharge of 100 tonnes of water per second.*

MEASURES FOR THE PROTECTION OF VALUABLE NATURAL FEATURES

- **Contractual protection**. The contract on protection is concluded with the owner of the real-estate located in the protected area or with the owner of a valuable natural feature if it has been established that the protection of a valuable natural feature can be ensured in this manner.
- **Stewardship of a valuable natural feature.** The contract on the stewardship is concluded with a person who is not the owner of a valuable natural feature or real-estate located in the protected area.
- **Protection of valuable natural features** is carried out through the instrument of protection which determines the valuable natural feature, its range and components, the purpose of protection, the rules of conduct or the protection regime and the development directions. By the instrument of protection the small protected areas - strict nature reserves, nature reserves and natural monuments, and large protected areas - national, regional and landscape parks may be established. The purpose of large protected areas is particularly to protect the landscape. In compliance with the ZON, a manager has to be appointed to the protected area.
- **Temporary protection.** The parts of nature which are justifiably presumed to have characteristics owing to which they will be designated as valuable natural features are temporarily protected. Two regulations on

the temporary protection (fossil vertebrates near Kozina and a wetland Mlake) have been adopted.

- **Restoration** of the damaged or destroyed valuable natural features. They are restored according to the reasonable application of the provision of the EPO on the restoration.
- **Right of pre-emption.** The state and local communities have a right of pre-emption in the purchase of real-estate located in protected areas.
- **Restrictions on legal transactions.** Legal transactions in the real-estate located in the protected areas and in the valuable natural features in the interest of nature conservation is permitted only in the cases referred to in the ZON.
- **Expropriation** and **property right restrictions** in the interest of nature conservation. Property right or any other real right concerning the real-estate may be seized or restricted for public benefit when that is necessary for the protection of valuable natural features or for the purpose of establishing the protected area.
- **Compensation** due to the restrictions and prohibitions, referred to in this Act or in the instruments of protection issued pursuant to this Act, which substantially reduce the opportunities for earning income and which cannot replace its loss by the activity permitted within the framework of the protection regimes. In addition, compensations are paid for damage caused by the protected animal species.

OBLIGATION TO INTEGRATE CONSERVATION MEASURES INTO THE SPATIAL PLANNS FOR THE EXPLOITATION OF NATURAL ASSETS

The nature conservation guidelines include all the existing directions, guidelines and protection regimes for the preservation of areas important for biodiversity, valuable natural features and protected areas, and are included in the planning procedures and procedures for the drawing up of documents for spatial planning and utilisation of valuable natural features. The nature conservation guidelines drawn up for the territory of the country form the foundations for the ecosystemic analysis of the territory pursuant to which the environmental vulnerability study shall be produced.

The assessment is foreseen of the plans and documents on the activities affecting the space and the utilisation of natural assets which might have an impact on the protected area established by the State or on the special protected area. The impacts of the planned activities on the area are assessed, and also the countervailing measures - i.e. activities by which the degradation of nature is mitigated or remedied - are defined. When the activity affecting the space results in the degradation of nature, the person responsible for that activity has to eliminate the adverse effects of that activity and cover all the costs of the elimination.

Activities affecting nature which may threaten biodiversity, a valuable natural feature or protected area for which a permit is not required under the regulations on spatial planning and other regulations are carried out on the basis of a nature conservation consent (permit issued pursuant to the Nature Conservation Act). The Government has to stipulate what activities affecting the area are subject to the nature conservation consent; the relevant regulation has not yet been issued.

Caves Protection Act

The proposed act for the protection of caves act is in its second reading at the national Assembly of the Republic of Slovenia. The Act will regulate the protection and use of caves as particularly threatened habitats, and the restoration of the polluted and damaged caves. The proposal stipulates that the caves, an unconstructed part of the underground world, are considered as public assets and valuable natural features owned by the State. The Decree on the protection of endangered animal species stipulates that all animal species permanently living in caves or underground waters are protected. With the adoption of the protection of caves act, their biotopes will be protected as well. The proposal of the Act is based on the fundamental environmental protection principles

(Photo: Marko Simić)

Figure 126. *Caves are specific systems, difficult to conserve due to numerous human activities on the surface that affect the subterranean environment.*

established by the ZVO and the principles of conservation of caves in their natural state; the priority protection of caves against use; the exploitation of caves in a sustainable manner; and the principle that speleological associations operate in the public interest. Its general provisions stipulate that the activities affecting caves, their use and protection should be carried out in such a way that the cave living organisms are not affected. With regard to biodiversity conservation, this act is important because it protects the extremely sensitive cave ecosystems.

Animal Protection Act

The Animal Protection Act regulates the public responsibility to protect animals, i.e. to protect their life, health and welfare. At the same time, it stipulates the principles of good practice in the handling of animals. Furthermore, it lays down what activities are prohibited and considered to be cruelty to animals.

In view of the biodiversity conservation this act is of extreme importance for the protection of species. Its provisions also apply to wild animals. Among other provisions, is stipulates that it is prohibited to cause suffering, illness or death of an animal without a justified cause. It is permitted to kill an animal when that is required for the maintenance of the natural balance and in cases when an animal poses a threat or causes considerable damage which can not be prevented otherwise. With regard to game, the Act stipulates that the hunting of game is permitted in compliance with the hunting regulations.

(Photo: Marko Simić)

Figure 127. *A sandpit near Bizeljsko (SE Slovenia) for extraction of quartz sand. The pit walls provide habitat to a bee-eater (Merops apiaster), nesting in them. It is an excellent example of cooperation between the mining and nature conservation sectors.*

The Animal Protection Act stipulates that the cruelty to animals is any handling or absence of handling which causes serious harm to an animal, its prolonged or repetitive suffering or which affects its health, and also the inappropriate or unnecessary killing of an animal.

PROTECTION MEASURES

Among the provision of the Act which might be considered as biodiversity conservation measures are particularly the measures prohibiting certain types of handling of animals. These include: the shooting of animals; setting traps; pelting animals with objects or pyrotechnic substances; chasing of animals living in the natural or urban environment; driving animals away from their shelters and nests; hunting wild animals for breeding, contrary to the hunting and fishing regulations; keeping of wild animals in unregistered zoos; releasing bred animals into the wild if they are not capable of survival. The exemptions are possible under other acts.

LEGAL FRAMEWORK FOR THE SUSTAINABLE USE OF THE COMPONENTS OF BIOLOGICAL AND LANDSCAPE DIVERSITY

The natural wealth has been exploited on the territory of Slovenia for centuries. Sectors which directly exploit the components of biodiversity are: forestry, agriculture, hunting and fisheries and the water management sector. All these activities are regulated by sectoral acts. Unfortunately, most of these acts do not incorporate the principles of biodiversity conservation and the sustainable use of its components. The exceptions are the forestry sector and, lately, agriculture. The strategies and development programmes of these two sectors comprise certain strategic objectives and directions for the conservation and sustainable use of biodiversity.

In addition, biodiversity is affected by other sectors, like tourism, industry, transport and the exploitation of mineral raw materials. These sectors indirectly exploit the components of biodiversity. Often the result is the fragmentation of the habitats of various plant and animal species. The strategies and development programmes of these sectors comprise only a few strategic objectives and directions for the biodiver-sity conservation. The only exceptions are the strategy of economic development and the regional development strategy, where the first steps in this direction had been taken. In order to meet the objectives of sustainable development,

a harmonised action is needed in the strategic documents preparation. Spatial planning is one of the main instruments for the establishment of specific activities in a certain area. The Nature Conservation Act stipulates that the nature conservation guidelines which function as the mandatory grounds for spatial planning have to be set up. In addition, the guidelines for the exploitation of natural assets have to be prepared. Their purpose is to promote the activities which conserve biodiversity and protect valuable natural features. In this way, the requirements of the international regulations (directives, conventions and other agreements) are harmonised with the national objectives.

Forests Act

The Forests Act regulates the conservation, protection, cultivation, exploitation and use of forests as natural wealth in such a manner as to ensure their sustainable and multipurpose management in compliance with the principles of protection of the environment and valuable natural features, and the optimum functioning of forests as ecosystems. The Act stipulates the conditions for the management of forested areas, individual trees and clusters of forest trees which grow outside urban areas, in order to maintain and strengthen their role in the environment. Important provisions are those on the implementation of the property right on forests, in order to ensure their ecological, social and production functions. Forest owners manage forests in compliance with the regulations, forest management plans[4] and administrative acts issued pursuant to the Act.

From the point of view of biodiversity conservation, certain provisions of the Forests Act are important at the levels of ecosystems and species as well as at the genome level (provisions on seeds, seedlings and forest seed banks). Amendments to the Forests Act are needed in order to harmonise it with the regulations on nature conservation, particularly concerning biodiversity conservation.

PLANNING AND PROGRAMMING

The **Forest Development Programme** stipulates the national policy of sustainable forest management, the orientations for the conservation and development of forests and conditions for their exploitation and multipurpose use. Forests cover approximately 60 % of Slovenia's territory. Therefore, the planning of forest management is of extreme importance for *in situ* protection and sustainable use. The forest development programme has been drawn up by taking into account the principles of the Convention on Biological Diversity. It establishes the *in situ* conservation of biodiversity and the sustainable use of its components. Beside the economic functions of forests, it also defines the orientations for sustainable use of the forest species. The implementation of the 'conservation part' of the strategy contributes substantially to biodiversity conservation in Slovenia.

(Photo: Branka Hlad)

Figure 128. *Hudičev boršt, an example of an isolated beech forest within steep grassland slopes on Zaplata above Preddvor (North Slovenia).*

MEASURES

Forest management (silviculture, exploitation, forest protection, construction and maintenance of forest infrastructure).

1. Silviculture and exploitation of forests are regulated and carried out on the basis of **forest management plans**.

- Forest owners exploit and cultivate their forests pursuant to the **authorisation procedure** based on the **silviculture plans**. Subject to authorisation are the required silviculture activities, guidelines and deadlines for the implementation of the silviculture and protection activities, the quantity and structure of trees for maximum removal, as well as guidelines and conditions for felling.
- **Prohibition** of all activities which reduce the vigour of the stand or the fertility of the site and the stability or continuity of the forest and which threaten its functions[5], existence or purpose, and activities concerning

[4] *Plans for the management of forests are: the regional forest management plans, plans for forest management units, silviculture plans and regional hunting plans.*

[5] *Under the Forests Act, the forests functions are ecological (protection of forest land and stands, hydrological, biotopical and climate functions), social (protection function - protection of infrastructure, recreational, tourist, educational, research, health functions, protection of natural and cultural heritage and other valuable natural features, defence and aesthetic function) and production (wood production, acquisition of other forest products and hunting function).*

the afforestation of non-forest areas within the forests unless provided for in a forest management plan.

- **Permit and consent** for activities affecting a certain area (pursuant to the spatial planning regulations) is required for the construction of facilities outside the forest if they have a negative effect on the forest ecosystem and its functions.
- **Prohibition of clear-cutting** as a manner of forest management, unless it is necessary for sanitary reasons or the carrying out of preventive protection activities or is provided for in the plans.
- **Restoration of forests** if they had been damaged or clear-cut contrary to the regulations, on the sites of fire and in forests damaged by various deleterious biotic and abiotic agents.
- **Permit for fencing** parts of the forest to protect seedlings or to temporarily protect forests against deer (if it is provided for in the plan), to protect valuable natural features, if appropriate and to protect special purpose forests (if stipulated in the act of designation).

(Photo: Branka Hlad)

Figure 129. *Burnt out area in Ljubljansko Barje. Fires are often due to the carelessness of people lighting fires in open nature.*

- **Limitation or prohibition of picking** (species, quantities, methods, sites and time of picking animals, fruits, mushrooms or plants) if any plant or animal species or forest function is threatened.

2. Protection of forests (monitoring and strengthening the biological balance and the implementation of preventive and suppressive measures). Owners and other users of the forests must implement all the prescribed measures to prevent and suppress plant diseases and the outbreaks of insect populations which could destroy the biological balance in a forest and to prevent other forest damage.

- **Order on sanitary felling** and preventive protection activities and the stipulation of further measures for the protection of forests.
- **Prohibition on application of chemical substances** in the forest; exemptions are possible (attested chemical substances which do not threaten biological balance) to protect seedlings or to reduce insect populations and fight forest fires.
- **Prohibition on forest grazing** (exemptions on the basis of prior criteria) and **making fire** in a forest.
- **Measures to eliminate reasons for the deterioration** of and damage to forests on the basis of monitoring the extent and level of deterioration and damage.
- **Conservation and restoration of habitats** of indigenous plant and animal species in forests (in compliance with forest management plans) and gradual re-establishment of the natural components of the forest biotic communities.

3. Construction and maintenance of the forest infrastructure is based on the technical, economic and environmental conditions. The construction, maintenance and use of forest roads[6] must not affect an area important for the conservation of wild animals or valuable natural features. The forest roads are public and may be used (on one's own responsibility). A special traffic regime is enforced in protective forests, special purpose forests, forests threatened by fire, and forests defined in forest management plans as areas important for the conservation of wild animals.

4. Protective forests and 'special purpose' forest.

- **Designation of protective forests** (forests which under strained environmental conditions protect themselves, their sites

[6] *Pursuant to Article 37, the Rules on the construction, maintenance and use of forest roads were issued which entered into force on 29 January 2000 (the Rules on the construction and maintenance of forest roads are no longer in force - Ur. l. RS, 44/87).*

and lower grounds and forests where any other environmental function is especially pronounced). By law such forests are designated as protected natural wealth.

- **Designation of 'special purpose' forests** (the emphasised functions are research and health function, the protection of valuable natural features and cultural heritage). By law, such forests are designated as protected natural wealth.
- **Tax reliefs, compensations and purchases** if enjoyment or enforcement of the property right is limited.
- Until the adoption of the spatial components of the forest management plans in compliance with this Act, the special purpose forests are defined by the regulations issued by a local community, if the accentuated function of the forest is in its own interest, or by Governmental regulation, if the accentuated function of the forest is in the public interest.
- **Pre-emptive right** for protective forests and special purpose forests.
- **Designation as forest reserves** (emphasised research and biotope functions).
- **Rules on the protection of forests** stipulate the conditions for the sustainable management and use of forests (the exploitation of their functions), the measures for the maintenance of the balance of a forest ecosystem (leaving dead biomass, conservation of wetland areas in forests, etc.), planning of measures for the prevention of harmful effects on forests, the monitoring of forest damage and the protection of forests against fire. In a special chapter on biotic balance measures for the conservation of biotic balance are defined in detail as well as the natural shelters, the monitoring of the biotic balance, the monitoring of the status of animal populations and their biotopes and certain additional measures for biodiversity conservation.
- In general, the Act also regulates management of forest genetic resources. The health protection of forest plants is defined in the *Plant Protection Act (2000)* and the *Rules on the protection of forests (2000)*. The legislation concerning the forest reproductive material is currently being amended and harmonised with the EC Directive 1999/105 and the OECD scheme. The Ordinance on the financing and co-financing of investments into forests (1994) and the Programme for the development of forests in Slovenia (1996) lay down specific guidelines for the conservation and use of biodiversity in forests and forestry in general (Kraigher, 1997).

(Photo: Branka Hlad)

Figure 130. *Lubnik. In the areas less favourable for agricultural production farmers still plough the fields in the traditional way, with horse and plough.*

Agriculture

Agriculture Act

The Agriculture Act defines the objectives of the agricultural policy; the planning of the agricultural and rural development; the measures of agricultural policy; the quality and labelling of agricultural products or foodstuffs; the trade in agricultural products or foodstuffs; the public services; the data bases and information in the field of agriculture; the procedures and bodies required for the implementation of the Act; the research work and education; as well as the development and professional tasks and the inspection control. The objectives of the agricultural policy in Slovenia are the preservation of the population density in the countryside, the protection of farm land against pollution and purposeless use, and the enforcement of the principles of environmental protection and nature conservation.

PLANNING

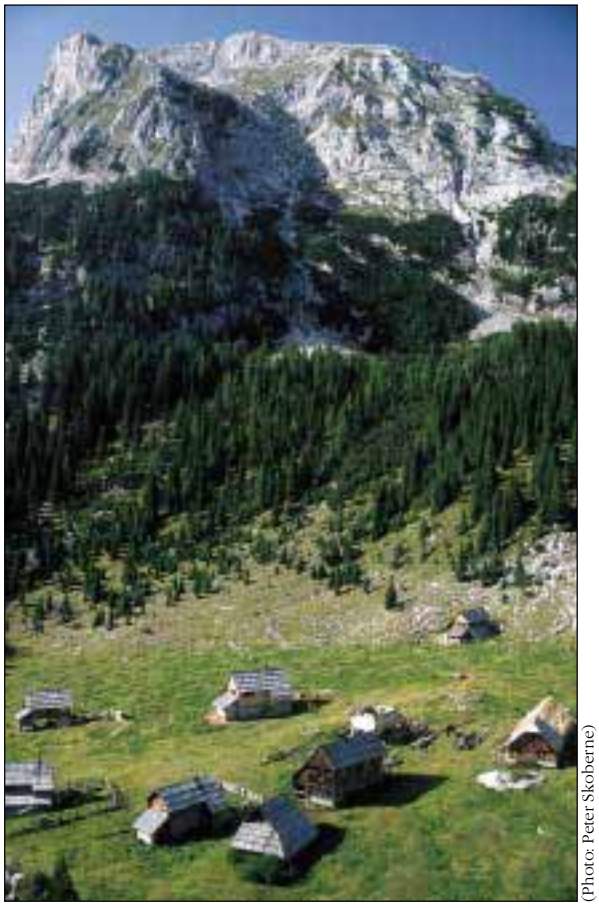
The introductory part of the Rural development plan adopted in December 1999 declares that the development of the countryside significantly affects biodiversity and nature conservation in the major part of Slovenia. Namely, the countryside represents 89.1 % of its territory. The plan also establishes the important foundations for the implementation of the financial mechanisms employed by the State for the promotion of the development of the countryside and agriculture in particular. Special objectives include the promotion of the agri-environmental practices for biodiversity conservation and the financial support to the sustainable agricultural ex-

ploitation of the natural resources. The international and national legislation concerning biodiversity conservation through the *in situ* conservation of endangered species' habitats and endangered habitats are still not taken into account. In the substantive part of the Rural Development Plan - the strategy and priority tasks for acquiring assistance from the European Agricultural Guidance and Guarantee Fund (EAGGF) - the assistance for the measures concerning biodiversity conservation - has not been provided for. This deficiency has been partly covered by adoption of the Agri-Environmental Programme of Slovenia, but the trend towards deplation of biodiversity has still not been halted.

MEASURES

The agricultural policy measures are oriented towards the promotion of sustainable agriculture by which the diversity of the plant and animal species is maintained and the soil and its fertility preserved, while the natural conditions for life in soil, water and air are protected.

The measures of the agricultural structural policy are oriented towards the increase in competitiveness in the production and processing of agricultural products and foodstuffs, environmental friendly agricultural production and the preservation of the population density in the countryside, while taking into account the environmental and conservation acceptability. If these measures are appropriately implemented they can conserve biodiversity. They are as follows:



(Photo: Peter Skoberne)

Figure 131. *Planina v Lazu. In the past, alpine pastures were formed to provide enough grazing for cattle. Since then the economic conditions have changed, and the alpine pastures can be maintained only through particular development programmes.*

- **Support to agriculture in areas with less favourable conditions**, such as support to mountain and hill farms, as well as support to other areas with limited conditions for agricultural production, is important for the biodiversity conservation since agriculture in these areas defines the landscape. On the other hand, from the point of view of the biodiversity conservation, providing support to the areas with special natural limitations - flood plains, marshes, strong winds, bogs, etc. - is harmful. Incentives are paid in areas where the agriculture has to be conserved in order to enforce environment friendly rural development and conserve the landscape. The support is provided in the form of compensatory payments.
- **Support to environment friendly agriculture** (in the form of direct payments per hectare or per animal) which contributes to the conservation and improvement of the natural resources, drinking water sources, biological and landscape diversity while also ensuring biodiversity in agriculture, the preservation and promotion of environment friendly technologies in agriculture, the conservation of environmentally sensitive areas, the prevention of natural encroachment of vegetation on agricultural land and the protection of the cultural heritage and valuable natural features related to agriculture.
- **Support to people** working in the agricultural sector and forestry, intended for their training (reorientation of production, introduction and application of modern technologies and enforcement of the stipulated hygienic, environmental and ethological standards).
- **Support to the processing of agricultural products and foodstuffs** (introduction of technological innovations, improvement of the staff and organisational structure, improvement of the quality of agricultural products and foodstuffs, improvement of hygienic conditions and environmental protection).
- **Support to the rural development** for the promotion of diversity in agriculture and all the related activities in the countryside; development and improvement of the agricultural infrastructure and services necessary for the development (management of water sources for irrigation purposes) and renovation of villages and other rural settlements.

- **Certification of organic or integrated agricultural products or foodstuffs** on the basis of the prescribed conditions (production and processing according to the organic methods and procedures with the application of natural methods for the prevention and suppression of diseases and pests; without the application of plant regulators or hormones; easily soluble mineral fertilizes; genetically modified organisms and their products; ionising radiation; with the breeding of animals which meets the biological and ethological requirements; the use of adapted species, varieties and breeds resistant to local conditions, and the application of permitted additives and procedures). The detailed conditions of organic and integrated production and processing are stipulated by two ministerial regulations.
- **Rules on organic production and processing of agricultural products and/or food**. The products and/or food from hunting and fishing may not be labelled as "organic". The organic production and processing is controlled by an organisation which meets the prescribed technical, administrative and organisational requirements. The basic principle is that the mark "organic" is awarded to food and products which have been produced without the application of ionising radiation, genetically modified organisms, easily soluble mineral fertilizes, plant regulators or hormones. The organic product or food is produced by natural methods and procedures.

The strategic directions of the Agri-Environmental Programme of Slovenia (SKOP) are laid down in the programme for the reform of the agricultural policy of 1998 within the second pillar of the reform concerning the restructuring of agriculture. The entire programme reflects substantial progress for the established management and a transition towards environment friendly agriculture. Its purpose is to promote agricultural production which will suit the needs of consumers and protect human health, guarantee sustainable use of the natural resources and enable the biodiversity and characteristics of the landscape in Slovenia to be preserved. With regard to the environmental component, the programme is divided into three sections which determine the nature and content of the measures concerning direct payments:

- Section I: reduction of negative effects of agriculture on the environment;
- Section II: conservation of natural attributes, biodiversity, soil fertility and traditional cultural landscape;
- Section III: protection of protected areas;
- Section IV: deals with the training and promotional activities which are not considered measures. The participation in the education process will be mandatory for farmers involved in the agri-environmental programme. Within the framework of the promotional activities the SKOP will be presented to the general public, including information for the consumers about new, sustainably produced agricultural products and foodstuffs and their quality.

Agricultural Land Act

The *Agricultural Land Act* regulates the use of the agricultural land and its protection, the trade in it and the lease conditions, the agrarian operations and the management of common pastures. The provisions of this Act apply by analogy to forests, unless otherwise stipulated by the law. Agricultural lands are those which are suitable for agricultural production. These include the overgrown land not intended for forest cultivation under the Forests Act. Agricultural land is categorised - according to the natural characteristics, location and the shape and size of the parcel - into the best agricultural land (land most suitable for cultivation) and other agricultural land. Land has to be used in accordance with the purpose of its use. Pollution and other forms of the degradation or impediment of plant growth have to be prevented. Agricultural land is considered to be polluted when the concentrations of harmful substances in the soil are such that its self-cleaning capacity is reduced, its physical, chemical or botanical characteristics deteriorate, the growth and development of plants is impeded or prevented, the groundwater and plants are polluted, and the permanent fertility of soil is in any other way diminished.

MEASURES

The plans concerning the use of agricultural land regulate the land use, the land use categories, the protection against unauthorised changes of these categories, and also the compensations due to the changes in land use categories of agricultural land and forests.

- **Prescribed manner** of cultivation of agricultural land for owners, leasers or other users of agricultural land.
- **Obligation to adapt** the agricultural production to the environmental and soil conditions, to use methods for the prevention of soil-compaction, erosion and pollution and to ensure the permanent fertility of land.
- **Rules concerning agricultural operations** (agricultural improvements such as

drainage, land-filling and irrigation). The Act does lay down the relevant procedure and the conditions which have to be met, but none of them concern biodiversity. The minister responsible for agriculture and forestry prescribes - with the consent of the minister responsible for the environment and spatial planning - the detailed regulations on the introduction, implementation, management, functioning and maintenance of the agricultural improvement systems. Until new regulations are adopted, the Instructions of 1981 on the agricultural improvements of the land continue to apply. None of the measures, requirements, conditions and procedures concern the nature conservation.

National Farmland and Forest Fund Act

The National Farmland and Forest Fund Act stipulates the setting-up of the Fund of the Republic of Slovenia for Agricultural Land and Forests and its tasks, competencies, rights and obligations. The Fund is a public institution which, in compliance with the development policy, regulations and acts, manages farmland, farms and forests, which are the property of the Republic of Slovenia. Some of its tasks are to guarantee the rational use and protect the environmental value of agricultural land, farms and forests and to carry out other tasks concerning agricultural land, farms and forests as defined in the Funds' regulations and instruments. The Fund answers to the Government and reports to it at least once a year. Its operations are supervised by the Ministry of Agriculture, Forestry and Food and the Ministry of Finance. The operational work is carried out by their regional branch offices or other institutions and by regional communities.

The Act regulates the transferral of the public agricultural land, farms and forests which are not the property of the Republic of Slovenia to the State or municipalities under the Ownership Transformation of Companies Act and under the Cooperatives Act and the transferral of agricultural land and forests, managed by or made available to the basic organisations of cooperators free of charge. Upon the enforcement of this Act, all this property is transferred to the fund or municipalities.

Figure 132. *In 2001, the List of Cultivars was amended by listing four of pumpkin sorts.*

(Photo: Peter Skoberne)

Seeds and Propagating Materials Act

The **Seeds and Propagating Materials Act** regulates the production, processing and placing on the market of seeds and propagating materials intended for agricultural and forestry production, the attestation and introduction of new domestic and foreign varieties of agricultural and forest plants and forest trees of foreign origin, the supervision and control of the quality of and trade in seeds and propagating material.

For the production in agriculture and forestry, only those seeds and propagating materials may be produced, processed and placed on the market which comply with the quality requirements and other conditions provided for in this Act and with the regulations issued pursuant to it. The seed is that part of the agricultural or forest plant which is used for sowing and propagating and is labelled as seed. The propagating materials are plants and parts of plants produced by the generative or vegetative method which are intended for fruit tree groves and vineyards and for hops, garden, field and forest cultivation. The provisions of this Act concern the propagating material of the agricultural and forest plants, the cereals' seeds, the seeds of industrial and forage plants, herbs and aromatic plants, fruit, flowers and forest trees. The forest seed objects are seed stands, elite trees, plus trees and seed orchards. The seed objects, clones and selected clones are selected and approved by an authorised organisation. The seed objects are managed in compliance with the plans. The forest seed and propagating material may be used only in the altitudes and seed areas where the seed has been collected.

MEASURES

The provisions of this Act concerning the species and genetic diversity conservation could be important for biodiversity conservation, but unfortunately no relevant measures have been adopted.

Plant Protection Act

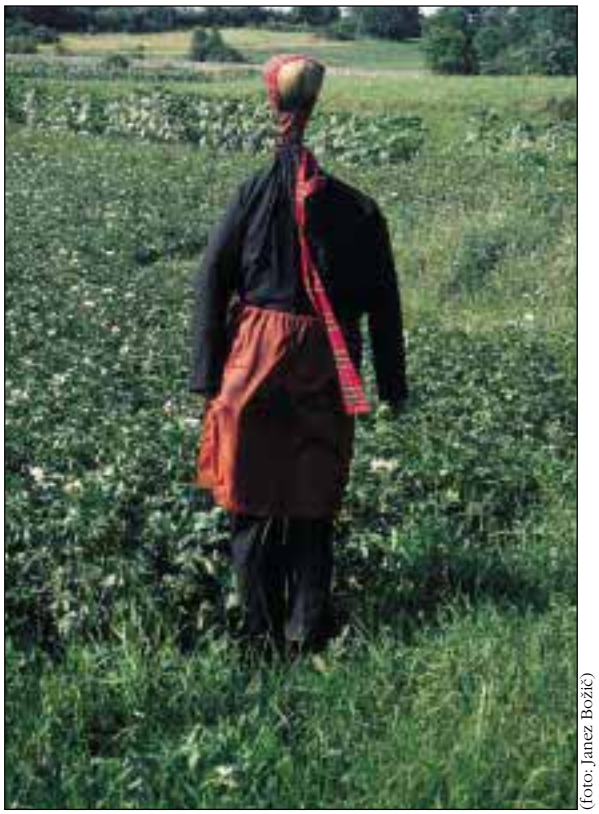
The *Plant Protection Act* regulates the biotic protection of plants and the public services for the protection of plants. It designates the bodies responsible for the enforcement of this Act and the inspectors control. The purpose of plant protection is the protection of the environment by the permanent control of pests, the introduction of biotic protection of plants and the monitoring and forecasting.

In view of biodiversity conservation, the provisions of this Act are important because they:

1. promote the preventive protection of plants and the measures which prevent the occurrence and expansion of pests instead of the application of the phytosanitary substances;
2. introduce the biotic protection of plants resulting in the higher diversity of species in and near agricultural land.

MEASURES

The biotic protection of plants is a method for the containment of pests in agriculture and forestry which uses live natural enemies of pest species, antagonists or competitors, or their products and other organisms capable of self-reproduction. An indigenous species is a species which naturally occurs in a certain ecosystem. A non-indigenous species is a species which has been introduced by humans and has not been present in a certain ecosystem prior to the introduction.



(foto: Janez Božič)

- **Permitted introduction, breeding or use of indigenous species** for the biotic protection of plants in the supervised facilities and outside, if all the conditions have been met concerning professional skills and technical qualifications prescribed by the minister responsible for agriculture and forestry, with the consent of the minister responsible for nature conservation.
- **Permitted use of non- indigenous species** for the biotic protection of plants in the supervised facilities and outside; the use is permitted of only those non-indigenous species which have been indicated in the list issued by the minister responsible for agriculture and forestry with the consent of the minister responsible for nature conservation.
- **Permit for the import and use of non-indigenous species** based on the finding that the activity affecting the nature does not threaten the natural balance or biodiversity; it is issued in compliance with the nature conservation regulations.
- **Prohibition on breeding specific species, varieties or clones of plants in a certain area.**
- **Limitation or prohibition of trade** in specific plant species and the mandatory mutual cooperation of owners of such plants in the containment of pests and the use of the relevant equipment.

Act on Protection of New Varieties of Plants

The *Act on Protection of New Varieties of Plants* stipulates the procedure concerning the insurance, acquisition and protection of the plant variety right. The varieties of all plant genera and species, including hybrids between genera and species, may be insured. In view of biodiversity conservation, the provisions of this Act are not significant since they do not regulate the suitability and environmental acceptability of a new variety. They merely stipulate the plant variety rights and the procedure for the registration of new plant varieties.

Fisheries

Freshwater Fisheries Act

The *Freshwater Fisheries Act* regulates the protection and breeding of fish and the designation of fisheries, fishing areas and districts. It specifies the fishbreeding plans, regulates the fishing activities in open waters, establishes and regulates

Figure 133. *A scarecrow in the fields of Brčena vas can be considered an example of the relationship between humans and nature. Crops are more damaged by game than by birds.*

the functioning of the fishing organisations and lays down the competencies and responsibilities of the fishing inspection.

The freshwater fishery comprises the breeding, protection and catching of fish, fish roe, shellfish, frogs and other aquatic animals unless they are considered game under the hunting regulations. All freshwaters in Slovenia (rivers, streams, backwaters, lakes, fish ponds, reservoirs) are fishing waters divided into the open and closed waters. The closed fishing waters are fish ponds and other artificial fish pools where water can be raised and lowered by technical means and where the free movement of fish is prevented or hindered. They are intended for intensive fish breeding. All other waters are considered open waters where fish form a part of the animal life in the human environment. All waters are the property of the state (Article 111 of the ZVO) and a public good.

The fishing areas and fishing districts are established for the appropriate exploitation of the fishing waters. The fishing area comprises either a large river basin or several small river basins. Such areas are established so that fish living in a large territory are bred and protected in a harmonised manner. The fishing district comprises an individual water body, its part or several water bodies in one fishing area. One or more fishing districts are managed by one fishing organisation which guarantees the conditions for the protection and breeding of fish and for the promotion of angling (facilities, technical staff, etc.). Angling is permitted on the basis of an angling permit issued by a fishing organisation for angling in the waters within the fishing district managed by that organisation.

(Photo: Peter Skoberne)

Figure 134. *Cerkniško jezero. Cerknica lake is an intermittent lake in the Dinaric karst. For centuries the local people have had the right to fish when the water is becoming low and disappearing underground.*

The fish-breeding plan is a long-term plan for breeding and protecting fish and for providing the technical solutions for reasonable management of a fishing district. This plan defines the species, number, productivity and age structure of fish populations which have to be in balance with other organisms in fish waters; the objectives of the fishing district management; and the type and extent of the activities needed to attain these objectives. The breeding and protection of fish include, in particular, the conservation and maintenance of the productivity and age structure of fish populations in fish waters; the breeding and stocking of fish; the construction and maintenance of fish farm facilities; the protection of fish and care for their health; scientific work; and the research on fish waters and fish.

Common interests concerning the protection and breeding of fish and the joint freshwater fisheries policy of Slovenia are enforced by the members of the Anglers Association, the employees of the Fisheries Institute and the employees of other organisations active in the area of freshwater fisheries.

MEASURES

For biodiversity conservation, the following measures are important:

- **Definition of a closed fishing season** when the angling of certain fish species is prohibited for their protection.
- **Definition of the minimum size** of a specimen. It is prohibited to catch undersized fish.
- **Continuous or temporary prohibition on angling** for certain species in specific fishing waters in order to conserve rare fish or for other justified reasons.
- **Prohibition on introduction of new species** into fishing waters without a permit.
- **Designation of protective waters** of specific fishing waters or their parts suitable for fish propagation, conservation of certain species or scientific purposes.
- **Prohibition on destruction of or causing damage to** the spawning grounds; on releasing ducks or geese into the spawning grounds; on preventing fish from returning from the flooded area back to the riverbed; and on washing agricultural and other machinery in fishing waters.
- **Permitted** (fish hooks) and **prohibited fishing** (use of explosive, spears, underwater guns, seines, nets, poison).

- In the design and construction of the hydro-electric facilities and in the canalisation of riverbeds, the **interests of the anglers** are taken into account. Waste water treatment plants should be incorporated into such facilities so that the existence and health of fish are protected and that their spawning grounds and passages are preserved. Turbines should be designed and maintained in such a way that fish could not enter them. A body responsible for issuing the permit for the construction of the hydro-electric plants may order that such facilities include 'underwater fish routes' if that is necessary for the natural migration of fish.

Marine Fisheries Act

The *Marine Fisheries Act* regulates the fishing, breeding and protection of marine fish and other marine animals in the fishing sea and the collection of marine plants in the sea. Marine animals and plants in the fishing areas are the property of the State (Article 111 of the ZVO). The right to use marine animals and plants, or the corresponding property rights, may be acquired on the basis of this Act and the regulations issued pursuant to it. The Act protects the fish and other marine animals and plants in the fishing sea against excessive exploitation and destruction. Sea fishing includes the catching of fish and shellfish. Fishing may be commercial or recreational. Commercial fishing is economically important and recreational fishing is a form of entertainment and relaxation. The conditions for and manner of commercial fishing are prescribed by the minister responsible for agriculture, forestry and food. Recreational fishing is permitted for Slovene nationals or foreigners who have obtained the relevant permit. The conditions for and manner of recreational fishing are prescribed by the competent minister.

MEASURES

The breeding of fish as well as the breeding and catching of other marine organisms, including sponges and corals, may be carried out by the organisations which have entered such activities in the register of companies and by individuals who fulfil the conditions referred to in this Act. In view of the biodiversity conservation, the following measures are relevant:

- **Prohibition on catching** fish fry, immature fish and other marine animals.
- **Close season** for specific fish species and other marine animals in order to protect fish fry, immature and economically important fish and other marine animals.

(Photo: Milan Orožen Adamič)

Figure 135. *Serranellus hepatus, a common sea-bottom species in the Adriatic Sea.*

- **Definition of the size of the meshes of nets** used in commercial fishing.
- **Prohibition on fishing and placing on the market** of undersized specimens of the economically important fish and other marine animals.
- **Limitation or prohibition** on the use of certain types of nets and other devices for commercial or recreational fishing within one mile off the coast in order to protect the demersal fish species and other marine animals, particularly against over exploitation and destruction.
- **Prohibited methods of fishing, picking and placing on the market** (explosives, chemical substances and other means that kill, poison or stun animals, any diving equipment, etc.).
- **Prohibition on discharging or disposing of** liquid or solid waste (originating in the production or processing), or any other material or substance, into the sea, rivers flowing into the sea and the connected lakes and lagoons, which destroy marine animals, have harmful effects on the biological conditions for their survival and development or reduce their market value.
- **Prohibition on fishing** in fishing reserves intended for the protection, breeding and propagation of fish and other marine animals. The fishing reserves are parts of the coastal sea within one mile off the coast with favourable natural conditions for the breeding and propagation of fish or other marine animals. The **fishing reserves are:** the landward section of the Bay of Portorož with its lagoons, the coastal sea by the Strunjan Peninsula and the landward section of the Bay of Strunjan and its lagoons.

Hunting Law

The *Hunting Law* regulates the protection, breeding, hunting and use of game (hunting) and

the management and maintenance of hunting grounds for the conservation of the balance between game and plants in the environment. Hunting is an activity carried out by the individuals organised in hunting associations, the employees of the hunting companies, and other organisations which meet the conditions stipulated by this Act (hunting organisations). **Game hunting** includes the searching for, tracking, killing and capturing of game and the collecting of dead animals and their parts (antlers, skin, other). **Game** are wild animals which have been, are, or will be hunted. As part of the animal life, game is a public property[7] and a public good. The provisions concerning the protection and breeding of wild animals do not apply to the breeding of wild animals in enclosures. Hunting grounds are established for the protection, breeding and hunting of wild animals. They are managed by the hunting organisations on the basis of the stipulated conditions. **Hunting and breeding areas**[8] with several hunting grounds are established in order to provide for the harmonised protection, breeding and hunting of wild animals in a larger area and to ensure a special public interest. In order to appropriately balance the structure and number of game with other living organisms in an area and to harmonise the interests of agriculture, forestry and other sectors, it is necessary to take into account the size of the habitat of a main game species which is necessary for the undisturbed development of its population.

The hunting organisation manages the hunting grounds on the basis of the **hunting management plan**. The management includes the protection, breeding and hunting of the game and its use, as well as the management and maintenance of the hunting grounds. The protection and breeding of game comprises the preservation, maintenance and improvement of suitable living conditions for game (management of grazing areas, feeding and watering facilities, etc.), the conservation of the appropriate structure and number of animals and their protection; the measures for the prevention and restitution of damage caused by the game in the hunting area; the introduction of game into the hunting area; the construction of the hunting facilities (feeding facilities, lookouts, hunting paths); and other activities related to the protection, breeding and hunting of game; as well as scientific research and education.

The public service[9] performs the tasks related to the conservation, maintenance and improvement of the living conditions for the game, selects the game species and introduces new species into the hunting grounds.

MEASURES

The following measures of the Hunting Act are directly or indirectly relevant to biodiversity:

- **Prohibition on reducing the number of game** in the wild to such an extent that its existence is threatened.
- **Prohibition on hunting** birds during the year, except for mallard, Eurasian jay, hooded crow and magpie.
- **Prohibition on hunting rare species** pursuant to the nature conservation legislation.
- **Partial closed season** in periods when the hunting of certain wild species is permitted.
- **Continuous or temporary prohibition of hunting** because of the rareness of the game, economic benefits or other justified reasons.
- **Permit for the introduction of game into the wild** is issued by the minister responsible for agriculture, forestry and food if it had been established during the prescribed procedure that the release of game into the wild does not threaten the health of wild game, the natural balance or the safety of people.
- **Rules on the application of chemical substances** for the protection of agricultural or forest plants which are harmful to the game.
- **Permit for the setting up of pens larger than 50 ha** is issued on the basis of an opinion given by the relevant expert organisation.
- **Permitted and prohibited hunting methods** (snares, traps, nets, limes, stunning devices and poisons, hunting with artificial light sources or from motor vehicles, during floods or high snow, etc.).
- **Prohibited means** of mass destruction of the game (i.e. hydrogen cyanide). Under the regulations on poisons and with the permission of the competent administrative body it is permitted to lay poison baits for foxes, hooded crows and magpies.

7 The Environmental Protection Act in its Article 111 stipulates that "Water, ..., wild animals, ... shall become the property of the State on the date of entry into force of this Act."

8 See the Forests Act.

9 The Act Regulating the Protection, Breeding and Hunting of Game and the Management of Hunting Grounds regulates the matters of a special public interest. In the present text they are replaced by "public service".

- **Order on the type and power of hunting arms and the power of cartridges to be used for the hunting of different game species** stipulates what type of arms may be used in the hunting of game.
- **Prohibition on destroying or demolishing litters and nests and collecting eggs** of wild fowl and to touch or taking the young of the game.

Water Act

The *Water Act* of 1981 provides little conservation to biodiversity conservation to a great extent. The relevant measures relate in particular to the protection of the human environment and drinking water supply. Nevertheless, these measures are important for the biodiversity conservation. They are:

- the management of the water regime in a way to maintain the integrity of river catchment areas; the use and exploitation of water and other human impacts affecting waters have to be carried out in such a way that the water regimes are maintained and managed so that the human environment is protected and economic progress is possible,
- the maintenance of water quantity (planned increase of forest surface areas, appropriate land cultivation, purposeful spatial planning and measures for the improvement of the spatial and time distribution of water), and quality (construction of retention systems, increase of the flow of watercourses, changes in the applied technological procedures, construction of waste water treatment plants and other measures preventing water pollution).

MEASURES

The Waters Act lays down the following measures which are important for biodiversity conservation:

(Photo: Marko Simić)

- **Payment of compensation** for the accidental pollution of water in the amount of costs paid for the necessary containment measures in such an event.
- **Obligation to obtain water management consents and permits**; this defines the cases when consent and permits are not mandatory, and specifies the bodies competent for issuing such permits and consents. The criteria for the granting or withdrawal of a consent or permit concern the limitation of the damage caused and the overall need for water. In view of biodiversity conservation, these permits and consents are not a conservation/protection measure.
- Activities affecting the water regime must not change the level of the water table and the direction of underground waters[10]. During every activity affecting the water regime the **minimum flow of a watercourse** should be guaranteed. The municipal body designates by an order a water protection zone and water protection measures (the protection of drinking water resources).
- **General prohibition on discharging dangerous substances**, which might threaten the life and health of fish and other animals and damage plants, into running and coastal waters.
- **General limitation concerning the amount and the method of application of chemical substances** in agriculture and forestry in order to prevent their harmful effects on the water regime.
- **Prohibition of activities** (the discharge of high temperature water which might have a harmful effect on aquatic plants and animals) which could result in the pollution of water with substances affecting chemical, physical, biological or bacteriological composition of water.
- **Designation of water protected areas** by the water management plans for the protection of watercourses and groundwater.
- The owners of land or those who hold a right to land are not allowed **to change the course of the stream and the amount of water** in their land if such action would be detrimental to the neighbouring land; this prohibition has an indirect impact on the conservation of habitats.

A new Water Act is currently being drawn up. It is more environmentally oriented and it regu-

Figure 136. *Construction of small hydroelectric power plants requires maintaining the 'ecological minimum', meaning that the minimum water flow to support the ecological function of the ecosystem remains in the stream. This requirement is often neglected due to lack of control of its implementation.*

[10] *These prohibitions are enforced so that the supply of drinking water and industrial water and other uses of water as well as agricultural production are not threatened.*

lates the use and exploitation of water so that the protection of water and aquatic ecosystems is guaranteed. The proposal stipulates the management of the sea, inland waters and underground waters as well as the aquatic and riparian zones. Objectives of the proposal include the promotion of the sustainable use of water which guarantees the long-term protection of water resources and their quality.

Mining Act

The *Mining Act* was adopted in 1999. It regulates the prospecting, exploitation and management of mineral resources as a natural resource. It defines in detail the mineral resources and the mining work and it lays down:

- The measures and conditions for the implementation of the mining work, the environmental protection during the prospecting and exploitation of mineral resources and during other mining work and the restoration of the environment after the completion of works.
- The granting of the mining right, the competencies for and manner of granting specific permits and the organisation and manner of the implementation of the mining inspection.
- The measures and conditions for carrying out the remediation projects after and/or during the exploitation of mineral resources.
- The Environmental Protection Act, the Nature Conservation Act and the Mining Act lay down that the environmental protection and nature conservation conditions have to be included in the procedure for granting a concession.

Spatial planning and permits for activities affecting the physical environment

Spatial Planning Act

The *Spatial Planning Act* defines spatial planning as the protection of a public good. It regulates the purposeful land use, the directions for the development of activities and their spatial organisation. In addition it defines the land use in accordance with the spatial possibilities and the needs of the society.

- The agricultural land and forests, water reservoirs, water and wetland areas, areas of valuable natural features and cultural heritage, all of major importance for long term development, are defined in the national and local spatial planning documents.
- Forests where various activities would threaten their protective role and endanger their existence are classified as the continuously protected forests. The special purpose forests are forests which are a valuable natural feature or a historic monument or are important for recreational, tourist, research, scientific or other reasons. Activities affecting such forests are only possible under the conditions and in the manner stipulated by the law.
- On the sea coast, lake shores and watercourses, mountain peaks and ranges, in areas of typical karst phenomena and areas important for outside recreation, any activities which are contrary to the areas' characteristics and which limit free access to them are not permitted. Restricted access and activities in these areas are possible only under the conditions and in the manner stipulated by the law.
- Activities which affect human health or ecological balance in nature are located and organised so that their harmful impacts are minimised with regard to the levels permitted by regulations.
- The landfill areas are located so that their harmful impact on the human environment, the ecological balance and the cultural landscape is minimised with regard to the levels permitted by the regulations. In a longterm municipal plan, the land use category of the waste collection areas is changed according to their new function.
- In the planning documents, the spatial planning decisions are based on the research, studies and projects on the natural characteristics of the area and on the possibilities of development in that area. The social development analysis and other documents concerning the possibilities of development in an area should reflect the mutual impacts of activities in a region and their impact on the natural and artificial valuable features of the human environ-ment. In these documents, the possible alternatives are presented, including the evaluation of the economic, environmental and other consequences.

Spatial planning at the national level

The National Assembly defines the long-term objectives of the spatial development and lays down the basic conditions for their fulfilment. While taking into account the protection and use of a public good, the long-term plan in its spatial components defines the basic directions and a general development concept of activities in an

area. The concept of the development primarily deals with the important agricultural areas and forests; the areas of main water resources; the areas of valuable natural features and cultural monuments; the areas at risk (landslides, erosion areas, flood plain areas); and the protection and development of the valuable landscape features.

In compliance with the long-term national plan, the mid-term social plan defines in its spatial components the measures for the protection and use of a public good, the measures for harmonised development of activities in an area and for harmonised regional development.

Spatial planning at the local level

While taking into account the guidelines for the long-term national plan, the municipal councils lay down the long-term objectives for the development of the municipality and define the main conditions for their fulfilment. The long-term municipal plan in its spatial components formulates the directions for the development of activities in an area, while taking into account the protection and use of a public good. It also lays down the concept of the intentional use of the agricultural land and forests; the areas of main water resources; the areas of valuable natural features and outstanding cultural features; the recreational areas; and the natural and endangered areas. The long-term municipal plan in its spatial components defines in detail for the areas outside human agglomerations, where a special public interest is defined, the planning directions for the protection and development of the natural valuable features and artifacts of the human environment; the detailed concept of the intentional use of an area, including the conditions for the conservation and development of the natural valuable features and artifacts of the human environment; the agricultural areas and forests with their functions; and the guidelines for the protection of landscape and its design.

The guidelines for the mid-term municipal plan lay down the grounds and objectives concerning the protection and development of the natural valuable features and artifacts of the human environment. During the formulation and harmonisation of interests concerning the spatial planning, the following components are of primary importance: the purpose, location, size, quality and infrastructure of a certain area; the impact of the planned activities on the environment; and other issues important for the spatial organisation of activities and the intentional land use. Arrangements concerning the bases of the mid-term social plan define the obligations concerning the protection and development of the natural valuable features and artifacts of the human environment.

During the process of harmonisation of the draft long-term and mid-term social plan of a municipality, maps of the spatial components of these plans have to be made available to the public for consultations. The alternatives and solutions concerning the spatial planning are then discussed by the public. The people have an opportunity to present their observations and comments in writing. Municipalities harmonise the preparation of the long-term and mid-term social plans while planning the development in large and functionally unified areas and while planning the activities affecting the intentional land use or the ecological conditions in other municipalities.

Act regulating Urban Planning and Other Forms of Land Use

The *Act regulating Urban Planning and Other Forms of Land Use* (540 decisions of the Supreme Court and the Constitutional Court have been issued with regard to the provisions of this Act) stipulates that settlements and other activities affecting the areas be planned in such a way that their urban and architectonic images are harmonised with the local characteristics, valuable natural features, cultural heritage, typology of the local architecture and other natural valuable features and artifacts of the human environment. In the urban planning of settlements and activities, the impact of urbanised areas and the relevant activities on the environment have to be studied and taken into account. Any activity whose effects can not be avoided is planned in such a way that the effects are minimised with regard to the levels permitted by regulations. The green areas located in settlements and other urbanised areas have to be provided for in the urban plans.

Spatial implementation documents

Under this Act the spatial realisation documents consist of the spatial planning conditions

(Photo: Branka Hlad)

Figure 137. *The valley of Radovna. The typical countryside and cultural heritage are also being lost due to the inappropriate architecture of the new buildings.*

and the spatial implementation plans. They are prepared on the basis of the data on the natural characteristics of an area and the current and future land use. They take into account the expertise for the long-term and mid-term social plan and the basic special technical documentation defined in the programme for drawing up spatial implementation documents. The natural characteristics and the created conditions in the area of the spatial implementation documents, and the impacts of the planned spatial arrangements, are defined in detail in the **expert grounds**. The urbanistic, design, construction, technical, technological and other conditions providing suitable living conditions are defined in detail in the spatial implementation plan. The measures for the conservation and development of the natural valuable features and artifacts of the human environment are included. The **spatial implementation plan** forms a basis for issuing a location permit and for the parcelling of land. It summarises the directions of the long-term community plan and decisions of the mid-term social plan concerning the discussed area. The current construction of the infrastructure and the expert grounds are considered. On the basis of the mentioned directions, the **spatial conditions** for the realisation of the planned decisions are laid down in the spatial implemantation plan. Spatial conditions reflect the influence, relation and dependency of an area on other areas, they provide solutions and measures for the protection and management of the landscape characteristics, the public good, and the arable land and they are a basis for the management of town parks and other green areas.

The programme concerning the preparation of the spatial implementation documents lists the bodies, organisations and communities which have to give their consent to the draft spatial implemantation documents.

For the construction of buildings, plants and facilities, an investor has to obtain a 'location permit'. In addition, a location permit is needed for any other activity, such as agricultural improvement, affecting the land and thus permanently altering its intentional use, the living and working conditions, the environmental balance in nature or the landscape characteristics. The location permits for buildings, facilities and plants and other activities affecting areas, which have a substantial impact on the ecological balance in nature, are issued by the minister responsible for spatial planning.

The location documents are drawn up on the basis of the data on the expected effects of a building, facility or plant, or any activity, on the environment. They include the agreed solutions with regard to the effects on the environment of the discussed activity and the consents issued by the competent bodies, organisations and communities in compliance with the law.

(Photo: Peter Skoberne)

Figure 138. *Leontopodium alpinum, a symbol of the Alps, was picked so much that it was becoming threatened and was therefore protected in Slovenia as long ago as in 1897.*

Biotechnology

In Slovenia, the proposal of the **act regulating the application of genetically modified organisms**, or better, **the act regulating the management of genetically modified organisms** is being drawn up in the field of *biological safety*. This act will regulate the management of genetically modified organisms (hereinafter referred to as GMOs) and stipulate the measures for the prevention of their possible detrimental effects on the environment, in particular on the conservation and sustainable use of biodiversity, and human health, as a result of the contained use of GMOs, their deliberate release into the environment and their placing on the market.

CONCLUSIONS CONCERNING LEGISLATION

1. In principle the legal regulation of the biodiversity conservation is adequate with regard to the segments laid down in the Convention. However, the delay of the sectors in the preparation of the relevant executive regulations is the cause for the low efficiency of the entire legal system. The result is that the appropriateness of the adopted legal measures cannot be assessed with regard to the set objectives and purposes.
2. In principle the legal regulation of the sustainable use of the components of biodiversity is adequate in the fields where new acts have been adopted, that is for forests and in part for agricultural land. Other fields can not be appropriately assessed.
3. The ownership of particular biodiversity components (populations, species, ecosystems) is regulated in such a way that waters, wild animals and aquatic plants are considered natural resources and thus the proper-

ty of the State. The land which provides a habitat for plants and animals may be owned by legal or natural persons. The preservation of property is at public interest and is therefore regulated in such a way that it is possible to legally intervene in the property right in order to define the manner of its enjoyment and acquisition for determining its social, economic and ecological function by which the legal mechanisms for the implementation of the biodiversity conservation are established. The establishment of a protected area as a protection measure has legal consequences for determining the property right in order to ensure its economic, social and ecological functions with regard to the manner of its enjoyment (restricted use and activities) and the actual acquisition of the property right (right of pre-emption by the State, consent for transactions in real-estate, restrictions on legal transactions with State property). It is possible to expropriate a real-estate for public benefit, and hence the persons who live in protected areas and who are deprived due to the restricted use and activities have a right to compensations for the caused damage under the conditions stipulated by the law or the right to submit a request for the purchase of a real estate whose use is minimum due to the stipulated restrictions.

4. The preparation and implementation of the incentive mechanisms is regulated by sectors. The legal basis for achieving the synergetic effects of funds allocated from various sources has been foreseen with the introduction of executive regulations and sectoral and intersectoral programmes.


LOG IN LOKA
BOGASTVO JE V RAZNOLIKOSTI

IMPLEMENTATION OF BIODIVERSITY CONSERVATION

IN SITU PROTECTION MEASURES

Protected Areas

Relevance and purpose of protected areas for biodiversity conservation

Protected areas of nature, in particular large protected areas (parks), are ecosystem units of extreme importance for the conservation of high biological and landscape diversity. Primerally, they are a nature protection category. However, the sustainable management of natural assets is based on their complexity. In these areas, the local population can enforce their fundamental developmental interests. Protected areas - in the public opinion a recognised and respected value - help raise awareness about the importance of the conservation of biological and landscape diversity.

(Photo: Peter Skoberne)

Figure 139. *Bohinj, mass tourism can affect the natural balance and diminish the value of protected areas.*

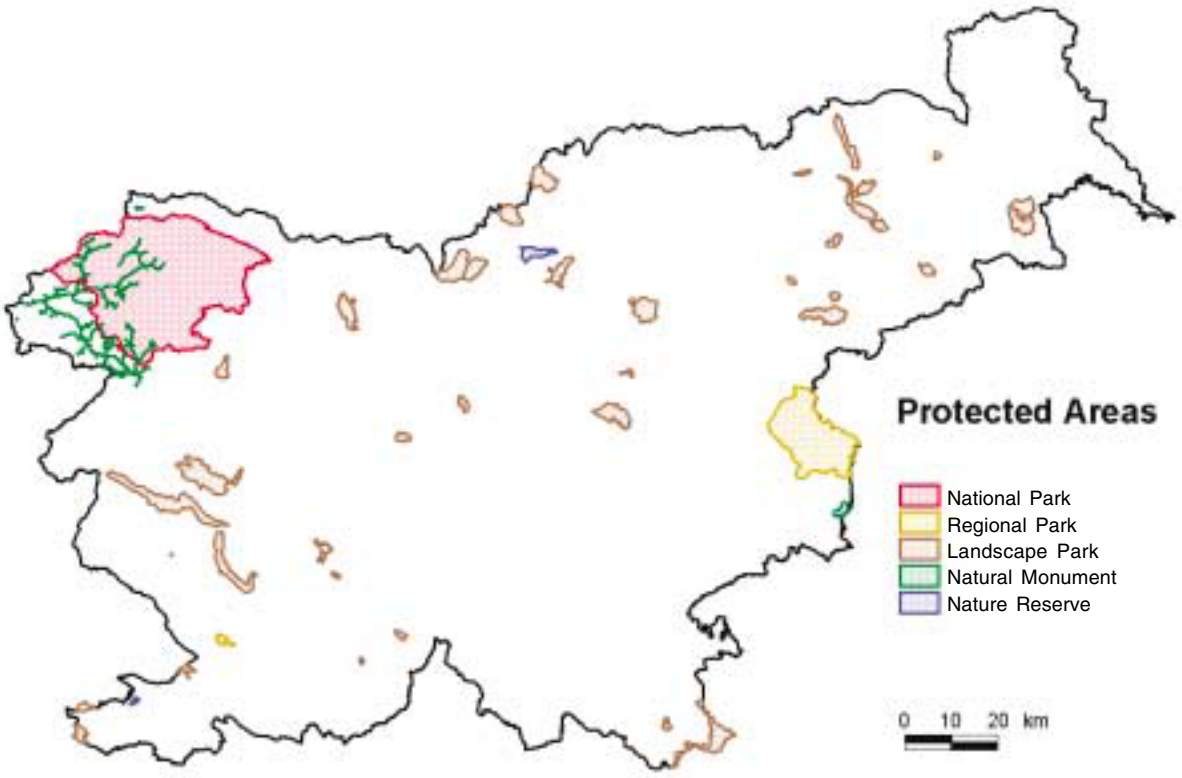
category	IUCN	established by
SMALL PROTECTED AREAS		
Strict Nature Reserve	I	Government
Nature Reserve	I or IV	Government Municipality
Natural Monument	III	Government Municipality
LARGE PROTECTED AREAS		
National Park	II and II/V	Parliament
Regional Park	V/III	Government
Landscape Park	V	Government Municipality

Table 44: *In the Nature Conservation Act, the natural protected areas are divided into small and large protected areas and these are further divided into six categories.*

Protected areas as a biodiversity conservation measure

Protected areas form a basis for integrated nature conservation. In many cases these are areas of the highest biological and landscape diversity and at the same time they cover the core areas of the Slovenian ecological network. The Convention on Biological Diversity defines these areas as units where system-based protection measures are enforced.

Strict protection regimes according to which human activities are excluded by rule, are enforced only in the Strict Nature Reserves and in the core area of a National Park (IUCN category II). Protected areas are established at the national level by Governmental decree or at the local level by an order, except for the National Park which is established by a State act.

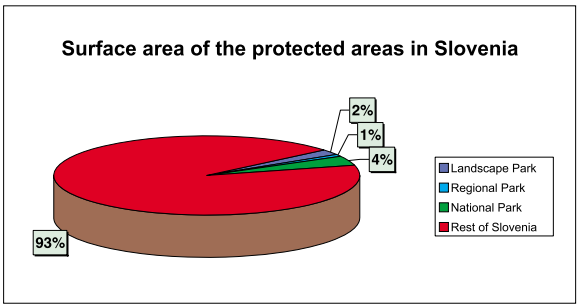


Map 11. *Map of the status of protected areas. Approximately 8 % of the territory of Slovenia is included in various categories of protection.*

Overview of protected areas

Most protected areas are designated as parks. In Slovenia, there are two protected areas with **international status:**

- the Škocjanske jame Regional Park (registered in 1986 the UNESCO World Heritage List and in 1999 the Ramsar List of Wetlands of International Importance).



Graph 25: *The National Park covers 4.1 % of the territory of Slovenia, 40 Landscape Parks cover 2.3 % and two Regional Parks cover 1 % of the territory. The information on Natural Monuments, Nature Reserves and other protected areas has not been compiled. (Source: MOP-ARSO, 2001)*

Table 45: *Surface of the protected areas in Slovenia (MOP-ARSO, 2001)*

Protected area category	IUCN	Number	Surface (ha)
Protection at state level			
National Park (NP)	I I / V	1	83,807.00
Regional Park (RP)	V / III	2	20,862.00
Nature Reserve (NR)	I / IV	10	120.00*
Landscape Park (KP)	V / III	1	650.00
Protection at local level			
Landscape Park (KP)	V	40	47,374.00
Nature Reserve (NR)	I / IV	49	**
Natural Monument (NS)	I I I	623	**
Monument of 'Designed' Nature (SON)+		77	**
Areas of Natural and Cultural Heritage++		10	**
Protection at international level			
The Convention Concerning Protection of the World Cultural and Natural Heritage		1 (1986)	413.00
the Ramsar Convention		2 (1993, 1990*)	1,063.00

* Data only for Škocjanski zatok Nature Reserve

** No data

\+ Monument of 'Designed Nature' is a category according to the Cultural and Natural Heritage Act

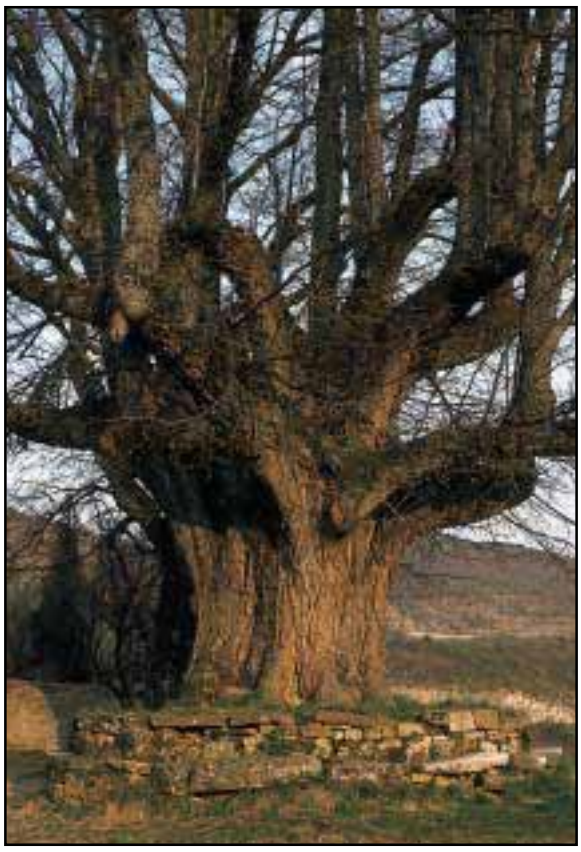
++ term deriving from several local community acts

(Photo: Marko Simić)

Figure 140 (left). *Škocjanske jame, the Škocjan caves, well known for their exceptionally large subterranean gorge, are inscribed in the UNESCO World Heritage List and the Ramsar List of Wetlands of international importance.*

- the Sečoveljske soline Landscape Park (registered in the 1993 Ramsar List of Wetlands of International Importance).

Among the remaining categories, the Natural Monuments are the most numerous. Most designated Natural Monuments are exceptional trees



(Photo: Peter Skoberne)

Figure 141 (left). *Trees are the most numerous protected nature sites; from the beginning of nature conservation, they have been considered natural treasures and a symbol of "Natural Monuments".*

which are not excessively threatened and whose protection is relatively easy. However, other valuable natural features, which have not been given the status of a protected area, are also important.

Most protected areas were established pursuant to the Natural and Cultural Heritage Act. The acts and the executive regulations, including conservation instruments which had been adopted before the Nature Conservation Act entered into force, remain valid until the enforcement of the new instruments for protection of valuable natural features, in compliance with the existing legislation.

Management of protected areas

Protected areas face many problems, but one of the major issues is lack of management. The Nature Conservation Act stipulates that the establisher of the protected area has to provide for its appropriate management by the establishment of a public institute or by granting a concession. Only three of the parks established by the State have as their managers independent public institute-Authorities (the Triglav National Park, the Škocjanske jame Regional Park and the Park Kozjansko). The concession for the management of the Škocjanski zatok Nature Reserve has been granted to the DOPPS - Birdlife Slovenia. The managers of all other protected areas have not yet been appointed. As a consequence, the objectives of protection as a nature conservation instrument cannot be achieved.

(Photo: Peter Skoberne)

Figure 142. *Kozjanski park. A good management plan and cooperation with the local people are essential for efficient management of a protected area.*

A management plan is of key importance when the management of a protected area is concerned. The implementation of the protection and development measures is based on such a plan. However, the relevant management plans have not yet been drawn up, except for the aforementioned parks and the Škocjanski zatok Nature Reserve. Consequently, the impact on the effi-

ciency and integrity of the management is negative.

The main issues to be solved concerning the management in protected areas are as follows:

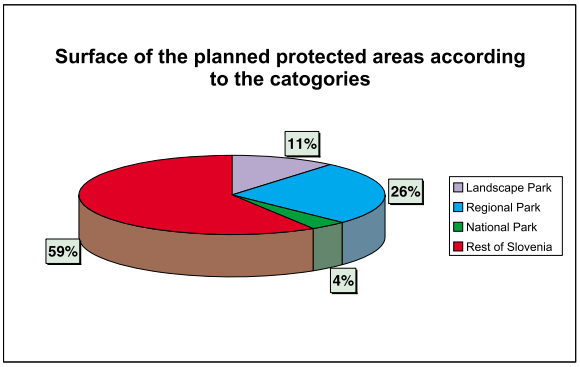
- discrepancy between the document establishing the protected area and the Nature Conservation Act;
- lack of funds and qualified staff for for managing public institutes;
- lack of funds and human resources for promotion of protected areas, and for training programmes, field equipment, infrastructure, compensations, incentives and purchases;
- non-compliance of the spatial planning documents and other strategic development plans with the objectives of the protected areas;
- lack of the management plans, or else they are only still being drawn up;
- non-harmonised system of nature protection control;
- ineffective inspectors control;
- lack of communication, or inadequate communication, between local communities, people living in protected areas and the Park Authorities.

Overview of the planned protected areas

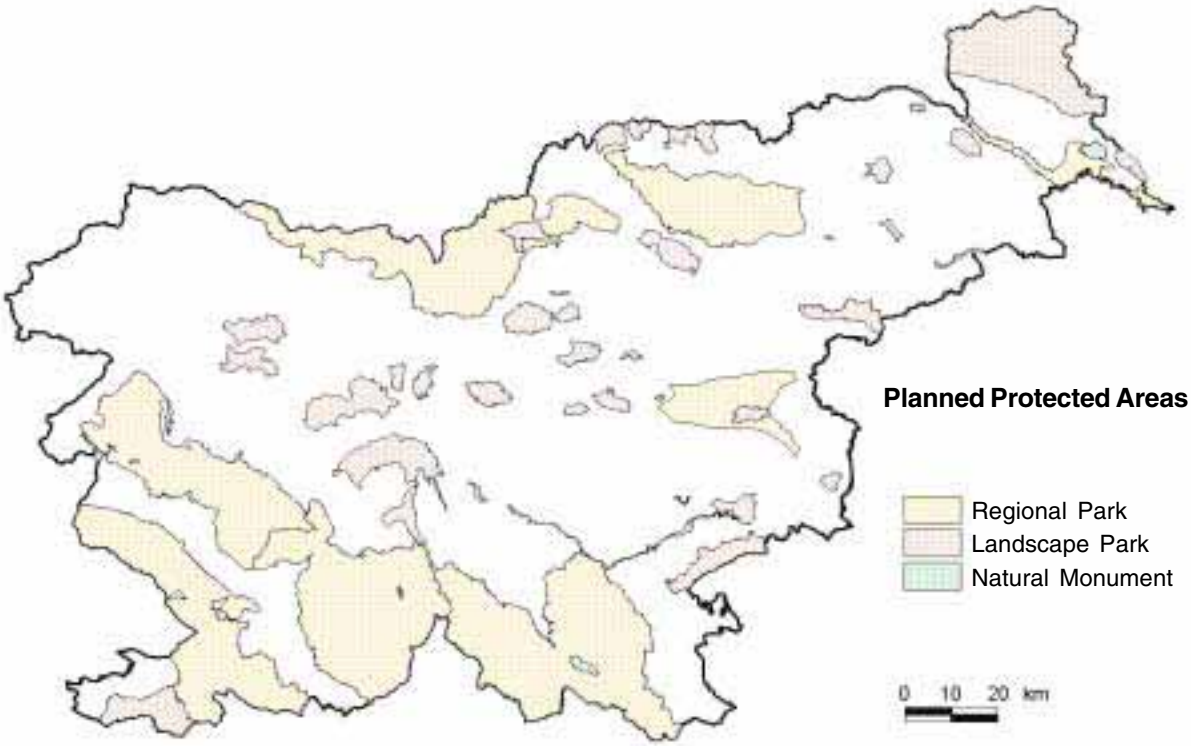
Slovenia is a country of great natural wealth and diversity. Unfortunately, not all outstanding areas have been given the protection status. Many valuable natural features and landscape features are not protected, because the interests of various sectors concerning the land use have not been harmonised. For that reason protected areas scheme was launched in 1998. Its amendment was adopted in 1999 within the framework of the spatial components of the National plan. The criteria for setting up this scheme include:

- the level of conserved nature, rarity, exceptionality, representativeness, complexity, diversity of the natural phenomena;
- the landscape types (representative, rare, preserved);
- the threatened and vulnerable ecosystems or landscape types;
- the balance (representativeness) of ecosystem and landscape patterns in all regions of Slovenia;
- local initiatives.

The scheme for protected areas focuses mainly on ecosystem conservation. New Landscape Parks (the river Drava, the river Dragonja, Ljubljansko barje, Goričko), which function as



Graph 26 (right): *Percentage of the surface area of the planned protected areas according to the IUCN categories (MOP-ARSO, 2001).*



Map 12: *Planned protected areas by categories. (MOP-ARSO, 2001).*

habitats of the endangered plant and animal species, have been formed. To protect the aquatic or riparian ecosystems. The emphasis has also been placed on the category of Regional Park which is considered to be the most suitable for protection of large, inter-linked, naturally preserved areas of high biological and landscape diversity where some economic activities are also performed (Snežnik, Kočevsko-Kolpa, Pohorje, Kras, Trnovski gozd, the Kamnik and Savinja Alps, and Karavanke, the river Mura).

NATURE RESERVES AND NATURAL MONUMENTS

The common objective of Slovenia is to protect approximately 30 % of its territory. Beside the category of Nature Parks, smaller sections of nature will be protected as Nature Reserves and Natural Monuments. Outstanding valuable natural features will be protected according to their rarity, outstanding size or shape, representativeness, complexity and ecosystem or landscape importance. Certain areas, which are proposed to be designated as Nature Reserves and Natural Monuments, lie within areas where the parks are to be established.

(Photo: Andrej Hudoklin)

(Photo: Marko Simić)

Figure 143. *Planinsko polje, together with Postojna cave and Cerknica polje forms the core area of the karst reaches of the Ljubljanica River. The idea of protecting this area led to the initiative to create the Snežnik Regional Park.*

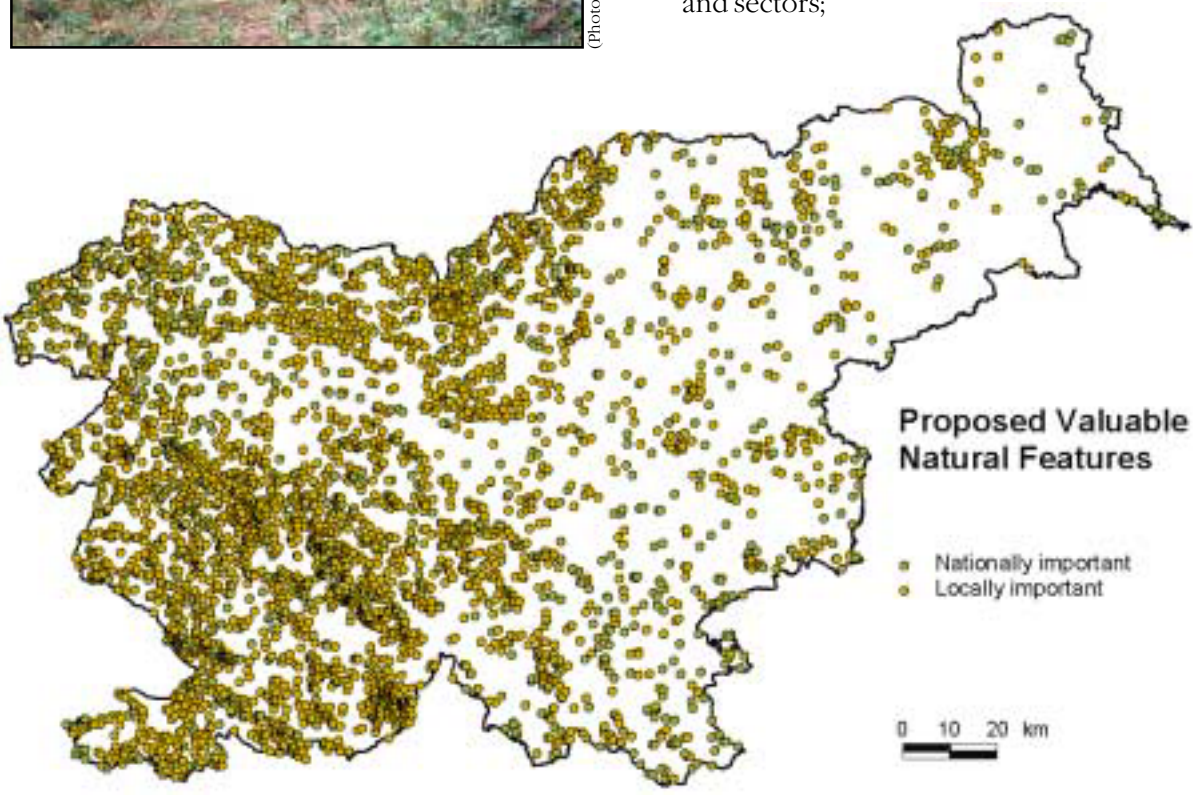
Figure 144 (left). *The wolf, Canis lupus, living in the area of three proposed Regional Parks (Snežnik, Kočevje and Trnovski gozd). These three areas are essential for the preservation of closed forest complexes as well as their inhabitants, particularly big mammals.*

Many areas proposed to be protected meet the international criteria, and represent grounds for the establishment of the transboundary protected areas.

Constrains related to the establishment of protected areas

The main constraints include:

- deficiency of fundamental research, habitat mapping, economic, regional and other applicative analyses,
- insufficient State support to the establishment of Nature Parks,
- lack of communication between institutions and sectors;



Map 13: *Proposed designation of valuable natural features (MOP-ARSO, 2001).*

Table 46: *Internationally important localities.*

Wetland Sites proposed for the inclusion on the Ramsar List	Important Bird Areas (IBA)	Biosphere Reserves (MAB)	Potential Crossborder Protected Areas
• floodplain of the Mura river	• Triglav National Park	• Triglav National Park	• Kras Regional Park
• the Drava river with Ormoško jezero and Šturmovci	• catchment area of the Nanoščica river	• the Kočevsko-Kolpa, Snežnik, Trnovski gozd areas	• Triglav National Park
• lowland forest Krakovski gozd	• '*Kras*' - Karst	• the Mura and Drava rivers	• Karavanke-Kamniško - Savinjske Alpe Reg. Park
• riparian wetlands of the lower Sava river and Jovsi	• Sečoveljske soline (Sečovlje salinas)		• Mura Regional Park
• Ljubljansko barje	• the Reka river valley		• Goričko Landscape Park
• karst catchment of the Ljubljanica river with fens on Bloke	• Ljubljansko barje		• Kočevsko Regional Park
• Čezsoški prodi and Vrbulje - the Soča river	• Planinsko polje		• Snežnik Regional Park
	• Cerkniško jezero		• Kolpa Landscape Park
	• Krakovski gozd		• Gorjanci Landscape Park
	• the Ribnica valley		
	• Kočevsko-Kolpa		
	• the Drava river		
	• the Mura river		
	• Goričko		

- passive participation of local communities in the preparation of proposals concerning protected areas, which often results in perceiving protected areas more as a limiting factor rather than a stimulating one.

Contractual protection and stewardship

The land owners sign agreements with the State concerning the protection of valuable natural features. The objective of such contractual protection is to ensure that the protection regimes and the regulated use of valuable natural features are respected. One of its measures is a financial mechanism for the valuable natural feature to be used in an agreed manner.

Figure 145. *Sečoveljske soline, a Landscape Park and a Ramsar Site, remains a State property.*

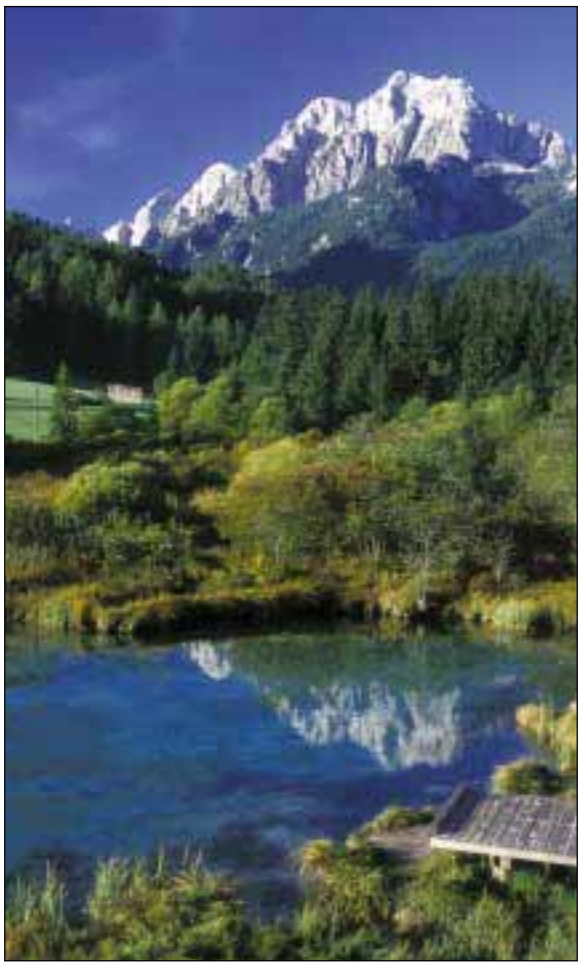
(Photo: Marko Simić)

Stewardship is a similar measure. Such a contractual relationship is concluded with a natural or legal person who does not own the area of the valuable natural feature. The Sečoveljske soline Landscape Park is the first protected area managed by such temporary stewardship, a measure conducted by the State.

Purchases of real-estate located in protected areas

Pursuant to the Nature Conservation Act, the State and local communities have the right of preemption in the purchase of real-estate located in protected areas. By this instrument, the State (municipality) becomes the owner of the biodiversity important areas. In these areas, when contractual protection is no longer rational - because of a special interest enforced or regime established by the State - through the purchase the primary interest, i.e. the protection (conservation) of a valuable natural feature, may be ensured.

The State purchases real-estate in direct agreement with the land owners. According to the data of the National Farmland and Forest Fund, the State - in compliance with the planned priority purchases and for conservation purposes, purchased 31.5 ha of land in the period from 1995 to 2000. This land is mostly wetlands (marshes, reed beds, meadows, pastures) and some abandoned arable land and forest. The Ledine marsh and several lands in the Zelenci Nature Reserve, the central area of the Triglav National Park, the Škocjan-



(Photo: Marko Simić)

ske jame Regional Park, and the protected area Mali Plac were purchased.

With regard to the purchase, mostly real-estate is considered, as in the case of the central part of the Triglav National Park, in particular when it has been decided that the purchase is essential for the protection of valuable natural features, habitats and ecologically important areas and adjacent land.

In recent years, the offers of the land owners for the purchase of land in the protected areas have exceeded the available budgetary funds and the organisational abilities of the administrative services for more effective conduct of procedures.

The funds available for implementation of such measures are scarce - the amount cannot be compared to the amounts allocated for such purposes by many EU countries.

Compensations and incentives

Land in protected areas is often unsuitable for agricultural production. Therefore, the farmers who live in such areas are entitled to different support for the preservation of the traditional farming techniques which are essential for the conservation of biological and landscape diversity. Support is given for the maintenance of the current status in compliance with the protection regime established in the protected area or valuable natural feature:

- if the applicant's income has significantly lowered (or will lower) - owing to the prohibition concerning the application of agrochemical substances - the reduced number of hay harvesting (first mowing after the blooming of grass and after the nesting period, prohibition of levelling, etc.);
- for the maintenance of the traditional landscape, e.g. the restoration of orchards on mown land, hedges, areas covered in trees and shrubs, traditional land use in protected areas (mowing of steep and uneven meadows, maintenance of litter-disposal facilities in forests, management of open land, maintenance of mountain trails, etc.);
- to support farmers in transition to organic farming.
- In Slovenia compensations have been paid since 1995. The purpose of this instrument is to offer farmers additional stimulation to cultivate land in protected areas in an environmentally friendly manner. Consequently, the conservation of numerous plant and animal species and the identity of the landscape are ensured:
- in 1996 and 1997, the farmers living in the Triglav National Park received support for the handmowing on uneven meadows; the farmers of Biš (near Ptuj) received compensation for the loss of income in the area of the grey heron colony; and in Lahinja Landscape Park for handmowing in floodplain meadows;
- since 1997 funds have been allocated for the maintenance of dry, extensively managed karst grasslands in the Škocjanske jame Regional Park;

Figure 146. *Natural Reserve Zelenci (spring of the Sava Dolinka River), one of the few examples of the State purchasing some of the land for conservation purposes.*

Figure 147. *Planina Vogar. The typical meadows of the Alpine environment depend on regular hand-mowing of the grass. By now, many of them have been levelled off or overgrown by forest.*

(Photo: Peter Skoberne)

- since 1998, financial support has been given for the transition to organic farming and for grazing on mountain pastures of the Triglav National Park.

Ecologically Important Areas and Ecological Networks

If conservation measures were focused only on protected areas, these could lead to the formation of isolated islands, with more or less preserved nature, lying in the urbanised and industrialised territory. In order to preserve links between ecologically important areas, the idea of an ecological network appeared. Its purpose and methodological bases are defined within the European Ecological Network (EECONET). States and the international community meet the objectives of network cooperation through various instruments (EU - Natura 2000; Council of Europe - Paneuropean Ecological Network and the Emerald Network, CORINE, Biotopes). Core areas with their buffer zones are defined according to certain criteria. Such zones are linked by continuous or non-continuous corridors. In Slovenia, the legal basis for the national ecological network is provided for in the Nature Conservation Act. It is based on the network of Ecologically Important Areas.

Environmental Impact Assessment

The Decree on categories of activities for which an environmental impact assessment is mandatory (1996; amended in 2000) focuses in particular on the activities carried out in protected areas. For some of these activities the Decree stipulates the application of more stringent measures if they are to be carried out in these areas.

EX SITU PROTECTION MEASURES

Protected species

At the national level, 28 plant species, 70 species or genera of fungi and over 200 animal species or higher taxonomic groups have been protected. At the local level 17 plant species (Nova Gorica municipality - 4; Sežana municipality - 13) have been protected. They are locally threathened due to mass picking. In particular those species are protected which are directly threatened because of the destruction of their specimens. In the expert proposals for the Red Data Lists of endangered plant and animal species many more are included (nearly 600 species of mosses, pterodophytes and spermatophytes; approximately 2000 animal taxa). Damaged or destroyed habitats are the most common causes of threat to these species. Therefore, the protection measures for habitats are essential for their conser-

(Photo: Marko Simič)

Figure 148. *Daphne blagayana, one of the two first protected plant species in Carniola. It was first described in the area of Polhov Gradec although the species is rare in Slovenia, growing at the most north-western edge of its distribution area.*

(Photo: Marko Simič)

Figure 149. *Rhinolophus ferrumequinum, in a karst cave near Sežana. Human activities are the main causes of the declining numbers of bats. Rhinolophae are among the most threatened mammal species in Slovenia.*

vation. The regulation on the protection of endangered species stipulates that the minister may temporarily, and the Government permanently, prohibit or limit any activities which would directly endanger the habitat of protected species. The most important measures for the protection of species' habitats are included in the regulations on the identification of Ecologically Important Areas and habitats, and on the establishment of protection guidelines for the conservation of habitats at a favourable status and of protected areas.

Deficiencies of acts on the protection of species

Regulations on the protection of plant and animal species are partly harmonised with the Nature Conservation Act, the EU directives on the protection of species and habitats and certain international agreements (Bern Convention). Under the Nature Conservation Act, the adoption of the ministerial regulation on the designation of endangered species and inclusion in the Red Data Lists is fundamental for their protection. Thus, the adoption of the regulation is the first step in the process of harmonising of the conservation system, and the next one is to amend the executive regulations on the protection of species in compliance with the EU directives. At the same time, executive regulations stipulating the particulars of the protection of plant and animal species, e.g. trade, breeding, keeping in captivity, etc., have to be adopted.

Botanical gardens, zoos, herbarium collections, animal shelters

The **Ljubljana Botanical Garden** is the most important botanical garden in Slovenia for the *ex-situ* conservation of indigenous plants. The University Botanical Garden, established in 1810, comprises a rich seed bank and a collection of live plants and some endemic and endangered species. Its tasks are the conservation of indigenous plants, with special emphasis placed on the endemic and endangered species. Since 1889 the garden has been issuing a yearly seed index (*Index seminum*) with the seeds of plants collected in the Julijana Alpinum - Alpine Botanical Garden. In 1997, the seed collection comprised 795 plant species. The modernised botanical garden has not yet been revived.

The purpose of the **Maribor University Botanical Garden** is to conserve the locally endangered species. It comprises a collection of conifers and aquatic plants. Both of these botanical gardens are members of the international association of botanical gardens - *Botanic Gardens Conservation International (BGCI)*.

The **Julijana Alpinum in Trenta** valley was established in 1920 and is now managed by the Slovenian Museum of Natural History. The **Arboretum Volčji potok** is a public institution. They are both research and educational institutions.

In addition, a few more botanical and dendrological collections exist in Slovenia (Sežana, Pristava-Rafut, etc.). They store a valuable gene pool, but none of the botanical collections has been given the status of a gene bank.

Herbarium collections are important for research into and knowledge about biodiversity. At the Department of Biology of the Ljubljana Biotechnical Faculty (LJU) and at the Slovenian Museum of Natural History (LJM) two herbarium collections are located. They are a basic source of knowledge about plant biodiversity and its conservation and at the same time they document biodiversity. The herbarium collection in Ljubljana is the richer and more important of the two. It comprises a set of exsiccates, some personal herbariums (for example of R. Justin and F. Dolšak) and a research collection of plants from Slovenia and abroad. A significant segment of the collection resulted from the exchange with other herbariums. In 2000 the herbarium collection comprised over 200,000 files. The historic collections in the Slovenian Museum of Natural History (Hacquet, K. Zois, Hladnik, Freyer, Flora exsiccata Germanica from the first half of the 19 century, etc.) are extremely important for the specialised research into and knowledge about the dynamics of flora.

Zoos are a 'time bridge' to the third century. Specialised and extremely endangered animal species survive there while their natural environment is being destroyed. They play an important role in the nature conservation and the protection of endangered animal species. The Endan-

(Photo: Peter Skoberne)

Figure 150. *Arboretum Volčji Potok. Botanical gardens and arboretums are important for ex-situ biodiversity conservation. They play a key role in nature education and public awareness.*

gered Species Programmes inside zoos protects animal species from extinction and at the same time facilitates their conservation in the natural environment. Through the implementation of these programmes specimens are introduced to their natural populations and these are thus strengthened.

In the Ljubljana ZOO, the Endangered Species Programmes of the following animal species is carried out: Salmon-Crested Cockatoo (*Cacatua moluccensis*), Wreathed Hornbill (*Aceros undulatus*), Black Stork (*Ciconia nigra*), Persian Leopard (*Panthera pardus saxicolor*), Asian Elephant (*Elephas maximus*), and Red-Cheeked Gibbon (*Hylobates gabriellae*). One of the main objectives of the ZOO is to breed and exhibit all indigenous amphibians and reptiles. It also focuses on the breeding of black and White Ruffled Lemur (*Varecia variegata variegata*), Reticulated Giraffe (*Giraffa camelopardalis reticulata*), Siberian Tiger (*Panthera tigris altaica*), European Brown Bear (*Ursus arctos arctos*) and Red Panda (*Ailurus fulgens*).

Organised education courses are one of the most important tasks of the ZOO. They have been regularly carried out since 1990. In 2000, 18,300 visitors took a guided tour around the park. The visitors are informed about the biological characteristics of an animal as well as about the nature conservation issues in general. The ZOO is furnished with the information and identification signs for the individual species presented. Communication with the media is well established and helps to raise public awareness about nature.

Wildlife senctuary. Within the ZOO there is also a wildlife senctuary, which was provided for in the Decree on the protection of endangered animal species of 1993. The injured or ill animals of the protected vertebrate species; the young which are not capable of surviving in the wild; animals kept in captivity in unsuitable living conditions; and animals which have been seized from the owner because of the illegal trade, are all received in the wildlife senctuary. Its purpose is to help animals, to handle them in a etnic manner and to return them to the wild. It plays a significant role in the raising of the public awareness and its education.

Figure 151. *Buckwheat is again becoming a frequent crop in the fields.*

(Photo: Peter Skoberne)

Gene banks

Cultivated plants

In 1995 the minister responsible for agriculture, forestry and food appointed a commission to draw up and implement a national project the Plant Gene Bank in Slovenia. The commission is composed of experts from the Agriculture Institute of Slovenia, the Biotechnical Faculty - Department of Agronomy, the Žalec Institute of Hop Research and Brewing, the Slovenian Forestry Institute and the Ministry of Agriculture, Forestry and Food.

The commission's tasks are:

- to coordinate the study and assessment of the collected genetic resources;
- to review and approve the annual programmes and allocate funds to agricultural genetic resources;
- to harmonise the long-term programmes with the Convention on Biological Diversity and to incorporate the programme into the national strategy for implementing the Convention on Biological Diversity;
- to establish and operate the central seed collection kept in cold storage at -20 °C at the Agriculture Institute of Slovenia, where long term storage facilities were established in 1994.
- to establish and operate a comprehensive documentation and information system about agricultural and forest plants; the system will use internet to facilitate communication between all institutions involved in the national programme and the international databases; in this way Slovenia's genetic resources will be presented and cooperation with the related institutions around the world guaranteed;
- to participate at the international level in the European Cooperative Programme for Crop Genetic Resources Networks (ECP/GR) (cereals, forages, fruit, grain legumes, fruit species, vines, industrial crops and potato, minor crops, documentation and information, *in situ* and on-farm conservation).

COLLECTION	INSTITUTION
Buckwheat and Wheat Seed Gene Banks Corn Seed Gene Bank Fruit Seed Gene Bank Gene Bank of Grass and Clover Seed	Biotechnical Faculty-Department of Agriculture
Hop Seed Gene Bank Medicinal plants Gene Bank	Institute for Hops and Brewing, Žalec
Horsebean Seed Gene Bank Onion Seed Gene Bank Cabbage Seed Gene Bank Lettuce Seed Gene Bank Gene Bank of Potato Clove Seed Gene Bank Grass Seed Gene Bank Wheat Seed Gene Bank Gene Bank of Vine Gene Bank of small fruits	Agriculture Institute of Slovenia

Table 47: *Overview of the current collections to be included in the central gene bank of Slovenia kept at the Agriculture Institute of Slovenia*

Better knowledge about the characteristics of genetic resources improves the possibilities for the re-introduction of old cultivars, populations and ecotypes in the sustainable cultivation and for the use of traditional crops. The collection of genetic resources has to be furthered in areas where the environment is heavily burdened or is threatened by a major ecological change (motorways, artificial lakes) in order to conserve the disappearing species. It is of utmost importance to check to what degree the genetic resources are conserved at farms. That is necessary for the study of the genetic erosion (abandonment of important crops) and the promotion of the planned activities. The mapping of ecotype sites in natural habitats and the monitoring of changes are also necessary. The following needs to be done:

- detailed evaluation of the material (molecular, genetic and phylogenetic studies, studies of economic characteristics);
- establishment of new methods and technologies for the conservation and regeneration of genetic resources;
- preparation of regulation.

Gene bank in livestock breeding

The biodiversity of domestic animals gained importance in Slovenia with the establishment of the European animal genetic data bank. Slovenia was among the first countries to participate and provide information on indigenous breeds of domestic animals. Since 1991, a group of researchers at the Biotechnical Faculty - Zootechnical Department has been interested in the conservation of domestic breeds. The *Programme on the conservation of indigenous breeds of domestic animals* covers all the necessary steps for the protection of the endangered breeds: the inventory, the establishment of the status and endangerment and the potential conservation measures. At first, the programme involved sheep, hens and pigs, and later on other species of domestic animals were included. The common objective is to find the remains of these breeds and to provide the original breeding material. Field studies are mandatory on sites where the remains of specific domestic breeds can be found. Genetic tests will be performed and blood samples will be collected and analysed for some animals. All the tasks related to the breeding - such as animal branding, the keeping of genealogy records, preventing genetic erosion caused by inbreeding, recovery planning, measuring the productivity of an animal and assessing its pure bred value - should be carried out on a permanent basis.

In the last decade, measures for lowering the number of breeds of domestic animals in Slovenia were taken with regard to the degree of threat to certain breeds. In order to maintain the level of conservation of biodiversity in livestock breeding, the conservation activities will have to be constantly carried out and updated. The introduction of new approaches and technologies of *in situ* conservation (sperm and embryo freezing, which is unfortunately not (yet) possible for all species) is mandatory.

The livestock gene bank should in particular:

- collect and record indigenous genetic material, including old indigenous breeds of domestic animals;
- evaluate and assess the collected genetic material according to international descriptors;
- store and renew samples of the collected genetic material;
- propagate and exchange genetic material.

(Photo: Peter Skoberne)

Figure 152. *Slovenia has a number of autochthonous domestic animal breeds adapted to local natural conditions. The Lippizaner is one of the most admired.*

HORSE	CATTLE	PIG	SHEEP	GOAT	HEN	BEE	DOG
Slovenian cold-blooded horse	Cika	Krškopoljski prašič	Bovška ovca	Bovška (Drežniška) koza	Štajerska grahasta kokoš	Kranjska čebela (*Apis mellifera Carnica*)	Kraški ovčar
Posavje horse	Slovenian brown cattle		Jezersko-Solčavska ovca				Kratkodlaki istrski gonič
Lipizzaner			Istrska pramenka				Resasti istrski gonič
			Belokranjska pramenka				Posavski gonič
							Slovenski planinski gonič

Table 48: *The gene bank managed by the Zootechnical Department at the Biotechnical Faculty stores 18 indigenous breeds of 8 autochthonous animal races (Source: BF, Zootechnical Department, 2001).*

The annual activities include the following technical, research and development activities:

- checking of rearing establishments and branding of animals;
- measuring of animals and their productivity, ethological measurements of various breeds, genetic tests;
- selection by exterior traits, pure-bred value assessment,
- keeping of breeder's records and genealogy documents,
- targeted breeding;
- selection of new lines of animal species and recovery planning;
- prevention of inbreeding;
- research on the development of new breeds; studies concerning the growth rate and body composition,
- analyses and studies of eggs,
- study of new indigenous breeds.

In addition to carrying out the basic research and technical work, it is also necessary to provide financial compensations to breeders who maintain these breeds *in situ*. The conservation of domestic animals in the autochthonous environment is the best solution for their conservation and for the conservation of landscape diversity. Such conservation defines a certain area and the people who live and work there. Direct support to the conservation of indigenous species of domestic animals is also enforced in the EU (see Regulations 1257/99 and 1750/99). Such support provides compensations to breeders who breed less productive indigenous breeds

Gene banks in forestry

Slovenian forestry is based on the principles of sustainability, sustainable forest management and the multifunctionality of forests. The forest management and silviculture measures are defined by the longevity of the forest trees. In Slovenia, the ecological, physiological and genetic characteristics of forest trees populations are adapted, as well as possible, to the forest sites in a specific forest ecosystem.

The longevity of trees and the earlier mentioned forest management principles are the reasons why the silviculture measures and the relevant requirements differ so much from the measures concerning the management of crops. Therefore, the criteria for the establishment, maintenance and use of gene banks differ with regard to agricultural and forest plants.

The **Slovenian forest gene bank (SGGB)** is considered to be an all-encompassing institution. In addition to the collection of seed (with pollen and tissue cultures), the main tasks of the Slovenian forest gene bank/forest seed objects concern the selection of seed stands which represent a form of *in situ* protection of forest genetic resources. Only such protection guarantees the emphasised protection of the genetic diversity because the *ex situ* protection of seed objects (seed banks, seed orchards, living archives and research specimens) is not as intensive as the *in situ* protection.

The Slovenian forest seed bank includes the *in situ* (in natural environment) and the *ex situ* (outside the natural environment) seed objects.

- seed stands (404 seed stands at 2304 ha are entered in the registry);
- seed bank (105 accessions);
- seed orchards (4);
- living archives of forest tree species (3);
- offspring tests and provenance trials (5).

The Slovenian forest gene bank database comprises the Central database on the Slovenian forest gene bank and the relevant registers:

- Register of selected seed stands (since 1955),
- Register of seed trees groups and regular stands (since 1998),
- Register of seed stock (the oldest accessions are from 1964; currently since 1971),
- Database on research stands, living archives and seed orchards.

The forest genetic resources include all forest reserves which have been systematically selected in Slovenia at different sites and cover approximately 10,000 ha (4,000 ha more are planned). It is stipulated in the forest management plans that forest reserves be protected in compliance with the protection regime of the strict Nature Reserves under the Nature Conservation Act. This means that the reproduction material from these stands is not available for use. In an indirect manner, forests in other protected areas perform the function of forest gene banks.

The Slovenian forest gene bank, together with the planned network of forest gene stands, is involved in the formulation of the international strategy for the conservation of forest genetic resources. The institution has actively and officially participated in the European Forest Genetic Resources Programme (EUFORGEN) since 1997. The forest gene banks experts are involved in the system for the exchange of information on plant gene banks in Slovenia (within the information system of the Commission on plant gene banks). The forestry part of the entire system is harmonised with the European information system on forest genetic resources (within EUFORGEN) managed by the International Plant Genetic Resource Institute (IPGRI) and FAO in Rome.

Microbiological collections

Micro-organisms kept in collections represent the known cultivable natural diversity of microbes. The world's main microbiological collections conserve approximately a million cultures, and many more may be found in industrial and private collections and in the collections of various institutes. Slovenia has not yet completed an overview of the number and diversity of microbe cultures available, nor has the number of isolates grown in Slovenia been compared to the number obtained from other collections. The management of these cultures helps us understand the world of micro-organisms; at the same time, these cultures form an important potential genetic resource of Slovenia (taxonomic rarity or exceptionality due to biotechnological potential), raise the understanding of the ecological part played by micro-organisms, and facilitate scientific development.

The stored micro-organism cultures are used only for comparison with and identification of other cultures (type strains, reference cultures), but also for the purposes of research, biotechnology procedures, education and patent protection. Microbiological collections are used to isolate micro-organisms in nature and to taxonomically identify and characterise the isolated strains. Other tasks performed by these collections include: the keeping records on cultures, simultaneous conservation of isolated cultures, gathering information on cultures, providing information through catalogues or in electronic form to the public, following of the legislation concerning the distribution of cultures and the regulations concerning the quarantine measures, the pathogenicity of strains and the international co-operation, etc.

In Slovenia, there are a few microbiological collections kept at faculties, institutes and in industry. However there has been no connection established between them and they have not been catalogued, so it is not known what they comprise. The last inventory of the microbiological collections was carried out in 1995 at the initiative of the Ministry of Science and Technology. The inventory was co-ordinated by the Chemicals Institute at the Department of Food Science and Technology of the Biotechnical Faculty in Ljubljana. The situation has probably changed in the last five years and the data on the functioning of these standard collections will have to be supplemented by data on biodiversity and by taxonomic research.

Conservation methods. Micro-organisms are conserved by various methods in order to achieve different degrees of genetic stability of strains. The usual conservation methods are: re-inoculation to oligonutrient culture medium, low temperature storage, dehydration, storage in mineral oil, lyophilization, storage in liquid nitrogen, etc. However, not all micro-organisms can be stored with the application of these methods.

Collection services. The stored micro-organism cultures are used for comparison with and identification of other cultures (type strains, reference cultures) and also for the purposes of research, biotechnology procedures, education and patent protection. Access to certain cultures may be free, others are stored as patented cul-

Table 49: *Overview of micro-organism collections in Slovenia*

TITLE OF COLLECTION	INSTITUTION
Microbiological collection of the Chemicals Institute (MZKI): collection of industrial filamentous fungi and yeasts*	Chemicals Institute in Ljubljana
Collection of industrial micro-organisms (ZIM):	
collection of yeasts	Department of Food Science and Technology of theBiotechnical Faculty
collection of symbiotic bacteria	Department of Food Science and Technology of theBiotechnical Faculty
collection of symbiotic mycorrhizal fungi	Department of Biology of the Biotechnical Faculty
collection of lactic acid bacteria	Zootechnical Department of the Biotechnical Faculty
Collection of anaerobic bacteria:	Zootechnical Department of the Biotechnical Faculty
Collection of wood fungi	Department of Forestry of the Biotechnical Faculty
Collection of extremophyle fungi (Ex-F), collection of bacteria (Ex-B)	Department of Biology of the Biotechnical Faculty
Live collection of mycorrhizal fungi, microfungi and macrofungi	Slovenian Forestry Institute
Macrofungi in various herbariums	Slovenian Museum of Natural History; Ljubljana University Herbarium
Collection of phytopathologic fungi	Department of Agronomy of the Biotechnical Faculty
Mycological collection and herbarium of the Slovenian Forestry Institute	Slovenian Forestry Institute
Live collection of pathogenic fungi	
Live collection of pathogenic fungi	

* MZKI is the only Slovenian collection included in various international collections and other networks; it meets the criteria for the IDA (International Depository Authority) status under the Budapest Treaty.

tures, safe deposits or permanent deposits. Microbiological collections are also used to isolate micro-organisms in nature, to taxonomically identify and characterise the isolated strains. Other services include: the keeping of records on isolated cultures and cultures obtained from other collections or institutions, simultaneous conservation of isolated cultures, providing information on cultures (one's own and cultures stored in other microbiological collections), providing information through catalogues or in electronic form to the public, following of the legislation concerning the distribution of cultures and the regulations concerning the quarantine regulations, the pathogenicity of strains, etc.

Patented strains. The Protection of Intellectual Property Right Act stipulates that prior to the filing of the application, the micro-organism has to be deposited in a collection with an International Depository Authority status. According to the provisions such a strain is made available to the public. The international relations concerning the depositories, deposits and patent offices are regulated by the Budapest Convention of 1981. In order to meet the requirements of this Convention and to be acknowledged as an International Depository Authority the collection has to meet certain requirements:

- it has to be located in and acknowledged by one of the parties;
- have a continuous existence;
- have the necessary staff and facilities,
- be impartial and objective,
- be available to any depositor under the same conditions,
- accept for deposit any or certain kinds of micro-organisms, examine their viability and store them in a genetically stable manner for 30 years,
- issue receipts and required viability statements,
- comply with the requirement of secrecy,
- furnish samples in conformity with the regulations.

ECONOMIC DEVELOPMENT OF SLOVENIA AND BIODIVERSITY

BACKGROUND

The development directions of the State and the criteria for the analysis and evaluation of the development are discussed in the Strategy of Economic Development of Slovenia. In July 2001, a new Strategy for the period until 2006 was drawn up (SEDS06), replacing the preceding Strategy of 1995 (SEDS95).

The main objective of the SEDS06 is the sustainable increase of the welfare of the population which is defined as a balanced entity functioning within the framework of its economic, social and environmental components. Welfare is based on the material as well as immaterial components, such as personal development, self-realisation, participation in society, safety, cooperation and the development of an individual and cultural identity.

Based on the new economic developmental paradigm, the strategy defines the priority developmental factors, main developmental directions and the relevant role of the State in development:

- transition to a knowledge based society;
- strengthening of the competitiveness of the economy;
- improving the efficiency of the State;
- upgrading the capacity to perform policies within the common EU market rules;
- harmonised regional development.

The purpose of the SEDS06 is the planned implemantation of sustainable development based on the developmental potential, achievements and conceptual strategic changes in the global environment.

In accordance with these developmental directions, the economic development of the country will have to support the conservation of biological and landscape diversity. The detailed analyses of the relation between economic development and biodiversity are not yet available. However, the representative indicators of the economic and environmental integration are presented below. Through these indicators, the seriousness of developmental problems concerning conservation of biological and landscape diversity in Slovenia are reflected.

ANALYSIS OF ECONOMIC DEVELOPMENT BASED ON REPRESENTATIVE INDICATORS

In view of the social and environmental status of Slovenia it has been estimated that it is more developed than could be expected when taking into account the achieved economic development measured by gross domestic product per capita. The level of Slovenia's sustainable development is relatively high in comparison to its economic development. It matches Italy, Britain and Belgium, which certainly can not be considered as completely environmentally oriented countries, but their GDP per capita is much higher. In this regard Slovenia could be compared to Greece, Portugal and Spain, where the sustainable development indicator is about 30 % lower. Including the environmental and social considerations into the analysis can therefore only improve the image of economic development in Slovenia. By doing that, many countries would only achieve the opposite.

This developmental feature defines Slovenia's identity, and the SEDS06 is based on it. Such directions have brought the realisation that development should take into account that:

- the economy should depend more on the domestic measures and resources (endogenous development);
- the potential of economic growth, based on the exploitation of domestic renewable resources, should be developed; and
- the development should be spatially balanced - regional harmony, spatial order.

Economic aspects of economic development

In the early nineties, in the period of transition of its economy, Slovenia was faced with recession. Approximately one fifth of its commercial market on the territory of the former Yugoslavia was cut off. The production and gross domestic product fell by around 15 % in the period from the mid-eighties to 1992. Unemployment increased from a negligible level to a relatively high percentage. In 1992 the rate of inflation was nearly 100 %. Slovenia reached the bottom of the transitional recession, and the recuperation started in 1993 with the macro-economic stabilisation based on monetary independence; the control over the prices of about one fifth of goods and services used for the calculation of the inflation index; the success of the public finances; and the successful transfer of export to the western markets.

The rate of inflation dropped to 10 % in 1995, but the rate of unemployment started to fall only in 1998. Slovenia's economic growth is sustainable, as is evident from the nearly exemplary macro-economic balance (see tables A to E), the general government revenues and expenditures as well as imports and exports. At the end of the last decade, a new development cycle began and this balance was upset. Macro-economic parameters may be balanced and stable only when "the transitional borrowing" is being carried out. When these debts are being paid off (recession), they can not be justified because in this way the solving of developmental problems is just being postponed. At the end of the last decade, Slovenia's GDP per capita surpassed that of the EU countries with the lowest GDP. It has come close to three quarters of the EU-15 average.

The economic policy tried to adapt as much as possible to the uncertain transitional processes and various international factors. It was relatively successful, since the process of restructuring was indeed controlled but continuous. On average, the investments are the most dynamic part of the domestic demand, and the productivity of work and profitability increase in parallel with them.

The economic transition has been completed with regard to the openness of the domestic market (lower customs tariffs); better economic relations with foreign countries; withdrawal of the State from direct interventions in the economy; and the capability of public finance to cope with the social consequences of the transition. The equity in the distribution of profit has decreased but the consequences are manageable and remediable.

A positive feature during the transitional period is that the structure of the economy has improved. The contribution of the industrial sector to the GDP has fallen while the share of services has increased. A large part of income is generated abroad and a large part of income generated in Slovenia outflows to other countries. In the process of economic restructuring many economically and environmentally unsuccessful companies have failed, and as the result the market transition has been completed in the spirit of sustainable development. The privatisation of industrial undertakings which has been carried out simultaneously with the transitional restructuring has offered an opportunity to companies to establish environmental reservation funds for reducing the environmental burden generated by these companies during the time of the state-run management. In this way the price of the company was lowered by the amount of the reservation funds. As a result, the total of these funds amounted to approximately DEM 520 million (DISAE SLO-104 programme for the implementation of the EU environmental *acquis*).

One of the initial measures of the independent Slovenian Government was to freeze prices of public utility services. As a consequence the investments in the current rehabilitation of specific environmental media have been blocked (urban waste management, water management). The renewed economic growth in 1993 thus resulted in the increased pressure on waters and waste management sector. With the internationalisation of the Slovenian economy the danger of investments from abroad in the intensive and dirty industry has increased. In the upcoming period of the economic boom, the balance between the environmental and economic objectives is a more problematic issue than it was in the period of the transitional depression.

Economic aspects of social development

The opportunity offered only to a few to possess the specific components of the environment merely shows the other side of social injustice. Those who are not allowed to enjoy public goods, for example biodiversity or basic environmental services, become more and more marginalized and excluded from social life. Globalisation and the increased pressure on the competitiveness of the economy, the efficiency of the state and the public sector can result in social problems. The competitiveness in the labour market increases unemployment but the opening of this market results in the irreversible outflow of human resource and the increased pressure from abroad.

The environmental protection measures (taxes on energy sources, public utility services, low environmental quality products) can influence the existing social balance because they primarily affect those population groups which spend most of their income on essentials. How-

ever, for the appropriate standard of living, the private as well as public goods are essential.

In the SEDS06 definition of welfare the central position is taken by the individual, his/her needs and interests, the quality of his/her life and overall development. The basis of this development is a possibility and an opportunity to choose. The following basic conditions have to be fulfilled for an individual to meet these objectives: long and healthy life, the opportunity to obtain education and information, and have access to funds needed for an appropriate living standard.

Economic aspects of environmental development

The indicators of economic development show that the environment is heavily burdened. The energy intensity is twice the average of the EU, the share of export based on natural resources is too large since important deposits of mineral and energy raw materials cannot be found in Slovenia. In the second half of the nineties, the production and export of the "dirty" industry increased faster than in all processing industry on average. On the basis of the environmental objectives of the Strategy of economic development until 1995 its environmental success can be evaluated. In this period the environmental expenditures increased, so did the share of public funds intended for environmental protection. The relative prices of energy sources and electric power increased, the CO_2 tax and water pollution tax were introduced (unlike waste tax), the content of pollutants in the primary energy sources was reduced as well as the use of domestic coal (which was used without the emission treatment facilities being provided for). However, the goods transport was transferred to railway. The environmentally friendly production of food is on the increase. With the adoption of the programme for the development of the agriculture, the food processing industry, the forestry and fisheries, the market-price policy was transformed to a structural policy. As developmental advantages the organic and integrated agricultural production are becoming increasingly valued. Unfortunately, the following directions have not been altogether successfully implemented:

- environmental protection expenditures were lower than planned;
- emissions caused by the transport sector are still increasing, the consumption of energy in the sector is too high; the railway cannot entirely replace the transport of goods by roads;
- planned changes in environmental considerations of agricultural policy are slowed down by the restrictions concerning general government expenditures.

A stable environmental protection policy has to be enforced in all the fields where it can contribute to a successful restoration of the degraded environment, also in the framework of the global and local issues, not just the national ones which hitherto took primacy. The level of sustainability of the economy whose growth is based on the degradation of the environment is defined by its capability to rehabilitate the degraded environmental capital. The potential economic growth is directly raised by successful environmental protection and lesser burdening of the environment. The conflict between the environmental and economic development should thus be solved.

One of the central environmental protection issues is the environmental policy. Since the objective of economic development is becoming increasingly less quantitative (as growth), change will also have to be made in the environmental protection policy, which has hitherto been focused on the regulation of conditions for the use of the environment and its admissible degradation. From the point of view of sustainable development, that does not suffice. The use of all renewable resources which contribute to the general welfare has to be maximised. It seems that in Slovenia sustainable development is more of a challenge for environmental policy than for the economy. In order to confirm that, the contributions of the environmental, social and economic capital to the sustainable development of the state (the Slovenian developmental pattern) have to be compared.

In Slovenia the development policy is faced with the problem of bridging the economic gap with other countries while maintaining the quality of the social and environmental capital at the same level.

	1995	1996	1997	1998	1999	2000 estimate
GDP, % real growth	4.1	3.5	4.6	3.8	5.2	4.6
Growth of foreign demands (export of goods & services)	1.1	3.6	11.6	6.7	1.7	12.7
Domestic demand, real	2.7	4.8	6.0	9.1	6.6	3.2
GDP per capita, purchasing power parties, in USD	12,500	13,200	14,100	14,800	15,481[(1)]	16,162[(1)]

Note: [(1)] Linear extrapolation 1995-2000.

Table 50: *Selected indicators of economic dynamic (Source of data and calculations: SURS, APP, MF, BS, estimates and projections UMAR).*

Table 51: *Selected indicators of economic stability. (Source of data and calculations: SURS, APP, MF, BS, estimates and projections UMAR).*

	1995	1996	1997	1998	1999	2000 estimate
Foreign debt, in million USD	2,970	3,981	4,123	4,915	5,400	6,217
External balance (balance of exports and imports of goods and services, in GDP in %)	-0.5	0.2	0.1	-0.8	-3.9	-3.3
Internal balance (difference between public financial revenues and expenditure, in GDP in %)	0.0	0.3	-1.2	-0.8	-0.6	-1.4
Inflation, average per year	12.6	9.7	9.1	7.9	6.1	8.9
Registered unemployment rate in %	13.9	13.9	14.4	14.5	13.6	12.2

Table 52: *Selected indicators of economic transformation and efficiency. (Source of data and calculations: SURS, APP, MF, BS, estimates and projections UMAR).*

	1995	1996	1997	1998	1999	2000 estimate
Custom Duties, in % of GDP	3.5	3.0	2.0	1.5	1.3	0.9
Subsidies, proportion in GDP	2.2	2.1	2.1	2.2	2.2	1.9
Transfers to provide social security for unemployed persons, in % of GDP	1.7	1.6	1.7	1.7	1.5	1.4
Gross fixed capital formation, real growth	16.8	8.9	11.6	11.3	19.1	0.2
Net investments, in % of GDP	5.7	5.4	6.1	7.7	11.1	10.3
Investment in economic infrastructure, proportion in gross fixed capital formation	19.4	23.1	22.1	21.8	21.0	20.7
Physical to Value added growth ration in manufacturing (Quality improvement ratio), change in % according to previous year[1]	-0.3	0.7	6.4	0.7	3.1	1.5
Labour productivity, growth	3.1	4.5	5.1	3.8	4.0	3.5
Cost Competitiveness of exports of goods, change according to previous year[2]	10.9	-5.1	0.3	2.1	-1.4	-1.4
Openness of the economy - Foreign trade coefficient [3]	113	112	116	115	109	122

NOTE:

[1] The quotient between the growth of the value added index and the physical growth of the production.

[2] The positive value shows higher profits made by companies in the export of goods while other factors remain unchanged because of the lower domestic costs - enterprise costs (wages, work productivity) and national costs (exchange rate, customs tariffs, taxes). The negative value shows the pressure of the domestic economic policy to increase the efficiency of the goods exporters.

[3] Import and export of goods and services in % of the GDP.

Table 53: *Distribution of fruits of economic growth: selected indicators. (Source of data and calculations: SURS, APP, MF, BS, estimates and projections UMAR). (the Spring Report, 2001; the Report on Macro-economic Trends, 2001)*

	1996	1997	1998	1999	2000 estimate
Earnings per persons in paid employment[1],	5.1	2.4	1.6	3.3	1.6
Transfers for social welfare[2], real growth	2.0	7.4	2.5	6.0	6.7
Government revenues except contributions for social welfare, real growth	8.2	5.6	7.1	8.1	1.5
Profits to enterprises[3], % of GDP	2.8	5.0	6.0	6.6	6.6
Profit repatriation [4], % of GDP	-0.7	-0.2	-0.2	0.2	0.4

NOTE:

[1] Gross wage per employee.

[2] Paid to household transfer for ensuring social welfare.

[3] Net operating surplus.

[4] As an outflow of profits of foreign enterprises operating in Slovenia; estimated from balance of payments' net primary income from abroad.

	1995	1996	1997	1998	1999	2000 estimation
Total GDP	100.0	100.0	100.0	100.0	100.0	100.0
Priority sectors of economy-environment integration	**38.9**	**38.4**	**38.8**	**38.9**	**37.5**	**37.6**
Agriculture, forestry, hunting	3.9	3.8	3.7	3.6	3.1	2.9
Fishery	0.0	0.0	0.0	0.0	0.0	0.0
Mining	1.2	1.2	1.2	1.1	1.0	0.9
Manufacturing	24.6	24.1	24.3	24.1	23.6	24.0
Electricity, gas & water supply	2.6	2.5	2.5	3.0	2.7	2.8
Transport, storage, communications	6.7	6.6	7.0	7.2	7.1	7.0
Other sectors	**47.9**	**48.8**	**49.3**	**48.9**	**49.6**	**50.7**
Construction	4.3	4.8	4.9	4.9	5.4	5.3
Wholesale, retail; certain repair	10.5	10.1	10.1	10.0	10.0	10.0
Hotels & restaurants	2.6	2.7	2.7	2.6	2.6	2.8
Financial intermediation	3.5	3.6	3.7	3.7	3.7	3.9
Real estate, renting and business services	10.1	10.3	10.0	10.3	10.4	10.5
Public administration & defence	4.6	4.8	5.1	5.0	4.9	5.0
Education	4.9	4.8	5.0	4.8	4.9	5.1
Health & social work	4.6	4.6	4.6	4.6	4.6	4.8
Other community, social and personal services	2.9	3.0	3.0	3.1	3.2	3.3
Rest[1]	**13.2**	**12.8**	**11.9**	**12.2**	**12.8**	**11.7**

Note:

[1] Taxes on products, services; subsidies; FISIM

Table 54: *Production structure GDP (Source of data and calculations: SURS, APP, MF, BS, and projections UMAR).*

	1995	1996	1997	1998	1999	2000 estimation
GDP growth	4.1	3.5	4.6	3.8	5.2	4.6
Priority sectors of economy-environment integration	**2.9**	**1.7**	**4.9**	**4.2**	**2.3**	**6.5**
Agriculture, forestry, hunting	1.6	1.0	-2.9	3.1	-2.1	-1.0
Fishery	-6.1	9.6	1.7	-4.4	3.1	-3.5
Mining	0.9	1.9	3.1	0.1	1.0	-1.4
Manufacturing	2.5	1.6	6.6	4.6	3.1	8.6
Electricity, gas & water supply	0.2	1.2	4.2	0.9	-0.8	2.9
Transport, storage, communications	5.9	2.6	4.2	5.2	3.2	4.7
Other sectors	**4.5**	**5.3**	**4.1**	**3.2**	**6.2**	**4.0**
Construction	9.2	13.2	7.7	4.6	15.8	2.8
Wholesale, retail; certain repair	6.7	3.0	2.8	2.8	6.3	2.5
Hotels & restaurants	3.5	4.4	3.6	0.9	3.1	9.8
Financial intermediation	3.5	11.0	0.1	4.5	3.3	5.9
Real estate, renting and business services	3.1	4.1	2.5	2.4	4.7	3.0
Public administration & defence	3.1	5.3	10.3	5.0	5.4	5.7
Education	2.8	1.1	4.9	3.1	3.4	3.7
Health & social work	2.1	6.4	3.1	1.7	6.4	4.2
Other community, social and personal services	2.1	4.9	4.1	5.8	5.6	4.5
Rest[1]	**6.9**	**2.6**	**5.2**	**4.6**	**10.1**	**1.9**

Note:

[1] Taxes on products, services; subsidies; FISIM

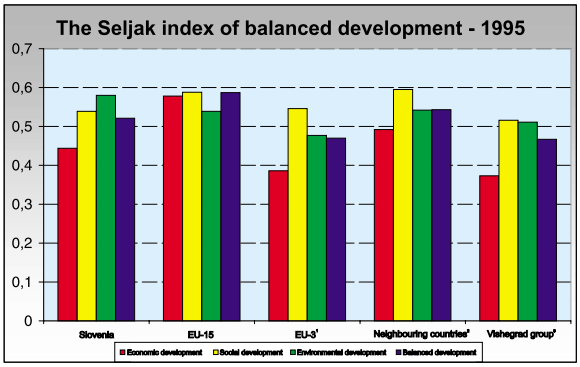
Table 55: *GDP growth, real, calculated for previous year. (Source of data and calculations: SURS, APP, MF, BS, estimates and projections UMAR).*

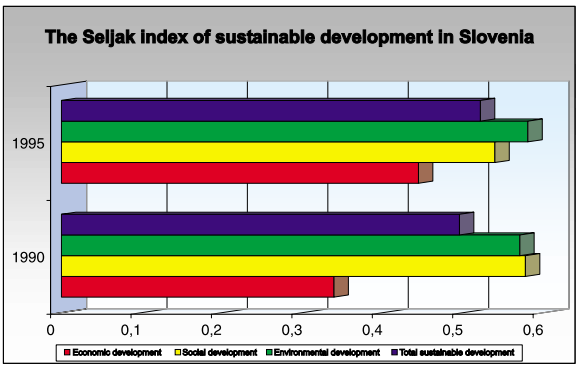
SLOVENIA'S DEVELOPMENT PATTERN

In the last decade the already established concepts of measuring the development, and their mutual comparison, which are mainly based on the economic criteria, have been criticised since they do not take into consideration the relevant social and environmental consequences. With the adoption of the SEDS06 Slovenia's direction of sustainable development is now clearly defined. Therefore, all three developmental components should be considered.

A successful and original experiment in this field was the Index of balanced development by Seljak (IBD), in which the level and dynamics of sustainable development in Slovenia and other countries in 1990 and 1995 were evaluated.

Developmental patterns of countries differ substantially. This also applies to Europe even though it is the most harmoniously developed region of that size and economic power in the world, with the exception of its eastern and south-eastern parts. Considerable differences in the development patterns, and the similar development directions of the current and the future EU member states, reflect the differences in their paths to development they have taken. In this way, the creation of the development identity of the current and future EU member states is hinted at with regard to the establishment of a specific development pattern. Further on, the differences in the development patterns of the EU member states, the East- and Central-European countries and Slovenia are identified (see Graph 27 and 28).





Graph 27: *The Seljak index of balanced development (Source: Seljak, 2000).*

Note: The closer to 1, the higher is the level of sustainable development; deviations are due to the rounding up of the values[11]. Arithmetic mean of the included countries. By the GDP pc, closest to Slovenia are the following EU-3 member states: [1] Spain, Greece, Portugal. [2] Italy, Austria, Hungary, Croatia. [3] Poland, Czech Republic, Slovak Republic, Hungary.

Graph 28: *The Seljak index of sustainable development in Slovenia (Source: Seljak, 2000).*

From the point of view of sustainability, the period has been beneficial to Slovenia. The economic, and hence environmental, components of welfare have improved. The speculation that the restructuring of the economy in the starting period of transition helped improve the environment was confirmed, but unfortunately the social issues have become more pronounced. The analyses of the first transitional period in Slovenia (1990 -1995) show a strong and positive trend of economic progress, slight positive changes with regard to the environment, and a negative trend in the social field.

Of all the countries involved, Slovenia is probably in the best position to enforce sustainable development, because it is lagging behind the EU countries in the field which is easiest for it to control - the economy.

After 1995, the positive trend of economic progress continued and the conditions started to improve in the social sector. However, the state of the environment began to worsen as a result of the growth of the economy and the rather defensive environmental protection policy of that time.

The fundamental requirement of the transition to sustainability is to try to avoid future mistakes, that is decisions which base their economic potential on the underestimated environmental and/or social capital. With regard to sustainable

[11] The author called the indicator as the 'Index of balanced development' and a study has been prepared under that title. For the purposes of terminological uniformity the term sustainable development is used.

[12] The highest and the lowest values of any country in the period 1990-1995 are taken into account (except the inflation, for which the highest value in 1995 was used).

development, Slovenia is faced with a rather simple task in comparison to the EU countries and the Central and East European countries. It is essential that at the beginning of a new development cycle Slovenia harmonises its allocation signals (prices of power, road transport costs, spatial development, etc.). That is necessary not only to increase the dynamics of the development but also to preserve the developmental identity of Slovenia.

The main feature of sustainability, by which the traditional developmental economy is upgraded, is the exchange of potential welfare for the current development and the development of the generations to come. The Genuine Savings Index (GSI) method is based on the time transferral of savings; negative as a result of destruction of resources or positive as a result of their increase.

The GSI is defined as the difference between the annual growth and the loss of GDP due to (un)sustainable use of welfare resources: produced resources (savings and expenditures on education) and non-produced resources (degradation of the environment resulting from the extraction of mineral and energy raw materials, tree felling and CO_2 emissions). The result - an annual increase in the welfare for future generations - is expressed as the share of genuine savings in the GDP which is the difference between the consumption (negative savings) and the renewal of welfare resources (in % of GDP). The

	Slovenia	EU-15	EU-3	Neighbouring countries	Vishegrad group
= Genuine Savings Index	23.1	22.1	10.7	18.4	24.2
+ Gross domestic savings	16.9	12.5	8.0	8.4	11.1
- Fixed capital consumption	6.2	9.5	5.0	10.0	13.1
+ Net domestic savings	7.1	4.7	4.9	3.5	4.8
+ Education expenditures	0.0	0.1	0.0	0.3	0.2
- Exploitation of energy raw materials	0.0	0.0	0.1	0.0	0.0
- Exploitation of mineral raw materials	0.0	0.0	0.0	0.0	0.0
- Felling of trees	0.4	0.2	0.3	0.7	0.3
- CO_2 emissions	12.9	14.0	9.6	12.6	17.4

Table 56: *Genuine Savings Index, 1997 (Source: Radej et al., 2000).*

	SATISFACTION WITH THE CURRENT DEVELOPMENT (with regard to the average EU-15 achievement	
	The current generation asks HAS THE CURRENT LEVEL OF WELFARE DECREASED?	The future generations ask HAS THE LEVEL OF WELFARE INCREASED ENOUGH? HAS THE SHARE OF THE ENVIRONMENTAL CAPITAL DECREASED IN THE TOTAL CAPITAL PORTFOLIO?
Ireland Finland Austria	**Relatively satisfied** The current level of welfare is increasing	**Relatively well satisfied** They would inherit an above average welfare; particularly its environmental potential would be preserved
Hungary Czech Rep.		**Relatively dissatisfied** The level of total welfare would increase substantially but he price would be high - the additional degradation of the environment would limit the developmental choices of the future generations with regard to environmental welfare
Slovenia Germany	**Relatively dissatisfied** The level of current welfare increases too slowly	**Relatively satisfied** They would reproach the current generation with the low utilisation of the produced capital but would praise the enrichment of their developmental choices arising from the undegraded environmental capital which they would have inherited
Poland USA		**Mostly dissatisfied** The level of total welfare would not increase enough and the price for it would be high - the developmental choices would be rather limited with regard to the current situation because of the high additional degradation of the environment

Table 57: *Identification of four development patterns with regard to the enforcement of sustainability, illustrative example (Source: Prepared by the Institute of Macroeconomic Analysis and Development (UMAR) - Economic Mirror, No. 9/2000, p. 8).*

costs of consumption of welfare resources are measured as a total of the amortisation of a fixed capital and the additional degradation of the environment. The increase in the welfare resources for future generations is measured by annual expenditures on education and the reduction in the degradation of the environment (in % GDP).

According to the GSI, Slovenia's current economic growth does not threaten the welfare of future generations, as the renewal (appreciation) of welfare resources exceeds their consumption (in 1997 the difference was 12.9 % of GDP). Nevertheless, that is no reason for satisfaction. The comparison with other countries shows that Slovenia's GSI is among the lowest of all. Its position slightly improves if we focus on the GSI deduction items. According to them, Slovenia (with environmental degradation equal to 0.4 % of GDP due to high CO_2 emissions) ranks in the middle of the listed countries, together with Portugal and Ireland, and that is only slightly under the EU-15 average.

Table 57 shows how future generations would be satisfied with the current economic choices were the current development **patterns to stay unchanged for a long time** and were the EU-15's development pattern considered as sustainably indifferent. Since this region is the world promoter of sustainability the simplification seems acceptable.

In Slovenia the issues of the environment and development are not similar to those elsewhere, as the future generations seem to be advising current generations to increase the exploitation of the economic capital and thus inevitably degrade the environment. In this way the current generations would benefit and the future generations would probably not be deprived. Domestic records, which show that the extent of tree felling is too low, that consumption of water is moderate and that biodiversity and space are not exploited, even support this hypothesis.

Trends in the priority sectors of integration of the economy and the environment

Energy sector

Among the economic sectors, energy is one of those which burden the environment most. Despite that, the development of the sector can contribute to the sustainable development of the economy, especially if it manages to substitute the non-renewable resources in production and consumption. In order to reduce the energy-related burdening of the environment, the share of the renewable resources in the consumption has to increase and so does the energy efficiency (EC(95)682f).

The *Resolution on the Strategy for Energy Use and Supply* directly addresses the environmental aspects of the energy sector management. The Resolution is based on certain principles of sustainable development and takes into account the sustainable use of biodiversity components which function as an energy resource. The primary strategic direction is to increase the energy efficiency of all sectors which consume energy. Beside the measures for efficient energy use, priority must be given to the renewable resources and to utilisation of the thermal energy in the environment and of waste heat. In general, the strategic directions for energy consumption and supply contribute to the biodiversity conservation. On the other hand, energy production can contradict the biodiversity conservation measures. The Convention on Biological Diversity stipulates that sustainable use is a use which conserves biodiversity. However, beside the sustainable use of biodiversity components, the appropriate management of abiotic resources representing habitats of many endangered biodiversity components (for example aquatic animals and plants) is important. Still, the strategy is not defined in this sense; these issues should be included in the provisions concerning the activities affecting the environment (construction of electric power facilities) where the environmental and spatial requirements are considered. The strategic decisions direct and motivate development. On the other hand, respect for nature conservation requirements is only a mechanism which mitigates the development trends, not influences them. That is why the development of certain forms of energy production affects biodiversity and reduces it.

Primary energy resources

The composition of primary energy inputs shows which energy resources are utilised in a country to satisfy its final consumers. The primary energy resources are: coal, lignite, crude oil, natural gas, geothermal energy, hydro energy, wind energy, sun energy, biomass (wood and wood residues, waste, biogas). Heat may be considered a primary input in the case of geothermal resources and heat produced in nuclear plants, or generated as hot water and steam in co-generation plants.

The composition of these resources reflects the (selective) changes in relative prices of energy resources, the restructuring of supply markets caused by a low share of domestic coal and the changes in the consumption structure, e.g. growth in the transport sector (se graph 29, 30, 31).

Primary energy production

The production of primary energy shows which energy resources are available in a certain

country. In Slovenia, energy self-sufficiency is 48 %, energy dependency 52 %. In the EU, the energy self-sufficiency is 54 % and energy dependency 46 %. It is expected that in Slovenia, and even more in the EU, the energy dependency will increase.

In the structure of energy production, the share of solid fuel (coal) is expected to drop, because by 2008 the explotation of brown coal in Trbovlje coal mine will have gradually stopped. The share of hydro energy is expected to increase with the construction of a number of hydroelectric power plants on the river Sava. The share of "new resources" (wind, sun, geothermal energy) is very low.

The potential for the utilisation of biomass and new resources is quite promising. It could be realised within the local energy supply systems which might be included in the regional development programmes. With regard to the rich wood supply, local energy sectors in numerous municipalities could be organised in a sustainable manner.

Consumption of primary energy resources

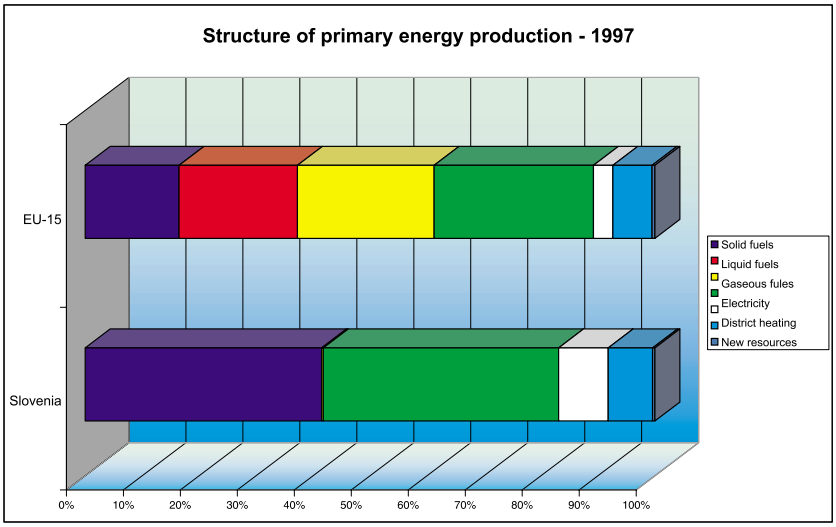
Consumption of primary energy resources shows which primary energy resources generate the consumed energy. The losses caused by the distribution and transformation of energy are included. From the environmental point of view, the structure of consumption in the EU countries is better than in Slovenia. The reasons are the higher consumption of natural gas and the lower share of coal. On the basis of the National Energy Programme, the share of solid fuels is expected to decrease (to 17.0 % according to the low economic growth scenario and to 18.2 % according to the high economic growth scenario) and the share of gaseous resources should increase (to 19.8 % and 22.7 % respectively). The Conventional Wisdom scenario of the EU (CWEU) provides for an even faster restructuring of the primary energy consumption than in Slovenia. Consequentially, in 20-years time Slovenia will be using a third more solid fuels and substantially less gaseous fuels (approximately a third) than the EU, even if it realises the planned scenarios.

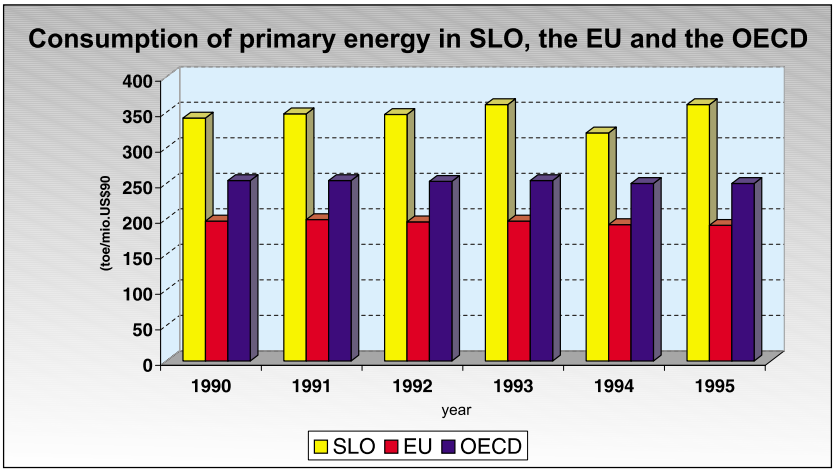
With regard to the environmental effects, the consumption of primary energy resources should be reduced by improved efficiency in the transformation of energy (co-generation) and its utilisation and by regulated demand.

Final energy consumption

Final energy consumption is the use of energy which is intended for end consumers. In 1987, the end consumption was 168 PJ (168 x 10^{15} joule); it dropped to 150 PJ in 1992, and then substantially increased. In 1997 it was 193 PJ, but in 1998 it dropped slightly to 182 PJ (see Table 4). In the last 15 years, the structure of final consumption changed significantly. The share of solid fuels dropped from 24 % to merely 8 %, but the share of consumed liquid fuels increased from 35 % to over 50 %. The share of other energy resources in the final consumption did not change substantially. The share of gaseous fuels amounted to around 15 %, electricity 20 %, and the district heating somewhere below 5 %. In the last 15 years the share of final energy consumption in industry dropped from 50 % to less than 30 %, but in transport it increased from 20 % to over 30 %.

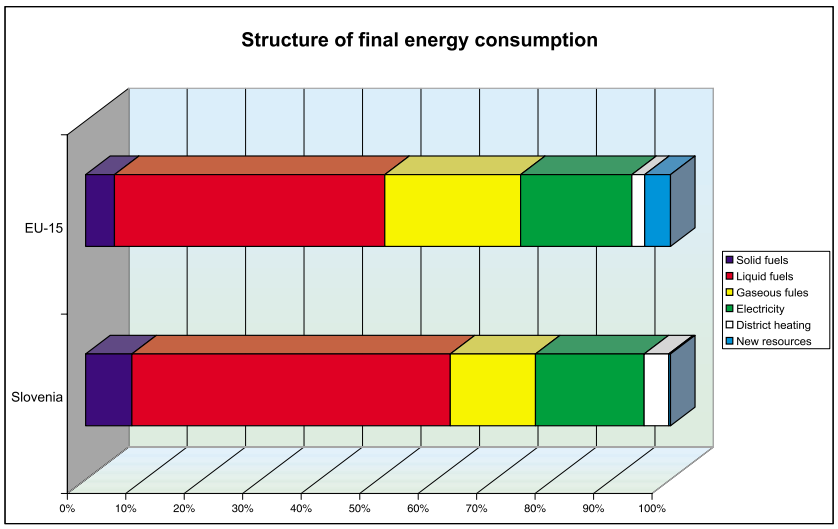
According to the SEDS06's low economic growth scenario (Strmšnik et al., 1999) it is expected that the final energy consumption in the period from 2000 to 2020 would decrease by an annual rate of 0.1 %. If the GDP were to increase, the energy consumption would increase by 0.6 % per year. If the CWEU scenario (the National Energy Programme) were realised, in 2020 Slovenia's final consumption structure would be similar to that of the EU for the three most important energy resources: the share of liquid fuels would be a little over 40 %, gaseous fuels around 23 % and electricity approximately 21 %. The differences would be notable in the share of solid fu-





Graph 29: *The structure of primary energy production - 1997.*

Graph 30: *The consumption of primary energy resources in Slovenia, the EU and the OECD.*



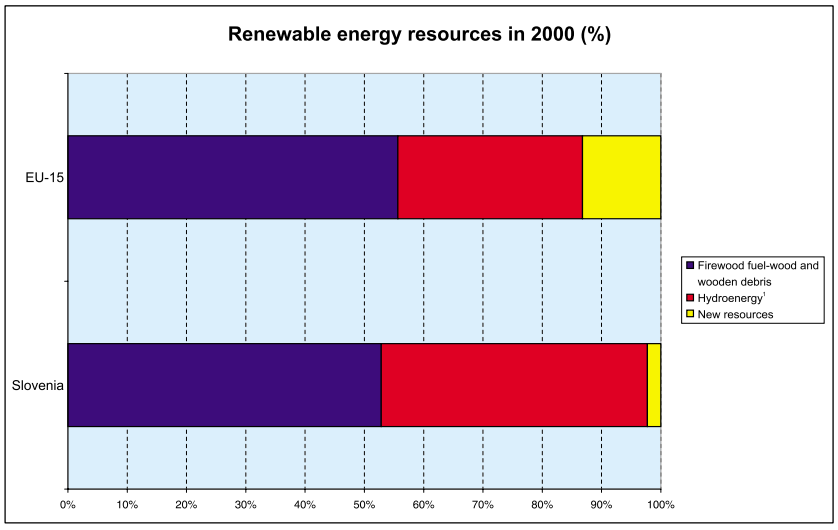
Graph 31: *Structure of final energy consumption - 1997 (Source: Povšnar in Radej et al., 2000)*

els and district heating: in the EU the consumption would be twice as low as in Slovenia and the share of new resources (wind, sun, geothermal energy) would be substantially higher, it would surpass Slovenia's by more than 7 %.

Renewable energy resources

Renewable resources are those which cannot be totally consumed because they are inexhaustible in the long-term. According to the Eurostat, these include solar energy, geothermal heat, biomass and waste (wood and wood residues, biogas, biofuels), wind energy and hydro power. In certain classifications of the renewable resources, which emphasise the environmental aspects, the hydroelectric power energy is excluded due to its impact on groundwater and the construction of large reservoirs.

In the last 15 years, the energy generated by renewable resources amounted to between 21 PJ and 24 PJ per year, and was approximately 23 PJ in 1998. When comparing the renewable resources to the production of primary energy so that primary energy definition is adapted to the Eurostat methodology - which classifies nuclear energy as primary energy (in a country which uses the fuel, regardless of its origin or place of enrichment) - it is established that the share of the produced renewable resources in the generated primary energy is between 16 % and 19 % (18.1 % in 1998). These figures can be compared to the EU data. In Slovenia, wood and wood residues represent more than a half of all renewable resources (55.4 % in 1998) and hydroelectric power around 45 % (42.4 % in 1998). The share of other resources is negligible. In primary production, the share of used renewable resources was between 8 % and 10 % in the last 15 years (8.7 % in 1998). The share of hydroelectric power in the total amount of electricity was between 25 % and 29 % (25.5 % in 1998).



Graph 32: *Proportion of renewable[1] energy resources in 2000 (Source: Povšnar in Radej et al, 2000).*

Note: *[1]Hydroenergy is considered a renewable source, nuclear fuel is Slovenia's primary resource (according to Eurostat).*

In the EU the production of energy from renewable resources has been increasing at a higher rate than the production of energy from other resources in the last decade. There the share of renewable resources in the needed primary energy has been increasing. In 1997 it was 5.8 % (in Slovenia 8.7 % in 1998). Of the total electricity generated in the EU in 1997, the share of electricity generated by the renewable resources was 14.6 % (in Slovenia 25.5 % in 1998).

The EU Commission proposed that by 2010 at least a 5 % share of renewable resources in the structure of primary energy resources should be attained. The proposal was rejected (Decision 98/352/EC and COM(97)599) but the activities which are focused on the increase of the share of such resources are being carried out within the specific EU environmental protection programmes.

A proposal for a (non-mandatory) directive on renewable resources has been drawn up. According to that proposal, the share of renewable resources in the needed primary energy should increase from the current 6 % to 12 %, particularly through the increase of the share of electricity generated by the renewable resources (hydroelectric energy is most important) in the total production of electricity from the current 14 % to 22 %.

Energy intensity

Energy is considered the essential source for the economic growth, but at the same time the supply of energy is one of the major reasons for the degradation of the environment: it debilitates the environment (through the exploitation of energy resources) and burdens it (through emissions). The connection between the consumption and the GDP growth (energy intensity) is being interrupted by the structural changes in the economy which have to be economically and environmentally justified.

In the period from 1990 to 1997, the average annual growth of energy intensity was 1.5 % with

regard to the consumption of primary energy; the final consumption of energy increased by 2.5 % and the GDP only by 0.7 %. The result was lower energy intensity in the said period. For 1,000 constant EUR GDP, 492 kilograms of oil equivalents of primary energy (toe; 466 more in 1990) and 321 final energy equivalents (285 more in 1990) were used.

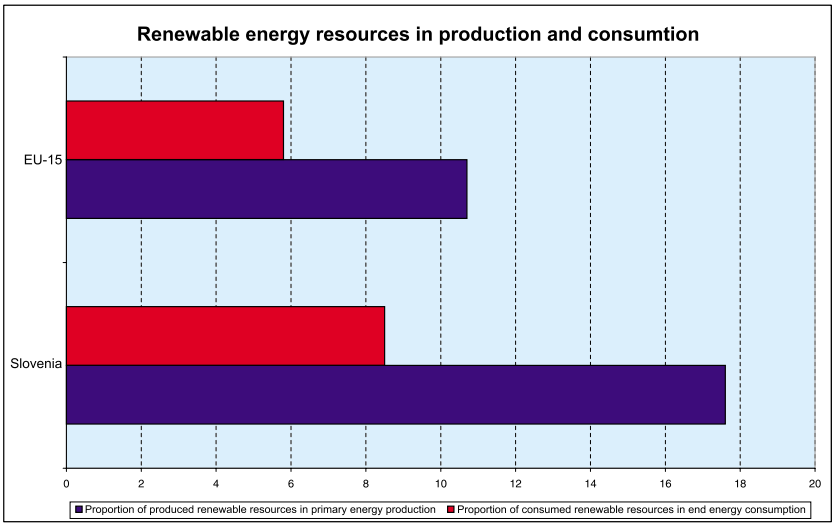
In 1997, at least twice as much energy per GDP unit was used in Slovenia as in the EU. It is expected that the increase in the GDP will result in lower energy intensity: in Slovenia, the reduction is predicted to be faster than in the EU, nevertheless, Slovenia will reach the same level only in the next 20 years.

(Photo: Peter Skoberne)

In comparison to the consumption in the EU, the detailed analyses of the energy consumption of big consumers in the processing industry show that energy efficiency (utilisation of energy per unit of product) of domestic companies is not such so much weaker as to offer an explanation for the lagging behind in energy intensity. The problem can be explained structurally, with the high share of energy-consuming sectors in the national economy.

Energy-consuming industries pose a true danger to sustainable development in Slovenia. Foreign investors are interested in the energy-consuming technologies (non-ferrous metals, iron industry, paper industry) because the prices and taxes are seemingly low, in particular with regard to the environmental bases. In individual cases it will not be possible to reverse the trend unless that is provided for in the national and local budgets. Support to certain activities could be given if funds intended for the protection of the environment were concentrated in the energy sector, i.e. the finances under the Fund for the decommissioning of the Krško Nuclear Power Plant would be used for improving the efficiency of energy transformation and its utilisation, and for increasing the share of renewable resources.

One of the most challenging issues of the environmental and economic integration of Slovenia into the EU is - in addition to the successful regulation of the road and rail transport - the transition to a lower energy intensity of the Slovenian economy by reducing the number of high energy-consuming industries.



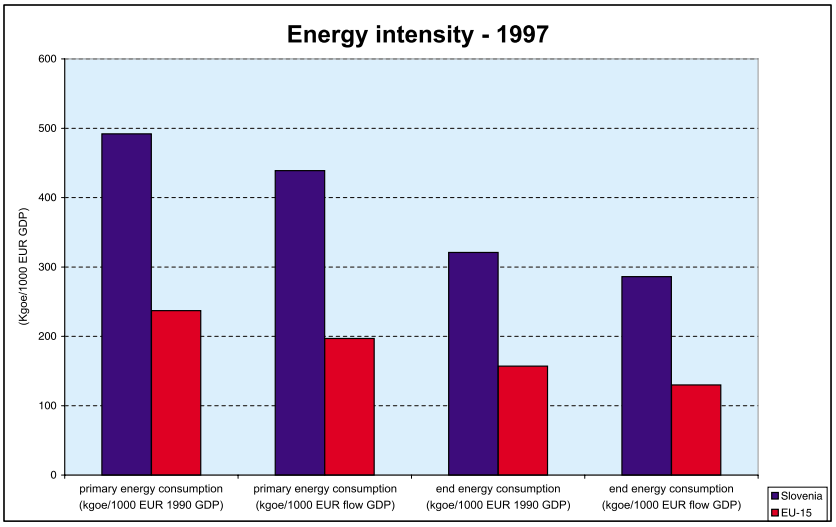
Graph 33: *Proportion of renewable energy resources in production and consumption (Source: Povšnar in Radej et al., 2000).*

(Photo: Marko Simić)

Figure 153 (left). *Watermills and sawmills have been abandoned, yet the produced energy has been used sustainably.*

Figure 154 (right). *Klavže on the Bača River, a once attractive gorge which, now being used for electric power production, has lost much of its natural beauty and conservation values.*

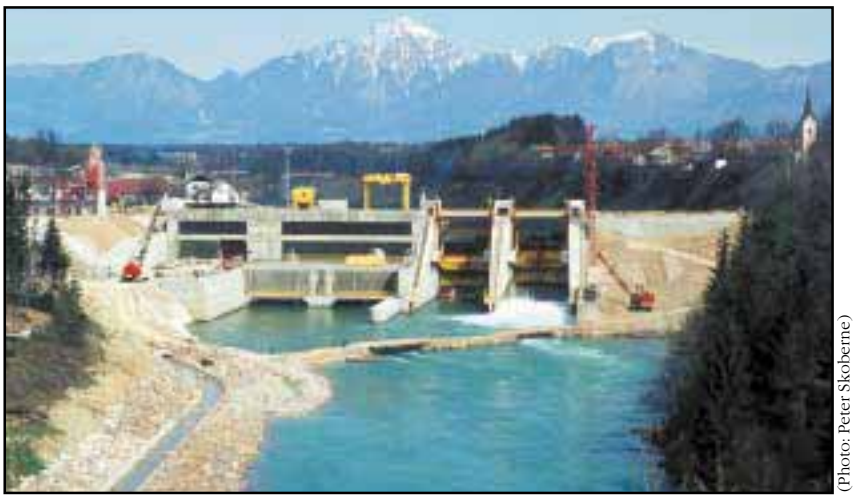
Graph 34*: Energy intensity, 1997; (Source: Povšnar in Radej et al, 2000).*



Impacts of the energy sector on biodiversity

Impacts on the environment originate in every stage of the energy system: production, transfer, transformation, distribution and final consumption. To a certain extent, the increased consumption of energy will be covered by the construction of a number of hydroelectric plants on the lower Sava river where the areas of high biodiversity are located. The increased utilisation of renewable resources (small hydroelectric power plants, biomass, geothermal energy, thermal utilisation of waste, wind power plants) is expected. Biodiversity is primarily affected by use of:

- fossil fuels:
  - global warming modifies ecological conditions on the planet in the long term; acid rain has adverse effects in particular on flora and fauna at the local and regional levels; the consequences of climatic change on biodiversity have not been sufficiently studied;
  - the construction and maintenance of oil and gas pipelines cause the destruction of habitats; the storage of oil and gas derivatives is a large consumer of space, and the result is the loss of habitats;
  - oil spills during the transport of fossil fuels threaten groundwater, surface waters and coastal areas as well as all species living in these ecosystems;
  - the functions and appearance of the landscape are all influenced by mining (coal), generation of electricity, the distribution and transport infrastructure, waste landfills;
- nuclear energy: beside the risk of radioactive contamination and radiation dangerous to humans and the environment, the following have an extremely harmful impact on biodiversity:
  - thermal pollution of watercourses by the discharge of high temperature water used as cooling water;
  - negative visual impact of nuclear plants, including the infrastructure for safe storage of medium- and low-level radioactive waste, on ecosystems and the landscape;
  - hydroelectric power plants:
  - flooding of large areas for the purpose of reservoirs results in extensive loss of habitats, plant and animal species and their migration routes; the hydrological cycle is significantly affected and so is the amount and quality of water, the amount and structure of sediment and its transportation; they all cause changes in the structure of the entire ecosystem;
  - dams of hydroelectric power plants alter the hydrological cycle, the quality and amount of available water, and cause the microclimatic conditions to change; the agricultural and forest land is lost; the risk of landslides increases, and so do the erosion and sedimentation processes; dams stand out in the landscape; the changes in the physical and chemical characteristics of water cause the degradation of the ecosystem and changes in the entire ichtyofauna and vertebrate communities;
  - small hydroelectric power plants with access routes, electricity lines and power lines cause the fragmentation of habitats and change the time and quantity distribution of flow, which destroys the structure of ecosystems, ecotones and landscape;
- other renewable energy resources, such as wind and solar farms with their infrastructure have a great impact on the environment; they result in the loss of habitats and plant species, and present a disturbance to the landscape.



(Photo: Peter Skoberne)

Figure 155. *Hydroelectric power plant on the Sava river. Large hydro-power constructions considerably change the area's hydrological cycle, micro-climate and functioning of the ecosystems and landscapes.*

Transport

Transport is the fastest growing source of environmental pollution. In all countries acceding to the EU, the railway infrastructure is better than the road network. The existing transport infrastructure, in particular the railways, should be used in the transit of goods which is expected to increase substantially. Accordingly, the economic incentives should be introduced.

In the 1990s, the mobility and transport in Slovenia increased. This is an indication that space, from an economic and environmental point of view, is among the most important developmental potentials of the State. In order to enforce the sustainable development pattern, the State will have to adopt a transport policy which will reduce the external transport costs. Simultaneously, the impacts of transport policy on the national savings will improve, since business in-

(Photo: Marko Simič)

Figure 156. *Road and railway corridor at Postojna. The Slovenian priority is construction of the main motorways, therefore improvements of the railway system come only second.*

vestments will stabilise (conclusion of the national highway construction programme) and the absorption of private savings for the purchase of new cars will slow down (conclusion of the phase of mass purchase of private cars). In this sense, the National transport policy is thus the least integrated policy.

In the field of transport, the importance of transfer (transport of goods) from roads to railways and the support to public passenger transport instead of private transport have again been emphasised (also in the SEDS95). This objective is also stated in the National Programme of Slovenian Railway Infrastructure Development. In the state budget some funds have been allocated to public passenger transport and to the highway construction programme (the national programme for the construction of highways in the Republic of Slovenia). However, there has been a postponement of fund to be allocated to, e.g. the railway sector and to most other infrastructure activities.

The means of transport

The share of the international transport in the territory of Slovenia is very high. In the total transport of goods (road and railway; 1995) the international transport amounts to 77 % (railway transport 92 %) and domestic to 23 %. In the EU, the share of road transport in total transport of goods is higher than in Slovenia (83 % in 1995 in comparison to 63 % in Slovenia). Only in Austria is that share lower (52 %). The passenger road transport takes up 81 % of all public transport; in EU 57 % of all passenger transport is done by bus and coach operators.

In the Strategy of Economic Development of Slovenia (1995) a few guidelines have been indicated for the formulation of the transport policy which are still of current interest. Full support should be given to public passenger transport and not to private car transport. Gradually, the road transport should be transferred to railway (that issue is also of interest in the EU, except in Austria). Roads and railways should be modernised and the railway service should be made more attractive. Transit transport should be transferred from roads to railways, and all environmental external costs of road transport should be included in its price.

Impacts of transport on biodiversity

Beside the environmental burdening (pollution and global climate change), transport affects biological and landscape diversity by being a great area consumer. The result is the fragmentation of habitats and their disappearance and the degradation of landscape. A high quality and well maintained transport infrastructure, including the technological advances in the production of transport means (lower fuel consumption, reduced emissions), reduces the impact of transport on the environment. If the trends in the transport sector remain unchanged, the reduction of biodiversity will be caused in particular by:

- road and railway transport infrastructure
  - ➢ direct reduction, degradation, fragmentation and destruction of habitats and interruptions to the migration routes of various animal species;
  - ➢ exploitation of mineral raw materials for the construction of roads and the relevant infrastructure contribute to the degradation of habitats and landscape;

Table 58: *Transport structure by means, 1995 (Source: Povšnar in Radej et al., 2000).*

	Slovenia	EU-15	EU-3[1]	Neighbouring countries[2]	Vishegrad group[3]
Road transport of goods (RTG) pc, in 1,000 tonnes/km, 1997	2.5	3.0	2.0	2.2	2.2
International share in total RTG, in %; 199755	19.0	23.3	23.0	43.5	
Road share in total transport of goods, in %62	83.0	93.3	70.0	53.5	
Road share in total passenger transport, in %	81	57.0	74.0	62.7	66.8
Air passenger transport pc, in passenger km	308.0	1,247.0	790.0	527.0	125.3

NOTE: [1] The following EU-3 Member States are the closest to Slovenia according to the GDP pc: Spain, Greece, Portugal.

[2] Italy, Austria, Hungary, Croatia.

[3] Poland, Czech Republic, Slovak Republic, Hungary.

(Photo: Marko Simič)

Figure 157. *Mouth of the Rižana River, changed by the developments of the Port of Koper, a successful enterprise, yet for all activities it uses considerably large areas.*

- potential accidents during the transport of dangerous substances, when an extremely sensitive karst aquifer could be polluted and thus subterranean fauna affected;

- shipping: pollution of the sea and coastal habitats (spillage in the case of an accident, intentional and accidental discharges of oil, ballast water and waste from ships, transport of dangerous substances); construction of ports causes the destruction of coastal habitats, the species and coastal landscape;

(Photo: Branka Hlad)

Figure 158. *Charcoal-burning in the Bena valley. There are still some places in Slovenia where charcoal has been charred in the traditional way.*

- air transport: the construction of airports alters the hydrological regime and causes the fragmentation of habitats and their destruction; the species are disturbed and the landscape is degraded.

Agriculture

The share of agriculture in the general economic production of the EU is relatively small: 2.3 % of the GDP and 5.3 % of employees (EEA, 1995). Agriculture provides food and raw materials to people, and at the same time it affects the land use and the quality of the environment. In the EU associated countries, agricultural production has dropped significantly during the transition, in particular in livestock breeding. Countries have lost their traditional markets, and consumers have started to buy cheaper basic products. In most of the countries, the number of cattle and sheep has fallen by approximately 50 %, and the drop in poultry and pig production has been about 30-35 %. In comparison to 1989, only one third of crops was produced. In conjunction with the reduced production, the level of pollution fell (Graph 35 and Table 59).

In order to reduce the costs, agriculture is being industrialised in Slovenia. This is evident from the intensity of production, creation of economies of scale, mechanisation and chemisation. The process is seen from the changed extent of production (total area of cultivated land; average size of a farm) and in the intensity of production (average consumption of pesticides or fertilizes, irrigation per ha of arable land). Agriculture is the biggest water consumer in Mediterranean Europe, and the consumption of water is still on the increase. For agricultural consumers the water prices are often subsidised. The adapted tax systems for the calculation of water supply are provided for large consumers (exemptions, price reductions, price per ha of irrigated land and not per consumption, etc.).

According to the national irrigation plan (which has never been implemented) the area of irrigated land should increase substantially in Slovenia. The non-irrigated part of arable land

Table 59: *Application of pesticides, 1995 (Source: Kovač in Radej et al., 2000).*

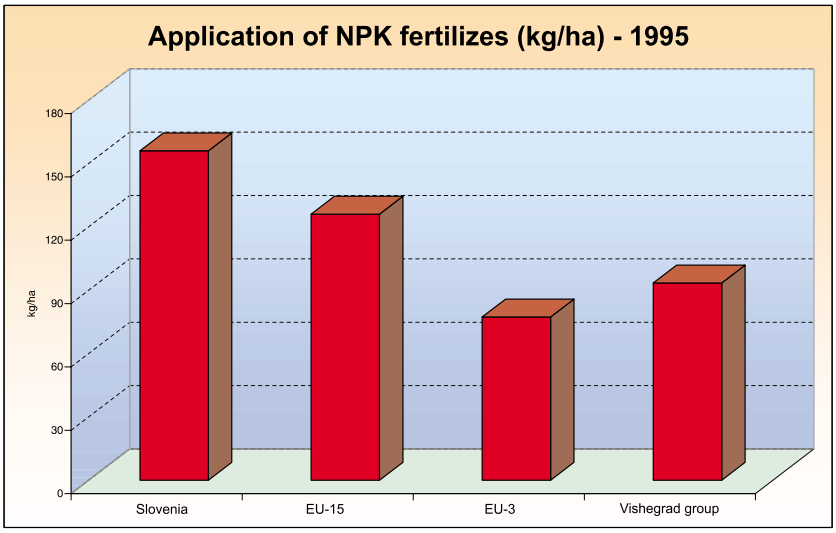
	Slovenia, 1998	EU-15	EU-31	Neighbouring countries[2]	Vishegrad group[3]
Quantity of sold pesticides per ha of arable land	3.11	-	-	-	-
Application of active pesticide substance per ha of arable land	-	2.17	2.98	0.90	1.58

NOTE: [1] The following EU-3 member states are the closest to Slovenia according to the GDP pc: Spain, Greece, Portugal.

[2] Italy, Austria, Hungary, Croatia.

[3] Poland, Czech Republic, Slovak Republic, Hungary.

would thus become less economically interesting, resulting in the marginalisation of areas with bad production conditions. With the increased intensity of production and yield the total area of agricultural land could decrease. Both would have negative effects on the environment. The marginalisation of agricultural areas has a greater impact in Slovenia as a small country, than in larger countries and the intensification of production will reduce its biodiversity. Although the cultural landscape will be maintained, the traditional small business and other activities in the rural area will be affected, and small farmers will be ruined. With the intensification of agricultural production the measures for controlling its negative effects should be introduced.



Graph 35: *Application of NPK fertilizes (kg/ha) - 1995 (Source: Kovač in Radej et al., 2000).*

Application of pesticides

In comparison to 1994 the consumption of pesticides per ha increased by 20 % in 1998: agro companies applied 6 times the amount of pesticides per ha than family farms. It is estimated that such a trend continued in 1999, since the reform of agriculture did not begin that year, as planned, due to the lack of budget funds.

The introduction of Common Agriculture Policy measures should be evident in the increase of the arable land, the reduction of land where production is intensive and the increase in the share of organic production. The processes in the accession countries could be quite different: at first the production is intensified to raise its competitiveness, but later on more environmentally friendly changes in the structure of agriculture could prevail, stimulated by the CAP.

With the adoption of Agenda 2000, the environmental objectives of agriculture became extremely significant. One of the ways of deintensifying agricultural production is to reduce the quantities of the applied plant health products and mineral fertilizes. Those farmers who undertake to manage their farms in an environmentally friendly manner are eligible for compensation because their production costs are higher than normal. The introduction and implementation of and control over the environmental measures in agriculture are mandatory in the EU.

Application of fertilizes per ha of arable land

In 1995, the consumption of NPK fertilizes per unit of arable land was 6 % higher in Slovenia than in the EU-15 countries on average. Certain data show that in recent years the surplus has even increased. The differences among the EU Member States are significant, but the consumption is falling.

On family farms less than a third of the quantity of mineral fertilizes are consumed than in the agro companies (1998). The reasons are the relatively high prices of mineral fertilizes and pesticides which increase the production costs.

It is estimated that the consumption of mineral fertilizes per unit of arable land will decrease after 2000, when the financial incentives for sustainable agricultural production are enforced. The financial incentives for intensive agriculture are significantly higher than incentives for sustainable agriculture, consequently many small farmers will join agro-companies whose policy is to apply as many fertilizes as possible.

Irrigated land as percentage of arable land

In comparison to other countries, the share of irrigated land in arable land is very small in Slovenia, approximately 0.5 %. Slovenia is rich in waters but, on the other hand, it does not exploit its possibilities as far as irrigation of agricultural land is concerned. In 1995, the Government adopted a strategy for the irrigation of agricultural land. In this strategy, the potential irrigation land was defined. It was established that water for approximately 50 % of this land could be provided (around 60,000 ha) which is some 12 % of all arable land in Slovenia (in EU 4.6 % on average). All the considered land is affected by long summer droughts which affect the quality and quantity of the current agricultural production. The relevant plan for the acquisition of a loan for the purpose has been drawn up but the irrigation scheme has not been concluded.

Agriculture and biodiversity

Rural areas cover a large part of Europe. The basic activity in these areas is agriculture, and thus large quantities of nutrients and chemicals are introduced into the environment, where agricultural systems, biodiversity and cultural landscape are closely linked.

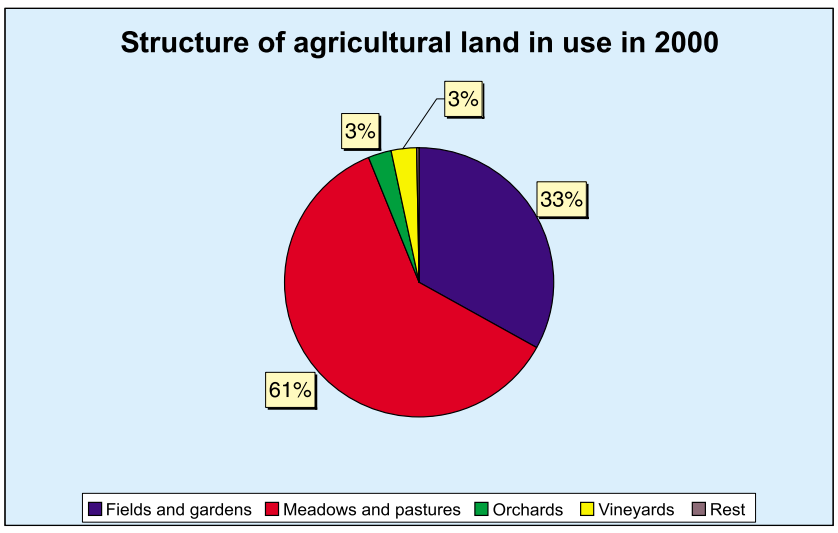
(Photo: Marko Simič)

Figure 159. *Surroundings of Bičin in the Dolenjska region; for maintaining species diversity it is important to keep small forests in an agricultural environment.*

STATUS OF AGRICULTURE (according to data from agri-environmental programmes)

The development of Slovenia's agriculture after the Second World War is reflected in its structure, production and market rules. Two diverse types of agricultural production developed: the state-run production on big farms and private production on small farms. The unfavourable size structure of agricultural land is reflected in the low productivity and production intensity which decrease the competitiveness of Slovenia's agriculture in comparison to that of European and world agriculture. Most Slovenian farms do not offer full employment to an entire family living on that farm. A rather large share of Slovenia's population lives on farms (around one fourth of the total population), but only 12 % work in agriculture. Approximately 50 % of all farms receives income from non-agricultural activities. In Slovenia, 96,669 family farms and 132 agro-companies were registered in 2000. More than 90 % of agricultural land is private, agro-companies manage less than 6 % of agricultural land. The average size of a family farm with regard to the size of the actually exploited agricultural land is 4.8 ha, the average size for agro-companies is 220.7 ha.

Graph 36: *Structure of agricultural land use in 2000 (Source: SKOP 2001-2006).*



In Slovenia, the natural conditions for agricultural production are rather unfavourable. Around 75 % of agricultural land is located in areas with less favourable conditions for agricultural production, and approximately two thirds of rural population live there (hill and mountain farms). Only one fourth of agricultural land is located in the lowland areas of Slovenia. In the land use structure, a large proportion is taken up by grasslands and only a minor share by fields. The natural attributes are suitable for permanent crops and production of various fruits and high quality wine, but on the other hand they contribute to the lower production capacity of agriculture, a limited range of cultures, and thus also to the poor adaptability of Slovenian agriculture to costlier production. A special problem is the natural encroachment of vegetation on agricultural land. In the last decades, natural encroachment of vegetation on agricultural land has covered around 140,000 ha and the trend is continuing. In 1991 the availability of arable land was 1,000 m^2 per capita, and in 1999 it dropped to 860 m^2.

LIVESTOCK BREEDING

Livestock breeding is the most important sector of Slovenia's agriculture. In the structure of final production it represents more than two thirds of the value. The major share is taken up by cattle breeding, followed by poultry and pig production. Livestock breeding is oriented towards breeding, which takes into consideration the ethological and environmental aspects.

To a large extent **livestock breeding** is conditioned by natural attributes, the grasslands. Milk and meat are the most important products of Slovenia's livestock breeding. This is reflected in the breed structure of cattle. Breeding of light spotted (56-85 %) and brown cattle (around 30 %) prevails. The share of black and white breeds is rather low (12-14 %), as well as the share of pure beef breeds and cross-breeds. To a certain extent farmers also breed indigenous cattle breeds such as: cika cattle, Istrian cattle and Slovenian brown cattle.

After the Second World War, the **poultry production** developed fastest. In the poultry production structure, chicken for fattening (around 60 %) and egg laying hens (around 27 %) prevail. With regard to the breeds, the share of the Slovenian indigenous breed Styrian hen is very low and the imported hybrids take the largest share.

In Slovenia, **pigs** are produced on large industrial farms and traditional farms. Extensive breeding is most wide-spread. However, on big

farms the production is oriented towards the breeding of modern pork breeds. The breed structure of pigs is extremely heterogeneous: Sweden landrasse, Deutsche landrasse and various cross-breeds prevail; the number of other breeds such as Large Yorkshire, Duroc and Pietrain is lower. Within the programme of the gene bank the only indigenous pig breed conserved is: the Krško-polje (blackbelted) pig.

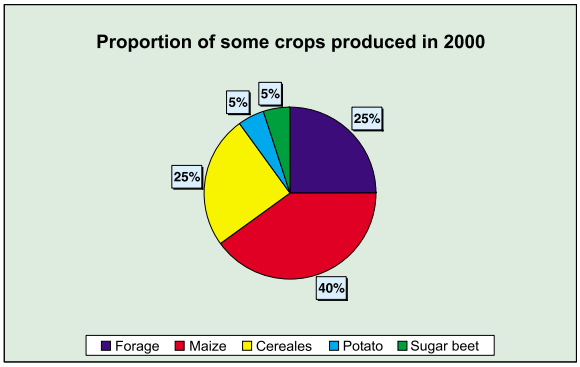
Small ruminants almost disappeared after the Second World War, but the number of sheep has been increasing steadily in the last decade. Small ruminants are mainly bred on family farms. In 2000 the share of goats was 24 % and sheep 76 %. The sheep population is mostly indigenous: Jezersko-Solčava, Bovec, Istrian pramenka and Bela Krajina pramenka sheep. In goat breeding, the Alpine and domestic goat prevail while the share of the indigenous breed, Drežnica goat, is very low.

In **horse breeding** the indigenous Slovenian cold-blooded horse and the Lipizzaner horse prevail. These two breeds are the symbols of Slovenian horse breeding. In the sub-Alpine area the Haflinger horse is being bred for recreational purposes and work. To a smaller extent the Slovenian trotter and the Posavje horse are also being bred.

There is a long tradition of **bee keeping** in Slovenia but the number of professional bee keepers is low. The annual production of honey varies between 12 and 20 kg per bee hive. Beside honey, many bee keepers produce pollen, royal jelly and propolis. Queen rearing has been revived since bee queens have become a valuable export good. The trade in bees and queens of the indigenous Carniolan honeybee (*Apis mellifera Carnica*) was developed alredy in the 19th century.

PLANT PRODUCTION

In the total structure of agricultural land the share of cropland is very small in Slovenia. The most important areas for intensive arable farming are located in the eastern part of Slovenia and in the river lowlands in the central part of the country.

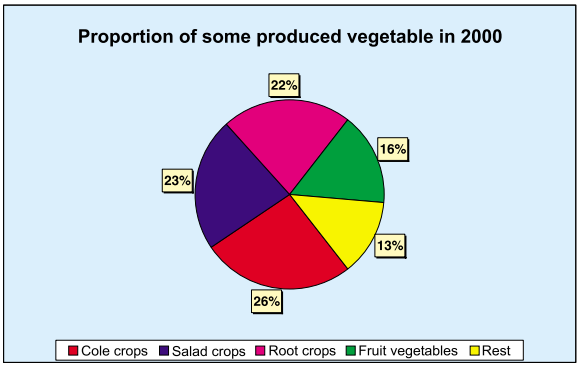


Graph 37: *Proportion of crops in agriculture (Source: SKOP 2001-2006).*

(Photo: Marko Simič)

Figure 160. *Grazing in the Pivka Valley. Compatible sheep grazing is useful for management of the grasslands.*

Statistical data for 2000 show that 1,893 ha were intended for market oriented **vegetable** production. Of that, 1,765 ha were intended for the production of vegetables, herbs, strawberries and grown mushrooms, and 127 ha for the production of flowers and decoration plants. The share of traditional production was 85 %. The share of integrated (13 %) and organic farming (2 %) was much lower.



Graph 38: *Share of vegetables in agriculture (Source: SKOP 2001-2006).*

For most crops the average production intensity is rather low. The same holds true for vegetables. The production intensity is high only when the production of crops (sugarbeet, hops) and vegetables (cabbage, lettuce, cucumbers) is market orientated. The production intensity has been increasing in the last years, but for most crops and vegetables the production per ha is still lower than in the EU countries.

In Slovenia **grasslands** cover nearly **two thirds of exploited agricultural land**, that is **314,434 ha** (**93 %** of **meadows** and **7 %** of **pastures**). The total area covered by grasslands have been reducing in the last decade because such land is quickly afforested.

Orchards cover **13,457 ha** of agricultural land (family farms orchards - 61 %, intensive production orchards - 39 %). The natural attributes are favourable for the production of various fruits. The most important species is apple. The

(Photo: Marko Simič)

Figure 161. *Arable land is scarce on the Karst. Farmers have made fields in the dolines, therefore called 'created-dolines'; today most of them are abandoned and left to swift overgrowing.*

production of pears, peaches, sour cherries and berries is important. In recent years the growing of olive trees has increased substantially. In extensive meadow orchards with standard trees the traditional old varieties prevail ('bobovec' (Kozjak apple), 'carjevič' (little tsar), Jonathan apple, parmena); in intensive orchards the following varieties grow: Idared, Jonagold, Golden Delicious, Gloucester. 'Meadow orchards' express the identity of Slovenia's rural areas and are a rich source of biodiversity in agriculture but unfortunately in the last few years they have been neglected. Consumers have been forced to buy new apple varieties. The production in extensive orchards had no longer been economic and market oriented and consequently the trees had grown old, the orchards had not been managed and the trees not pruned. Fortunately, these orchards are being revived since the market is again interested in traditional varieties.

Wine-growing and wine production are traditional and popular activities. They are complementary activities to 41 % of family farms, and vineyards cover approximately 14,500 ha. Uncultivated vineyards are often overgrown. In Slovenia the wine-growing areas are divided into three wine-growing regions: Primorje with a Mediterranean climate; Posavje with a moderate continental climate and Podravje with a continental climate. The wine-growing locations are among the best in the world. At the same time they are very demanding because two thirds of vineyards are located in areas where the slopes exceed 20 %, and one third in areas where the slopes exceed 45 %. In good years, the share of high-quality wine is 10 %, of quality wine 40 % and of table wine 50 %. The main problems in wine-growing are the disadvantageous age structure of vineyards and the obsolete technology which is not being modernised. In addition the natural conditions are not perfect. All these circumstances are reflected in the low production of wine per hectare. In the future more attention should be focused on domestic varieties and the preparation of propagating material.

(Photo: Branka Hlad)

Figure 162. *The Jezernica stream is a typical canalised water flow causing impoverishment of its biodiversity and diminished functioning of the area.*

IMPACTS OF AGRICULTURE ON BIOLOGICAL AND LANDSCAPE DIVERSITY

Farmers play an essential role in the conservation of biological and landscape diversity. Many areas, important from the point of view of biodiversity, are joined with the agricultural land (areas of extensive production and areas regulated by the EU Habitats and Bird Directives).

In Slovenia, the problems concerning agriculture and the environment are in particular related to:

- the abandonment of agricultural land and its consequential colonisation by scrub and trees; the result is the deterioration of rural landscape, further economic, cultural and social marginalisation of the affected areas and the reduction of biodiversity;
- intensive farming in lowland areas (increase of arable areas, removal of vegetation cover, intensive arable farming):
  - the potential threat is the **pollution** of drinking water and soil, followed by the long term degradation and pollution of natural resources and the reduction in the diversity of animal and plant species;
  - the disappearance of hedges, forests and small watercourses which **reduces the diversity of habitats and landscape**;
  - the **degradation of soil**, if the activity is not suitable for the given conditions, and erosion if the removal of vegetation cover and the cultivation of land are unsuitable;
  - **fertilisation** leads to the loss of habitats poor in nutrients, it contaminates flora

and fauna with microbes and chemicals, heavy metals enter the food chain and water is polluted (eutrophication, oxygen shortage, growth of algae and aquatic plants, reduced populations of fish and other aquatic fauna);

- **pesticides** poison wild animals other than those intended; degrade habitats and cause the disappearance of food sources for higher animals; they increase the resistance of target species; they poison groundwater which maintains the natural balance in the aquatic and riparian ecosystems; they reduce the drinking water supply;
- the **canalisation of rivers and streams** modifies the hydrological cycle and burdens the natural aquatic and riparian ecosystems (flora and fauna) by destroying the natural balance and by potential reduction of biological and landscape diversity; draining affects aquatic and riparian ecosystems, wetlands are destroyed, the botanical structures of grasslands, reed beds and other habitats are changed as well as the structure of soil and soil ecosystems, the need for irrigation increases in areas where the water table is lowered;
- **irrigation** could lead to soil salinization and acidification which reduce the species' diversity; it depletes aquifers and watercourses during dry periods and that alters the ecological conditions in the watercourse and near it;
- **among other** consequences the loss of architectural heritage; some buildings structures function as habitats for certain animal species (bats; old barns as nesting places for some birds - barn owl, common kestrel).

(Photo: Matjaž Bedjanič)

Figure 163. *Fritillaria meleagris, an endangered species in Slovenia. Due to land reclamation for agriculture and urban areas its localities have considerably declined.*

(Photo: Marko Simič)

Figure 164. *Fields on the terraces at Globodol in the Dolenjska region.*

(Photo: Peter Skoberne)

Figure 165. *Planting potatoes in Bohinj. Maintaining the quality of seeds is crucial for conserving the cultivar.*

In some regions the landscape and biological diversity are threatened by the intensification of agricultural production (lowlands) and in others by the abandonment of arable land in areas with less favourable conditions where intensive cultivation is not possible (hills and mountains). In lowlands most of wet meadows had been drained for intensive production of corn, wheat and sugarbeet. Because of the excessive application of mineral fertilizes and phytopharmaceuticals the fields, orchards and meadows became inhospitable for many plants and animals.

Sustainable agriculture contributes to the conservation of the environment and to ecological balance. At the same time it influences the settlement patterns and the appearance of the cultural landscape. Agricultural activities play various

roles in Slovenia's rural areas. That lists it among the countries with the highest number of different plant and animal species' habitats in Europe. The conservation of natural resources is relatively high, the rural landscape is diverse and preserved, the traditional farming has been maintained and with it the cycle of substances.

Even though the technological improvements have reduced the costs and prices of agricultural products, the consumers tend to buy food which was produced in a traditional way. The increasing demand for organic farming products is a clear sign of new understanding of the quality of food.

Forestry

In comparison to other countries and other natural resources forests are the most abundant natural resource in Slovenia. Although most of the forests in Slovenia are privately owned (71%) - and it is expected that this share will be even greater in the future due to the unfinished process of land restitution - the state of the forests is not endangered if the valid legislation persists.

Forest management in Slovenia is based on balancing of all forest functions (ecological, social and economic) in the long-term perspective both in private and public forests. Sustainable forest management is founded on forest management plans, which are adopted in close cooperation with stakeholders and are derived from the Forest Development Programme of Slovenia. Biodiversity is given special attention in the programme as well as in forest management plans.

Extraction of wood from the forests

In the period 1991-2000 the amount of felling planned in regional forest management plans attained 3 million cubic metres annually. However, this figure was not reached mainly due to the rather weak interest of forest owners with smaller property, for whom the income from the forest would be very low and felling difficult to organise. The gap between the planned and actually harvested amount of wood was the biggest for pulp and firewood, where the costs on average were higher than the market price. Recently, the interest in felling firewood is rising because the fossil fuels are getting more expensive and wood is becoming an increasingly competitive substance for heating.

The low harvesting intensity in the period 1991-2000 has not only resulted in positive environmental consequences, in the sense of attaining the goals of the UN Framework Convention on Climate Change (a great proportion of carbon emission was sequestrated in wood), but has also had negative impacts. Much less thinning was carried out than planned. This not only lessened the possibility of improving the quality of forest stands but has also reduced the chance of enhancing biodiversity of the forests through active support to indigenous species that are sparsely distributed in the forests.

In the period 1991-2000 felling attained only 40% of growth. Growing stock has therefore risen considerably, but is not yet optimal. Such trends in the last decade enable the planning of a higher allowable cut. The Slovenian Forest Service has thus in the draft regional forest management plans, valid until 2010, proposed allowable cut on an average of 4 million cubic metres annually, which is 25% more than in the past decade.

(Photo: Marko Simič)

Figure 166. *Traces of resin collecting on an old pine tree at Kamen on Karst are the only evidence of an activity that has died out.*

Graph 39: *Total wood harvesting intensity; fellings as % of annual increment; 1990 (Source: Kovac in Radej et al, 2000).*

Note: *[1]The following EU-3 member states are the closest to Slovenia according to the GDP pc: Spain, Greece, Portugal. [2]Italy, Austria, Hungary, Croatia. [3]Poland, Czech Republic, Slovak Republic, Hungary.*

The forestry experts do not expect such a level of cutting to have negative impacts on the forest diversity, particularly if special measures for biodiversity conservation, which are part of the draft plans, are implemented.

Forest management

Close-to-nature forest management, as practised in Slovenia and some other European countries, is one of the few activities in which the nature conservation and economic exploitation are joined. It emerged from the recognition that forests are essential for living, where the protection of homes and fertile land, especially in Alpine region and in vulnerable karst areas, plays particularly important role.

On the territory of nowadays Slovenia, the foresters began to plan the amount of felling and development of forests more than 200 years ago in order to safeguard the forest and ensure sustained yield from the forest. Since the 1960s, forestry has become a modern science and economic activity based on the latest biology and forest ecology discoveries and experience in the management of natural processes.

Forests, important renewable natural resource and landscape feature, are managed as natural ecosystems according to the principles of sustainability and multipurposeness. The basic objective of forestry is to ensure the sustainability of forests and their ecological, social and production functions in a manner similar to the natural processes. To a great extent such forest management conserves their natural biodiversity.

Forest management and silviculture measures take into account the site and tree characteristics of forests - their vitality, health and contribution to the overall stability as well as the capability to fulfil their functions. Tending is the most important measure for shaping forest stands in accordance with the goals set. The silviculture system is chosen as a consequence of concrete circumstances and does not depend on certain schemes that would disregard the actual conditions. The silvicultural approach is site specific and is as a rule based on small-scale interventions. In most cases silviculture, which is aimed at production of high-quality wood, also encompasses the fulfilment of ecological and social forest functions. Where these functions are exceptionally important, the production of wood is limited. Such circumstances call for careful and planned decision-making, in agreement with the forest owner and the local community. All these factors are regulated by the Forests Act.

In the period 1998-2000, the Slovenian Forest Service (Regulation on the forest management and silviculture plans) evaluated the forest area according to all 16 functions stipulated by the Forests Act (four ecological, nine social and three production functions).

Importance of the function Function	Key %	Important %
Protection of forest land and stands	13.1	22.1
Biotope function	4.9	13.0
Hydrologic function	2.4	42.1
Climatic function	1.9	3.8

Table 60: *Forest surface area with emphasised ecological functions (status in 2000).*

The result of the evaluation is given in table 60 for ecological functions. From the point of view of biodiversity conservation, it is of vital importance that of the total 1,134,227 ha of forests, 46,805 ha have already been designated as protective forests because of the role they play in the protection of forest land and stands, 10,923 ha of forests however have been designated as forest reserves. In protective forests, human activities are only permitted exceptionally (to strengthen their protective function).Forest reserves are deliberately left to natural processes and no human interventions are permitted. A new proposal for the designation of 'protective forests' and forest reserves has been drawn up by the Slovenian Forest Service. According to this proposal, 'protective forests' should encompass 84,128 ha and forest reserves 13,505 ha. The proposal has been included in the forestry expert grounds of the Spatial plan for the period until 2020. Most of the planned nature parks in Slovenia cover forest areas, and the share of forests with a protection status will thus increase.

(Photo: Andrej Hudoklin)

Figure 167. *Although Glis glis has been traditionally hunted in Slovenia, research has never been conducted on how hunting affects dormouse populations.*

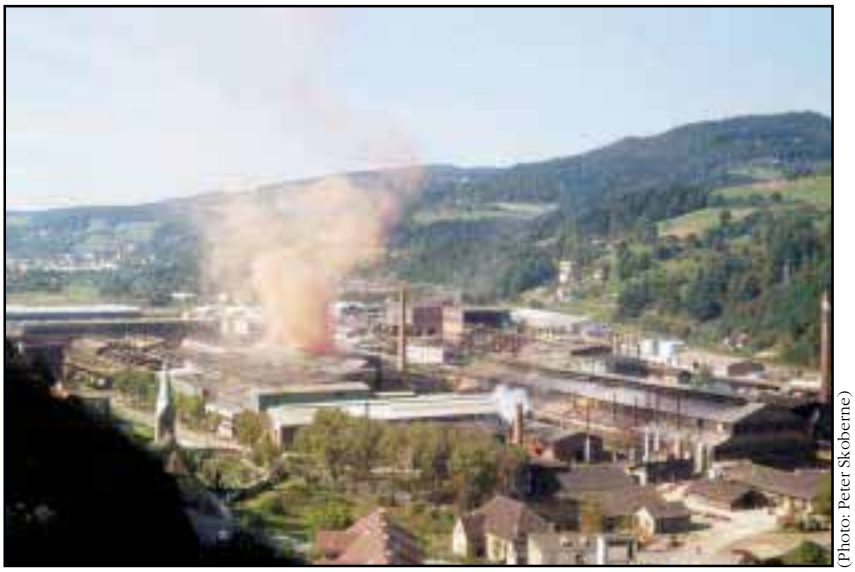
One of the objectives of forest management is to select small forest areas (up to a few tens of ares) located at ecologically outstanding sites (wetlands, steep rock walls) with a large share of old and decaying trees, not normally present in a managed forest, and to leave them unmanaged in order to create eco-cells.

Habitat protection

The Rules on the protection of forests lay down in detail that dead trees are to be left undis-

turbed. They also stipulate other measures which contribute to the conservation of biodiversity in forests. These measures include restrictions concerning: picking of mushrooms, plants and animals in the forest; construction of forest roads near important habitats (lairs - dens, nests, mating sites) of rare and endangered forest animals and plants; carrying out of seasonal forest management activities in the vicinity of these habitats.

The designation of 'undisturbed zones' covering a few hundred hectares of forests is one of the measures by which favourable living conditions for forest animals and thus for forest biodiversity conservation are ensured. Because of their location and ecological characteristics the "undisturbed zones" are essential for forest animals. In order to preserve an environment as undisturbed as possible for animals, forest visitors are kept outside these zones.



(Photo: Peter Skoberne)

Figure 168. *Ravne na Koroškem, the main air polluters are domestic heating systems and traffic, as well as locally industry.*

Processing industry

With regard to the transition to sustainable development, the content of natural resources in products should be adapted to their long-term relative rareness. A country with limited raw materials and energy resources should not specialise in the manufacturing of products with a large content of raw materials but in the manufacturing of products in which the produced input is high (knowledge, work, capital, technology). Such an economic orientation is particularly relevant for the export-oriented industry. Foreign businessmen might be stimulated to purchase products with a high input of production factors whose economic yield is higher than the economic costs if part of these costs were "paid" by the environment. The State owned natural resources and natural resources whose extraction is controlled by the State are mainly faced with such a situation.

It is important that the economy, whose environmental protection policy is to avoid costs arising from the degradation of the environment, should not specialise in production whose competitiveness is the result of the utilisation of the underestimated natural resources.

From a macro-economic and developmental point of view, foreign markets are extremely important, and because of this the share of natural raw materials in the export of goods as well as the harmonised fluctuation of their competitive advantages should be monitored.

Share of added value of 'dirty' industries in the export

The major processing industry polluters are the producers of iron and steel, industrial chemicals, non-ferrous metals, minerals, paper and pulp and other chemicals. These six sectors produce more than 80 % of all estimated harmful emissions (integral emissions) into the environment. In the period from 1995 to 1999, the total production in these sectors increased faster (average annual rate of 2.0 %) than in the entire processing industry (average annual rate of 1,6 %).

In 1995 these particularly problematic activities included 921 companies with 41,600 employees and they made one fifth of the added value of the processing industry. The priority with regard to the environmental protection is to focus on the production of chemicals and artificial fibres and the production of other non-metallic mineral raw materials.

The export orientation of this 'dirty' production exceeds that of the processing industry on average. In 1995 the processing industry exported 50.7 % of its production. In total 60 % of the estimated integrated emissions from the processing industry can be related to export.

Slovenia's export of 'dirty' products is focused on 4 main product groups whose share is more than 50 %: paper and cardboard, aluminium, metal products and cut paper and cardboard. In the last few years the share of the following prod-

Table 61: *Environmental aspects of the export of the processing industry (Source: Zakotnik in Radej et al., 2000).*

	1995	1996	1997	1998	1999
	Processing industry = 100				
Intensity of the export of goods with regard to the natural resources, in % of export	16.7	16.3	16.6	15.6	15.3
Share of added value of dirty industries, in % of added value	20.3	-	-	-	-

ucts increased: metal products (from 11.4 % to 14.1 %), aluminium (from 14.0 % to 17.6 %), flat and rolled steel alloy products (from 2.5 % to 6.6 %). The preliminary estimates show that the conditions have been improving since the late 1990s.

The competitiveness studies (Gmeiner, in Radej et al., 2000) show that Slovenia should encourage technological progress in the following industries:

- rubber industry;
- production of machinery and equipment with the application of the following technologies: surface materials technology, high-efficiency metals, joining techniques;
- car industry;
- production of electric and optic equipment in the field of telecommunication signal processing, thin film techniques, optoelectronics, laser techniques. These subsectors cover nearly two thirds of the production of the processing industry (2000). In the period from 2001 to 2006 their growth is expected to be faster by 0.2 % than the growth in the processing industry on average.

Impact of industry sector on biodiversity

The impacts of industry on the reduction of biodiversity are as follows:

- due to the low prices of land, industrial and small business facilities are often built in wetlands and other areas important for the nature conservation;
- waste landfills, the pollution of air, soil and water, including thermal pollution, and the abstraction of water all affect the quality of aquatic and riparian ecosystems and the natural balance in them;
- surface exploitation of natural resources physically affects ecosystems and their balance.

Mining

In Slovenia, the geological conditions are such that energy and metal and non-metallic mineral raw materials are available to a certain extent.

The energy mineral raw materials include coal, uranium, oil and natural gas and geothermal energy resources. Slovenia's coal-bearing regions are: Velenje basin, Zasavje tertiary basin, Krško-Brežice plain and North-East Slovenia. Uranium deposits are located in the Žirovski vrh area and in the vicinity of Škofja Loka. There are several areas in Slovenia where oil and natural gas might be found (Mura region, Coastal area, the Alps and Dinaric Mountains and some tertiary basins). Geothermal energy could be exploited on approximately 16 % of the territory. Prospective areas are: the Pannonian basin, Rogaška-Celje-Šoštanj area, Krško-Brežice depression, Planina-Laško-Zagorje area and Ljubljana basin.

(Photo: Marko Simić)

Figure 169. *The lead mine at Mežica. Nowadays used for touristic purposes, it attracts domestic and foreign visitors. Parts of the mine with some rare minerals wulfenite, calcite, galena and sphalerite are protected as natural monuments.*

There are around 200 deposits of the **metal mineral raw materials**; not all of them are exploited, in some cases the deposits are minimal. Economically important could be the deposits of mercury, lead and zinc, copper, antimony, iron and bauxite.

The non-ferrous mineral raw materials of higher market value (industrial minerals and aggregates) which could be exported are not abundant in Slovenia. The mineral raw materials of lower value (raw materials for the construction industry) prevail. Slovenia exploits them to cover its own needs, or else enriches them and they are processed into semi-products and final products. In Slovenia the following mineral raw materials are exploited: chart, quartz sand, calcite, lacustrine chalk, bentonite, tuff (pozzolana), ceramic and brick clay, raw materials for the lime and cement industry (limestone, marl), natural stone, technical building stone (limestone, dolomite, keratophyre, meta-diabase), as well as gravel and sand. Domestic mineral raw materials are used in the construction, glass, ceramic and chemical industry, metallurgy and metal industry, for remediation operations in the environment and waters, in agriculture, the food processing industry, etc.

Mining is a traditional activity in Slovenia. In the past, the exploitation of mercury was impor-

tant at the global level but nowadays the technologically accomplished underground exploitation of lignite plays an important role.

In the last decades the underground mines of energy materials and metallic mineral raw materials have been closed down, only surface mining of non-metallic mineral raw materials and underground coal mines remain. Of all coal mines only the Velenje mine and the Trbovlje-Hrastnik mine still operate. The Žirovski vrh uranium mine is the only mine which has been opened since the Second World War. It is currently being closed down (the operation started in 1991). The Idrija mercury mine was closed in 1991, and in Mezica the last tonnes of lead and zinc were produced in 1994.

Trends in the development of mining

The need for mineral raw materials is increasing in Slovenia. Companies mostly import raw materials, only a few of them exploit the domestic deposits (brick, cement, lime production). With the programme for construction of the highway network, the need for raw materials used in construction has drastically increased. It is planned that in the near future only new and extended existing surface mining sites of non-metallic mineral raw materials will be exploited. Through the legislation, the mining sector tries to incorporate in its activities the measures for reducing the adverse effects on the environment and people, in particular on the local population. Illegal exploitation of mineral raw materials remains the key problem which causes imbalance in the provision of mineral raw materials and presents an unfair competition to legal exploitation. At the same time, illegal excavation burdens the environment and degrades habitats.

Mining and biodiversity

In most cases, the effects of mining on biodiversity can be controlled. The exploitation sites are rather limited and the processes of exploitation, enrichment and processing of raw materials do not have permanent adverse effects on the environment. The exploitation of mineral raw materials degrades ecosystems, and the rehabilitation of the mining areas, such as surface mining sites (quarries, gravel pits, sand pits), is essential for the biodiversity conservation because these secondary habitats are populated by endangered plant or animal species. They are particularly significant in areas where similar natural habitats have disappeared (sandy cliffs, water covered areas, etc.). The cooperation between the mining and nature conservation sectors guarantees the biodiversity conservation on and near the exploitation sites and provides for biodiversity conservation within the framework of the restoration of disused mines, quarries and pits. An example of good biodiversity conservation practice is the sand pit near Bizeljsko, where the habitat of the European bee-eater (*Merops apiaster*) is preserved. The information on that habitat has also been made available to the public.

Figure 170. *A water mill on the Mura river.*

(Photo: Peter Skoberne)

Tourism

Tourism is the world's fastest growing industry. The World Tourist Organisation (WTO) estimates that in 1999 tourism generated US$ 455 billion, and the expected income in 2020 is US$ 2,000 billion. A similar trend is evident in the number of tourists. In 1999 there were 664 million people travelling, and in 2020 the number is expected to reach 1.5 billion.

Tourism and recreation bring income and jobs, increased understanding of other cultures, preservation of natural and cultural heritage and at the same time investment in infrastructure. On the other hand, some forms of tourism, and some recreational activities, can cause destruction of habitats and degradation of landscapes and competition for natural resources (land, freshwater) and services (energy, transport). More than other human activities tourism depends on the quality of the natural and cultural environment for their continued success. However, as particular areas become attractive destinations for tourism and recreation, unmanaged environmental impacts may undermine future earnings. This is particularly crucial in Central and Eastern Europe, where the temptation might be to develop unsustainable tourism as a fast boost to economic recovery.

In Slovenia tourism employs 50,000 people and generates SIT 350 billion (or 9 % of GDP). According to the World Tourist Organisation estimates, by 2020 the tourism will have grown by 6 % in Slovenia and by only 2 % in the rest of Europe. The rate of growth is expected to be higher only in Russia and Croatia.

According to the accommodation capacity and the number of overnight stays there are only three important tourist regions in Slovenia: the Coastal area with Portorož and Izola, the Alpine area with Kranjska Gora and Bled, and the health resorts in the North-East Slovenia (Čatež, Moravske Toplice and Podčetrtek with the highest number of visitors).

The *Resolution on strategic goals for the development of tourism in the Republic of Slovenia* and its programme of activities and implementation measures, stipulates that the basic tourist products are the environment and the attractiveness of the environment. In Slovenia there are numerous outstanding natural and cultural features. The development of tourism in Slovenia is founded in particular on:

- the preserved wildlife;
- the outstanding natural attractions;
- the exploitation of small-range natural attractions which offer opportunities for the establishment of nature trails for organised visits suitable for school children and smaller groups.

It has been emphasised in the Resolution that tourist products should be easily accessible and authentic and that nature should be conserved and protected. In the tourist offers available to guests the following benefits should be emphasised: the outdoor activities, the exploration of nature and its enjoyment. The priority objectives of the Resolution are the measures concerning the protection and restoration of resources for further tourist development and the conservation of landscape and other cultural characteristics. Slovenia's activities in tourism will be primarily oriented towards the development of the sustainable forms of tourism which facilitate wise land use and environment friendly activities, facilities and installations. In the Resolution, the areas suitable for tourism are defined. In some of these areas biodiversity has been preserved (the mountains, the Karst and Coast Region, health resort areas).The developmental concepts are defined for such tourist products which exploit the potential of areas with preserved biodiversity. In certain regions these concepts take into account the impacts of tourism on the sustainable use of biodiversity components.

(Photo: Marko Simić)

Figure 171. *Trenta. The typical architecture is an expression of the local people's response to natural conditions.*

Tourism is an economic branch which successfully markets high biodiversity and preserved nature and at the same time conserves areas of high biodiversity if the conditions, including knowledge, are right. The Resolution stipulates that the natural and cultural heritage should be commercialised in such a way that the national parks and other protected areas of natural and cultural heritage are included in the tourist offer so that they are economically used in such a way that the environment is protected and the profit increases. In the Resolution there are no additional provisions concerning the relation between the establishment of protected areas and the relevant infrastructure on the one hand, and tourist development on the other. When discussing the tourist infrastructure, the parks' facilities, which enable visitors to experience nature and enjoy its wildlife, are not included. It is stated that "a re-evaluation of the tourist use of the

Country	IUCN category	Protected area (ha)	No. of inhabitants	No. of visitors (per year)
Germany	I	**Bayerischer Wald National Park and Biosphere Reserve (13,000)**	0	1,500,000 - 2,000,000
Poland	I	Ojcow National Park (2,000)	no data	250,000
Estonia	II	Lahemaa National Park (65,000)	no data	1,000,000
France	II	Vanoise National Park (40,000)	0	2,000,000
Slovak Republic	II	Tatra National Park (74,000)	no data	4,000,000
Slovenia	II	Triglav National Park (85,000)	2,000	2,000,000
France	V	Brotonne Parc Naturel Regional (40,000)	33,000	900,000
Republic of Ireland	V	Glenveagh National park (10,000)	0	100,000
Great Britain	V	Lake District National Park (229,000)	40,000	20,000,000

Table 62: *Visitors to selected European protected areas (Source: FNNPE, 1993)*

Triglav National Park and other protected areas, where more cost-effective utilisation of space and higher profit are possible, could be carried out". In addition it is emphasised that "for this purpose, the type and manner of tourist use should be laid down at the time of the designation of a protected area (the number of visitors per day)". In European protected areas (parks), where the contribution to tourism and the local economy is substantial, the role of the appropriate park infrastructure and whole tourist offer in the extension of guests' stay (average stay and prolonged tourist season) has been emphasised. In this case the protection status of an area functions as a trade mark which guarantees the experience of nature. The valuable natural features of the protected area and its biodiversity are preserved, because the visitors are restricted in their explorations by the park infrastructure.

Figure 172 (below). *The frozen Cerknica lake attracts many visitors. Lack of infrastructure, unorganised visits and bad behaviour by some visitors affect nature and cause damage to agricultural land.*

Figure 173 (bottom). *Primula auricula, is one of those plant species which attract visitors, and are also a motif of nature tourism, particularly when found outside the alpine area.*

IMPACTS OF TOURISM ON BIODIVERSITY

Similar to other activities in the environment, tourism increases the use and the burdening of the natural resources (in particular drinking water, land, pollution of water and air, noise, risks of natural disasters such as landslides and avalanches) and the fragmentation of ecosystems and thus the loss of biodiversity. The impacts are evident at the local, regional and global levels (emissions from road transport). The tourists areas are presented according to the topics discussed in the Report on the state of the environment (the EEA, 1995: 489-497).

(Photo: Marko Simić)

(Photo: Marko Simić)

1. **National parks and protected areas.** In Europe, a total of 2900 nationally protected areas cover 8.5 million km² sites (including sites in the former USSR and Turkey). Tourism in protected areas has become increasingly popular in recent years (table 62).

   National parks and other protected areas are by their nature vulnerable to environmental degradation, and require careful environmental management (tourism facilities, overcrowding changes in habitats, erosion, invasive species, conflicts between tourism and nature conservation as well as traditional agriculture etc.). Problems are greatest in areas closer to urban centres and where arrivals are mainly by private car. However, increased tourism and recreation may also contribute to improved resource management, as a result of higher incomes for both parks and local people, and tourist interest in flora and fauna may help to safeguard biodiversity.

   In Slovenia the most visited areas are Bohinjsko jezero, Pokljuka, Vršič and the Trenta Valley in the Triglav National Park. Most visitors come in July and August. Many come because of numerous summer festivals (the Bohinj Nights, Kravji bal etc.).

2. **Rural areas**. A recent comprehensive survey of EU tourists in 1986 suggested that, for their main holidays, 25 % of EU citizens prefer to visit the countryside. Western European countries are witnessing the rapid development of rural tourism. This is caused partly by the necessity to diversify the rural economy, due to the declining role of agriculture. The types of impacts in rural areas are similar to those in protected areas, although they can affect wider areas. The increasing popularity of golf may in particular have a powerful adverse impact on nature. Golf developments can cause environmental damage where they require removal of earth, take farm and forest land, destroy the natural landscape, disrupt existing hydrological patterns, and entail the draining of wetlands to create greens, fairways and artificial lakes, need irrigation, fertilising and use of pesticides.

3. **Mountains**. Mountain areas are popular destinations for tourism in Europe. Most of the tourism and recreation in mountain ar-

eas in Europe is concentrated in the 190,000 km² of the Alps. This area receives some 100 million tourists every year, of which about 40 % visit during the holiday season and the remaining 60 % weekends. Alpine tourism is developed above all in France, Switzerland, Austria and Italy. The number of visitors to the Alps in the summer has stayed roughly constant over the last 20 years. However, winter visitors have increased considerably over the same period. The Alpine region is an extremely sensitive space, and the mountains are the last remaining areas in Central and Eastern Europe that are relatively untouched by human activity. They support a rich biodiversity, although relatively few species can survive in the harsh environment.

Of the Slovenian mountains the most popular are the Julian Alps - Triglav, the area of Triglav lakes, Komna, the area of the Krn lakes, Pokljuka and Velo polje and the mountains in the vicinity of Vršič mountain pass.

The cumulative environmental impacts of skiing are considerable:

- construction of ski pistes and related infrastructure, including access roads and parking and tourist centres, have required forest clearance, thus leading to a higher incidence of avalanches,
- loss of habitats and disturbance of endangered species,
- increasing water and air pollution (usually there are no purification installations), exhaust from private cars and coaches,
- increased (unsustainable) use of water (producing artificial snow by using 28 million litres of water per kilometre of piste, artificial snow melts slowly, reducing the short recuperation time for Alpine grasses and flowers, and contributing to erosion, increased risk of runoff and avalanches),
- extraction of water for producing artificial snow affects the watercourses particularly during the winter drought, and seriously alters the ecological conditions in and around the watercourses,
- ski pistes, cables, tourist centres and inappropriate developments are associated with visual and functional degradation of landscapes.

Tourism and recreation in mountain areas in summer are less concentrated than activities associated with skiing in winter. The impacts are more considerable along much-used long distance footpaths and cross-country motorcycling routes, which can destroy the vegetation cover, leading to increased soil erosion.

(Photo: Peter Skoberne)

(Photo: Marko Simić)

4. **Coastal areas**. The Mediterranean basin is still the world's most important tourist destination, currently attracting some 35 % of international tourists world-wide. The Mediterranean basin's attractive landscapes, cultural heritage, traditional lifestyle and good climate and beaches have made it a very popular tourist destination. Between 1970 and 1990, the number of tourists to the Mediterranean basin tripled from 54 to 157 million. Impacts of tourism in the Mediterranean:
   - overdevelopment (unplanned growth of hotels, pools and other tourist facilities) with little regard for visual impacts or local architecture,
   - alteration of the natural shore to create bathing-areas, and construction of marinas and other infrastructural requisites,
   - planned development directed towards mass tourism,
   - lack of sewage and effluent treatment and disposal (only 30 % of municipal wastewater from Mediterranean coastal towns receives treatment before being

Figure 174 (top). *Mountaineering has an impact on the alpine nature, particularly in summer and along the main paths, including all main accesses to the Aljaž tower on the top of Mount Triglav.*

Figure 175 (above). *Winter-sports centre on Krvavec. Skiing grounds change the alpine landscape and alter the functioning of the sensitive ecosystems. Most problematic are areas where water is extracted for making artificial snow.*

(Photo: Marko Simić)

Figure 176. *Marina Izola. The Slovenian coast is only 46 km long, the development pressures are high, and some uses - like construction of ports - entirely change the coastline.*

discharged), spillages from pleasure boats are also a major source of pollution,

- unsustainable exploitation of natural resources (overabstraction of water for drinking water, bathing, golf courses and water theme parks),
- traffic congestion on coastal roads and construction of new roads causing fragmentation of habitats and disruption to migrating routes,
- changes in traditional lifestyles where local populations are outnumbered by tourists, particularly in poorer regions with overdependence on tourist incomes.

5. **Cities and heritage sites**. Many of the major tourist attractions in Europe are of historic, cultural or religious interest. Museums and historic buildings in cities are visited by more than 750,000 visitors per year. The UNESCO World Heritage List, currently with over 350 sites world-wide, includes cultural, natural and mixed sites. Currently there are about ten times as many cultural sites as natural sites in Europe.
6. **Thematic and leisure parks**. There have been growing investments in theme parks throughout Europe. These are designed to spread the tourist season throughout the year, and increase domestic tourism. However, the resource use of these parks is considerable.

Trends in Slovenian tourism are similar to the world trends. "Experience centres" (aqua parks, thematic parks) are becoming fashionable. Another trend is exclusive tourism for the rich who arrive in personal planes (small sport airfields), they play golf and reside in luxury hotels. The adrenaline sports (hang-gliding, sky-diving, canyoning) attract other people. For them the Soča Valley is one of the most popular destinations. Areas of untouched nature are an advantage in the development of tourism and can be successfully marketed. However, its natural capacity has to be taken into account otherwise the area is not only affected but it also loses its basic tourist attraction.

(Photo: Branka Hlad)

Figure 177. *Rafting is becoming more and more popular in Slovenia, inflicting great pressure particularly on the Soča river.*

Although specialised studies on the impact of tourism on biodiversity have not yet been conducted, the field data compiled by the regional institutes for the conservation of the natural and cultural heritage already show that animals are being disturbed and plants destroyed, especially in the Alpine region (cable cars, ski slopes, visitors) and that the Slovenian coast has been heavily burdened (marinas, shipping, anchoring, visitors).

(Photo: Marko Simić)

Figure 178. *Gathering forest fruits has a long tradition in Slovenia. However, if commercialised or done massively, it can threaten the species and affect their habitats.*

Sustainable use of biodiversity components in other sectors

Beside the economic sectors dealt with in the above analyses and evaluations, there are some fields that are of extreme importance for the biodiversity conservation. Fisheries, hunting, picking of various plants and animals, trade in plant and animal species, water management and biotechnology are activities which directly or indirectly use the components of biodiversity.

Fisheries

Freshwater fisheries

Inland waters in Slovenia are divided between 11 fishing regions and 65 fishing districts. Approximately 90 % of all fishing waters are managed by 62 local anglers associations affiliated in an um-

brella organisation, the Fishing Association of Slovenia. The remaining waters are managed by the Fisheries Research Institute in Ljubljana. Fishery management is carried out on 11,823 ha of waters and is based on breeding, restocking and sport fishing. The sustainable breeding of indigenous species is carried out on 849 ha of protected waters. The reserves cover 176 ha or up to 3.6 % of all fishing waters in Slovenia.

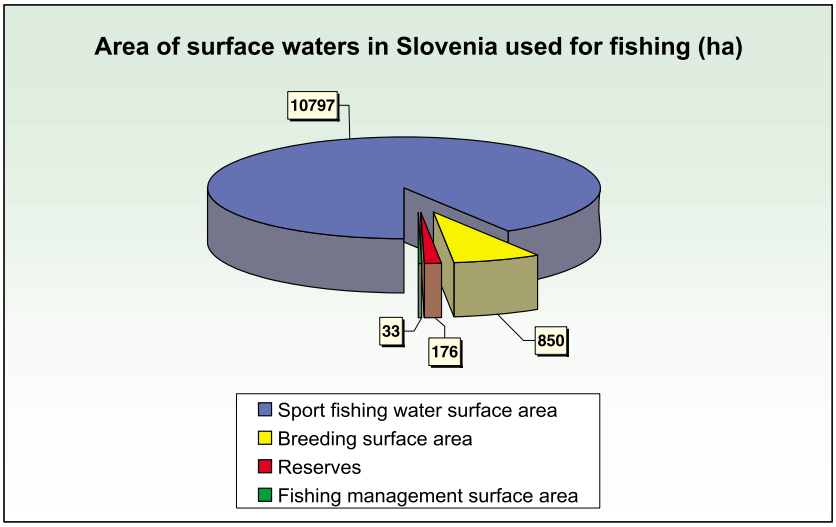
The Fishing Association of Slovenia has more than 16,000 members. Its tasks are: to draw up the strategy for the development of freshwaters fishery, to supervise the work of the local anglers associations, to provide training courses for fishers and anglers, and to cooperate with national authorities and organisations. The most important objectives are the protection and breeding of indigenous species and their introduction into open waters. All local anglers associations draw up and implement their own 5-year fish-breeding plans and the annual restocking and breeding plans which comply with these. In addition to scientific research, the Fisheries Research Institute in Ljubljana is also involved in the management of indigenous fish species and the fish cadastre. It monitors the status of fishing waters on the basis of the data on restocking and catch of specific freshwater fish species provided by the local anglers associations, and its own data on the quality of fishing waters.

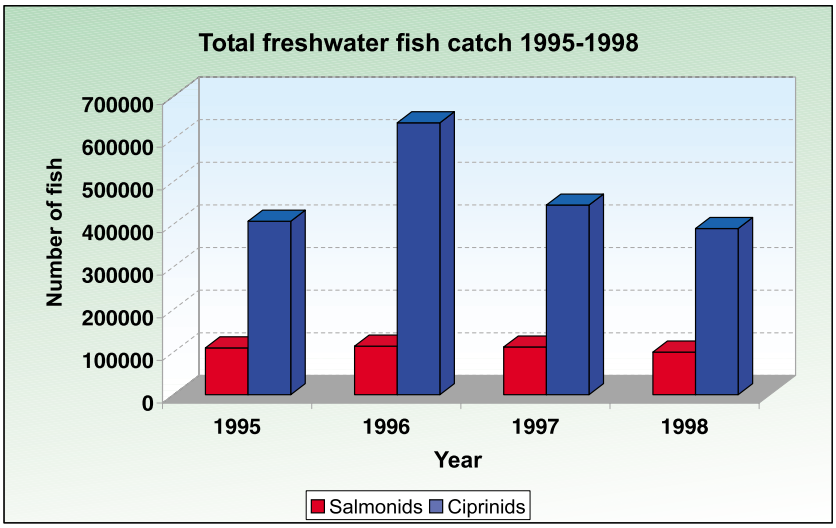
The Slovenian inland waters are not commercially exploited. Waters are designated as sport fishing areas or protection districts. The latter include the breeding streams, standing water intended for breeding indigenous species and reserves for producing fish roe of the endangered indigenous species to restock of breeding streams.

The main objective of sustainable breeding is the production of one-year and two-year fingerlings of indigenous species. These specimens are translocated to sport fishing districts for maintenance and supplement stocking during the periods of most intensive angling. The Salmonid species are bred in breeding streams and the Cyprinidae species in fish ponds.

Brown trout (*Salmo trutta fario*) in the Black sea basin, and marble trout (*Salmo trutta marmoratus*) in the Adriatic basin are bred in a sustainable manner. In order to protect the marble trout, the stocking of brown trout in the Adriatic basin was prohibited in 1996. As a result, the number of half-breeds between the brown and marble trout decreased in the breeding streams of the Adriatic basin. Until 1997, on average 17,500 half-breeds were caught in these breeding streams. The number dropped to 7,000 in the period from 1997 to1998 (Budihna & Bertok, 2000).

In Slovenia, the sustainable breeding of Cyprinidae species is not extensive and no appropriate breeding programmes have been drawn up. Of the Cyprinidae species the following are most frequently bred: sneep (*Chondrostoma nasus*), Danube roach (*Rutilnus pigus virgo*), northern pike (*Esox lucius*), pike perch (*Stizostedion lucioperca*), tench (*Tinca tinca*), and to a lesser extent, sheat fish (*Siluris glanis*), while the quantity of bred common carp (*Cyprinus carpio*) is considerable.

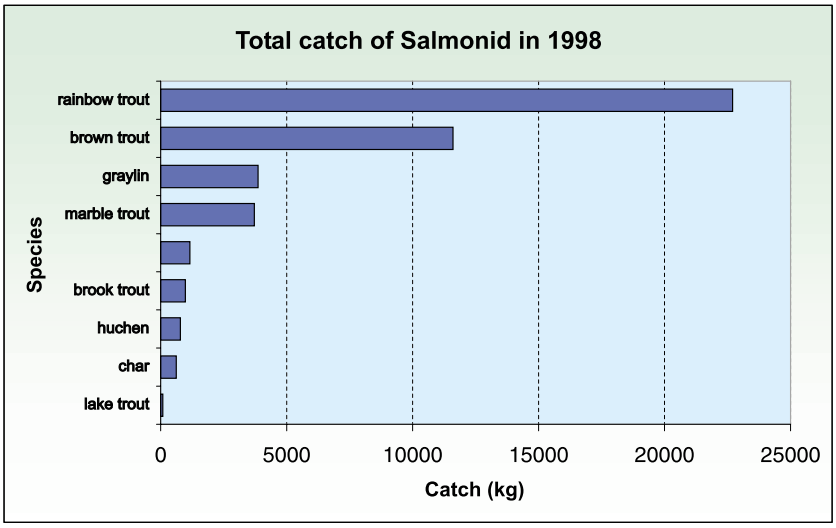


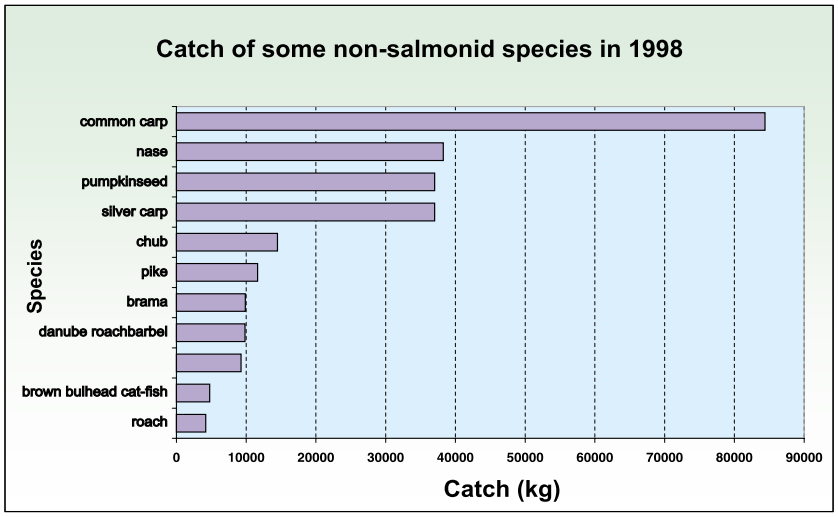


Graph 40 (top): *Area of surface waters used for fishing.*

Graph 41 (above): *Total Slovenian freshwater fish catch from 1991 to 1998 (Source: Budihna and Bertok, 2000).*

Graph 42 (below): *Total Slovenian catch of Salmonid species in 1998 (Source: Budihna and Bertok, 2000)*





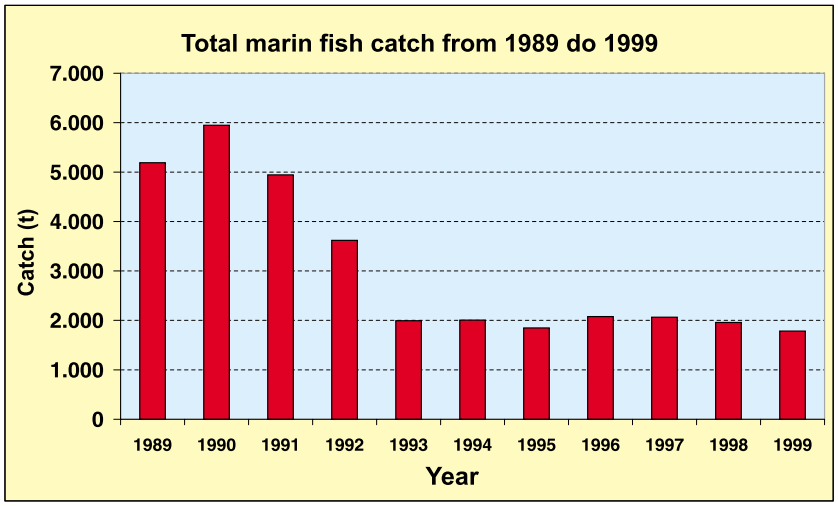
Graph 43: *Slovenian catch of some non-salmonid species in 1998 (Source: Budihna and Bertok, 2000).*

In fish farms the intensive breeding of indigenous species is carried out up to the fingerlings stage. Among the most popular are marble trout (*Salmo trutta marmoratus*), huchen (*Hucho hucho*) and grayling (*Thymallus thymallus*). Brown trout is bred for supplement stocking and for placing on the market. The streams where sport angling is conducted are populated with non-indigenous species such as steelhead (*Oncorhynchus mykiss*) and brook trout (*Salvelinus fontinalis*).

The sport fishing catch should be equal to the fish growth rate (fish biomass of suitable length to be caught). The catch of Salmonid species (47 to 55 tonnes) and Cyprinidae species (214 to 259 tonnes) has been quite constant in recent years.

In Slovenia, 9 Salmonid and 28 Cyprinidae and other species are caught. The sport angling is trout oriented, however the following species are the most interesting: huchen (*Hucho hucho*), marble trout (*Salmo marmoratus*), brown trout (*Salmo trutta fario*), half-breeds between the marble and brown trout, grayling (*Thymallus thymallus*), steelhead (*Oncorhynchus mykiss*), northern pike (*Esox lucius*) and common carp (*Cyprinus carpio*). Of the Salmonid species the steelhead is most caught, and of the Cyprinidae species the common carp.

Graph 44: *Total Slovenian marine fish catch from 1989 to 1999 (Source: Marceta, 2000).*



Freshwater fishery and biodiversity

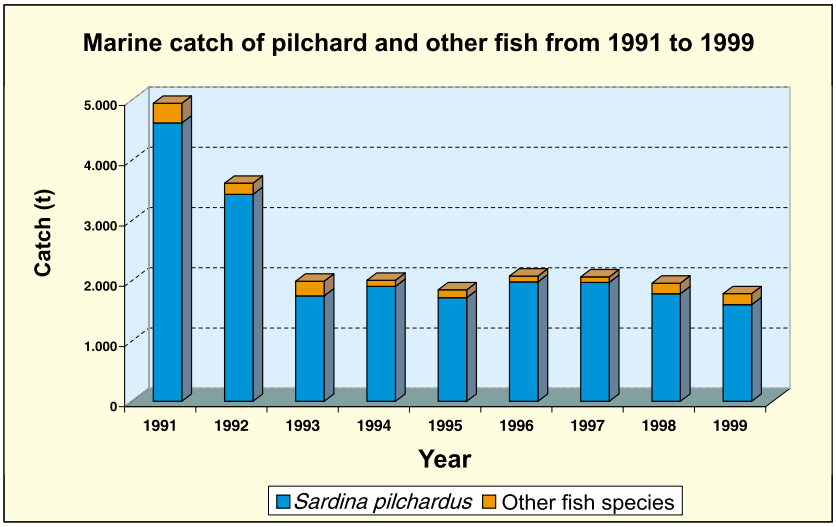
Overcatch may cause a drop in the number of specimens of a certain species or its total disappearance. The latter is usually related to the changes in the habitats, the translocation of fish between different basins and the introduction of fish from geographically distant areas. Pursuant to the relevant legislation, the introduction of non-indigenous species in Slovenian watercourses is prohibited but anglers often populate the waters with such species in order to increase the number of fish in a stream and to increase the variety of species. In most water habitats the result has been the loss of the natural balance. Such consequences are the result of the introduction of white amur (*Ctenopharyngodon idella*), silver carp (*Hypophthalmichthys molitrix*) and bighead carp (*Hypophthalmichthys nobilis*). Fish ponds were populated with white amur to remove the redundant aquatic vegetation, and the purpose of the other two species was to reduce phytoplankton. With the introduction of carps, the breeding and fishing waters were populated with other non-indigenous species: carassius (*Carassius gabelio*), brown bullhead (*Ictalurus nebulosus*) and pseudorasbora (*Pseudorasbora parva*). The consequences of the translocation of species between various basins which can not be remedied are the disappearance of an endemic species of the Adriatic basin - *Chondrostoma genei* which has been replaced by *Chondrostoma nasus*, and the genetic pollution of the endemic marble trout (*Salmo marmoratus*) as the result of the population of the Soča river watershed with the brown trout (*Salmo trutta fario*). The cross-breeding has been so successful that the genetically pure marble trout can now only be found in a few of the Soča's tributaries (Povž, 2000).

Marine fishery

In Slovenia modern marine fishing was developed after the Second World War. In the 1950s, Izola was the biggest fishing centre in the former Yugoslavia and the catch gradually increased until the mid 1970s. In the 1980s the use of new fishing technology resulted in a sudden growth in the quantities of the caught fish, and in 1983 the biggest catch was recorded - 8,076 tonnes. Since then the quantities had gradually dropped and then drastically fell in the early 1990s, because the fishing areas in the Croatian sea were no longer accessible to Slovene fishermen and the former market was lost. Since 2000 the catch has amounted to around 2,000 tonnes per year.

The large scale fishing, which is important from the economic point of view, includes private and commercial fishing. It is carried out mostly in Slovenia's territorial waters and partly in the international waters of the North Adriatic Sea (commercial fishing).

Private fishermen mostly posses small vessels. Therefore they mainly catch fish in the territorial sea. They use different fishing gear, such as stab and tangle nets, beach seines, purse seines, pots and longlines. Since the 1980s, they have also been using bottom trawls. With regard to the species the catch is diverse. Musky octopus (*Eledone moschata*), common cuttlefish (*Sepia officinalis*), whiting (*Merlangius merlangus*), common pandora (*Pagellus erythrinus*), dover sole (*Solea vulgaris*), flounder (*Pleuronectes flesus*) and other white fish species are caught in smaller quantities. In commercial fishing mostly seines had been used until 1978. They were gradually replaced by pelagic pair trawls and since 1991 the seines have no longer been used. Such fishing mostly focuses on pelagic species (99 %), while the share of demersal species (0.8 %) and cephalopods (0.2 %) is almost negligible. In the industrial catch of pelagic species the major share was taken up by sardine (*Sardina pilchardus*) in the last decade (1991-1999). It amounted to approximately 90 % of the total catch of marine fish in Slovenia in that period. In commercial fishing, sardine is a target species. Other smaller pelagic species such as anchovy (*Engraulis encrasicolus*), sprat (*Sprattus sprattus*), horse mackerel (*Trachurus spp.*), mackerel (*Scomber scombrus*) and chum mackerel (*Scomber japonicus*) are caught by pelagic trawl and are only a side catch.



Graph 45: *Total Slovenian marine catch from 1991 to 1999, catch of European sardine (Sardina pilchardus), and catch of other fish species in tones (Source: Marceta, 2000).*

According to the estimates (Marčeta, 2001), the share of commercial fishing in the total catch is 94 % and the share of private fishing 6 %. The share of sport fishing is unknown. More than 90 % of the marine fish catch, mostly small pelagic species, is processed. More commercially valuable fish like john dory (*Zeus faber*), dover sole (*Solea vulgaris*), bass (*Dicentrarchus labrax*), gilthead bream (*Sparus auratus*) and common pandora (*Pagellus erythrinus*) are sold on fish-markets and in restaurants around Slovenia.

A significant subsector of the marine fishing is mariculture, the growing of various fish and shellfish. Mariculture in Slovenia started with the growing of the Mediterranean mussel in Strunjanski zaliv and Piranski zaliv in 1980. The production of shellfish (*Mytilus galloprovincialis*) had been increasing until 1988, with the peak of 703 tonnes a year. When the export of the Mediterranean mussel to Italy stopped, the production fell and now it only meets the domestic demand. The result was the transformation of mariculture into a fish breeding facility. In 1991 the breeding of bass (*Dicentrarchus labrax*) and gilthead bream (*Sparus auratus*) began in the Gulf of Piran.

(Photo: Ciril Mlinar)

Figure 179. *Hippocampus guttatus, is a threatened species due to habitat alteration, as well as to selling dried animals as tourist souvenirs.*

year	1991	1992	1993	1994	1995	1996	1997	1998	1999
gilthead bream (*Sparus auratus*)	0.4	4.3	5.7	40.9	20.3	20.8	59.9	55.7	30.6
bass (*Dicentrarchus labrax*)	2.2	6.3	12.6	34.3	29.0	53.0	29.0	53.8	34.9
shellfish (*Mytilus galloprovincialis*)	65.3	140.1	42.7	27.5	12.8	50.4	36.6	44.0	35.0
total	**67.9**	**150.7**	**61.1**	**102.7**	**62.1**	**125.2**	**126.7**	**153.5**	**100.5**

Table 63: *Slovenian mariculture production in tonnes in the period 1991 - 1999 (Source: Marčeta, 2000)*

The studies of the marine fish fauna have always been closely related to the economic exploitation of the sea. Therefore, they have mainly focused on the fishing species. The main objectives of these studies have been research into the propagation, migrations and depth distribution of fish during the year and the estimates of the stock of pelagic species: sardine, sprat and anchovy; the research into the structure and dynamics of the populations of commercially exploited organisms in the Slovenian part of the Gulf of Trieste; and the accessibility of the benthic resources (Kubik and Štirn, 1975; Kubik, 1976; Štirn & Bolje, 1989; Bolje, 1992). Since 1995 the status of the fish stock in the Slovenian part of the Adriatic Sea has been monitored (Červek & Marčeta, 1995, 1997, Marčeta & Červek 1998, Marčeta & Ramšak, 1999).

Marine fishery and biodiversity

The occasional lack of oxygen in the benthic layer, the degradation of habitats and the overcatch are the main factors that threaten the populations of fish and other marine organisms. Among the most endangered Mediterranean species are the Mediterranean killfish (*Aphanius fasciatus*) and two species of seahorses (*Hippocampus hippocampus* and *Hippocampus guttatus*). The species are endangered because their habitats have been threatened and because the dried-out specimens are sold as tourist souvenirs.

While discussing the effects of marine fishing on species, the Slovenian part of the Adriatic Sea can not be separated from its other parts. Declines in the stocks of red mullet (*Mullus barbatus*) and hake (*Merluccius merluccius*) have been noted in the Adriatic Sea. Pursuant to the legislation, the use of trawling fishing gear (pelagic and benthic trawls) is prohibited. In exceptional cases the Ministry of the Agriculture, Forestry and Food issues permits for the use of such fishing gear. The collection of shellfish with dredgers - which literally plough the sea bottom - is strictly prohibited. The sporadic deaths of bottlenose dolphins (*Tursiops truncatus*) and sea turtles have been noted in the Adriatic Sea. The main reason is the tangling of animals into the fishing nets.

The Slovenian sea is divided into three protected areas: the Strunjan Nature Reserve, the Debeli Rtič Natural Monument and the cape Rt Madona Natural Monument. In order to meet the requirements of the European Union, the marine meadow of neptunegrass (*Posidonia oceanica*) will have to be protected.

Hunting

In Slovenia, 415 local hunting associations with 21,906 members (in the year 2000) manage 1.5 million ha of hunting grounds. The remaining 271,647 ha of hunting grounds are included in 11 breeding and hunting districts which have been given different status: some are managed by the Slovenian Forest Service, others by the local hunting associations, and some function as individual legal entities (including the Triglav National Park). Large hunting grounds, which employ management staff, were designated as game breeding grounds soon after their establishment. Their purpose is to conserve all game in the natural environment, both for breeding and for hunting. In the process of the establishment of these grounds, the size of the habitats of the main species had been taken into account in order to harmonise the interests of agriculture, hunting, forestry and other activities (water management) in the area. One of the activities carried out in the breeding and hunting districts is scientific research.

Table 64: *Comparison of the number of animals shot in the hunting season of 1990/91 and 2000/01 (Source: Lovska zveza Slovenije, 2000).*

species	year 1990/91	year 2000/01
brawn bear	41	45
roe deer	40,295	31,080
red deer	5,043	3,686
chamois	1,404	1,983
wild boar	3,641	5,068
pheasant	37,820	39,658
hare	9,388	2,135
mallard	11,080	6,164

Hunting and biodiversity

The hunting statistics show that the number of shot small game (brown hare *Lepus europeus*, mallard *Anas platyrhynchos*) decreased in the last decade. Brown bear (*Ursus arctos*) is being shot on the basis of the annual decision issued by the minister responsible for agriculture, forestry and food. The number of specimens to be shot is defined with regard to the estimates of the size of the population. Similar decisions are being issued for grey wolf (*Canis lupus*) and Eurasian lynx (*Lynx lynx*). In the last ten years, 9 wolves and 38 lynx were legally shot.

It is evident that hunting tourism is on the decline. The reason lies in the decreased number of small game and the lack of interest in this activity. Nowadays hunting tourism is oriented towards the hunting of hoofed game, for which the demand in the European market is higher than the supply. In the hunting season 1998/99, 5358 hunting tourists visited Slovenia's hunting grounds. Most of them were Slovenes (1,939), followed by Austrians (1,524), Italians (1,360), Germans (391) and others (144).

In order to guarantee the availability of the trophy specimens, in the past the hunters conserved certain endangered bird and mammal

year	pheasant	partridge	mallard
1969/70	48,809	2402	0
1970/71	37,070	1040	60
1971/72	74,694	1935	210
1972/73	54,749	1393	2794
1973/74	57,973	1869	1387
1974/75	44,919	985	5073
1975/76	38,331	2618	4527
1976/77	0	0	0
1977/78	55,781	170	2137
1978	56,093	100	2829
1979	53,795	50	3258
1980	41,419	0	2370
1981	51,449	0	3524
1982	39,790	0	2928
1983	35,042	1030	3531
1984	44,424	776	3398
1985	20,236	0	2482
1986	46,635	1491	2659
1987	36,074	2070	5363
1988	52,468	4143	6301
1989	56,128	3236	8859
1990	47,786	3791	7368
1991	46,929	4541	8275
1992	55,723	4317	5683
1993/94	62,101	7324	6026
1994/95	58,929	5740	8038
1995/96	56,880	5991	7078
1996/97	57,299	6725	5501
1997/98	62,317	5973	7962
1998/99	21,618	815	2289
1999/00	24,228	1452	2343

Table 65: *Repopulation of small game in the hunting districts of Slovenia from 1970 to 2000 (Source: Lovska zveza Slovenije, 2000)*

species. In the Medved Breeding and Hunting District in the Kočevje region and in the Jelen District in the Notranjska region the vital and stable population of brown bear has been preserved. In both districts wolf was protected in the mid-1970s. In 1993 this species was officially protected in the entire territory of Slovenia pursuant to the Decree on the protection of endangered animal species. Lynx had populated the territory of Slovenia until the mid 19th century. It was repopulated in 1973 in the Medved Breeding and Hunting District. The project is considered to be one of the most successful repopulations of lynx in Europe. In the breeding and hunting districts on the mountain range of Begunjščica the population of *Capra hircus ibex* has been maintained by repopulating the area with specimens introduced from abroad. A new colony has been established on Planjava and Brana in the Kamnik Alps. In the Julian Alps the repopulation of the Triglav Breeding and Hunting District with the *Capra hircus ibex* started in 1965. In addition, the breeding activities of hunters contributed to the expansion of red deer (*Cervus elaphus*), chamois (*Rupicapra rupicapra*) and small game.

In the period from 1963 to 1968, around 3,000 specimens of brown hare (*Lepus europeus*) from the Czech Republic and Vojvodina were released without any expertise. There were no expected results so the repopulation was stopped. The repopulation of grey partridge (*Perdix perdix*) has also been unsuccessful. Since common pheasant (*Phasianus colchicus*) can no longer be naturally bred in Slovenia the commercial introduction is used. This means that pheasants are introduced in the area during the hunting season. However, such introduction is being opposed by many. The repopulation of mallard has been successful because the total or partial protection has been enforced by the introduction of a shorter hunting season, the repopulation of specimens and planned management.

Trends

In the future the hunting organisations could orientate themselves towards the implementation of the tasks concerning the protection of wild animals and their habitats, the training of hunters, educating the young and the public, and participating in the research programmes. The economic effects of the game management should be secondary to the nature conservation objectives. The objective of hunting activities is no longer only care for game but also for its habitats. The old, deep-rooted misconceptions: that predators are harmful; that game should be managed in the same way as livestock; that large numbers of herbivore game should be maintained; that non-indigenous species should be introduced; and that it is only trophy hunting that counts - should be substituted by knowledge about these matters (Tarman, 1996).

Hunting in Slovenia is well organised and the hunters are well educated, so their contribution

(Photo: Dorotea Veršа)

Figure 180. *Due to uncontrolled and excessive gathering of mushrooms many species and their habitats are threatened.*

to the nature conservation efforts should be notable (Kryštufek; 2000). Already in the past, the hunters protected numerous species when their populations were endangered because of the excessive hunting or because their habitats had been threatened. Within the framework of their activities, hunters maintain pastures for game, create puddles, set up bait stations for bears and birds of prey and feeding facilities for deer, they fix nestboxes for birds nesting in hollows and set baits for the vaccination of foxes (Papež et al., 1996).

The intervention in an animal population and its habitat can affect the entire ecosystem. It is permitted to interfere (hunting, fishing) with the populations of animal species which constitute an indivisible part of an ecosystem, but such interventions should be planned on the basis of the analyses of the state of the ecosystem or biomic entities.

Gathering and picking

Gathering is among the activities which could adversely affect biodiversity. People pick fungi, fruit (blueberries, strawberries), medicinal plants (arnica, centiyane), decorative plants (*Rhododendron luteum, Pulsatilla grandis*) and some animal species (snails, frogs, molluscs, etc.). Some of these species are highly marketable. The analysis of the intensity of picking, the commercial use of the species and their impact on biodiversity has not yet been conducted, but the monitoring of the picking of protected fungi has been more systematic.

Fungi

Higher fungi (hereinafter referred to as fungi) should be discussed from various aspects. They represent a significant part of biota and at the same time they are interesting for people. Mushrooms are edible, but on the other hand some are poisonous. Certain species are valuable market goods which fetch high prices. Mushroom picking is a popular hobby among Slovenes. The tradition of picking and consuming wild fungi is kept up in other European countries and is well established in Eastern Europe, particularly in Italy and France. In recent years, mushroom picking has become popular in other countries where such a tradition had not existed in the past (Great Britain, Scandinavian countries). Mushroom picking is closely related to recreational activities and to the ancient motivation of a man as a gatherer, not hunter or farmer. Often this motive gives rise to the desire to know more about fungi, and the knowledge often surpasses the consumer or amateur level. Amateur mushroom pickers/mycologists are the basic source of knowledge about the taxonomy of fungi in Slovenia and around Europe.

The fact that mushroom picking is so popular in Slovenia, and that this natural resource is exploited for commercial purposes, has initiated the need to monitor and control the trade in mushrooms.

Pursuant to the Decree on the protection of wild fungi, the legal and natural persons who are registered mushroom purchasers have to keep a register of the species and quantities of purchased fungi (Table). It is difficult to talk about the increase or decrease in the commercial exploitation of fungi since the annual quantities depend on the 'mushroom season'.

The available data show that over 500 tonnes of mainly fresh wild fungi are purchased every year. The most popular fungi are of genus *Boletus, Armillaria* and *Cantharellus*. Nine more wild fungi species are being purchased in smaller quantities. Most of the purchases are carried out in September and October, since most mushrooms grow in autumn.

Excessive mushroom picking is one of the factors of potential threat to fungi in their natural environment. The taking of young mushrooms causes a disturbance in their development. The picking of edible mushrooms threatens also the inedible and even poisonous ones, because some pickers destroy them on purpose. The mechanism of the endangerment of fungi is explained in detail in the chapter on higher fungi.

Amateur mushroom pickers are organised in 20 registered associations, grouped within the Association of Mycological Societies of Slovenia. The objective of these societies is to educate the members about the conservation of the diversity of fungi and thus reduce the adverse effect of unlimited picking and exploitation of fungi as market goods. Many people who are interested in the picking of mushrooms, the experts and amateur mycologists, are members of the Association of Mycological Societies. Its potential in the field of education, mycological exhibitions and the implementation of programmes for the conservation of fungi has not yet been realised.

Trade in animal and plant species

Illegal trade, hunting, and habitat degradation, are the main reasons for the decline of populations of many animal and plant species all over the world. At the global level, the trade in endangered species exceeds US$ 40 billion per year. Every year 15 million mammals, 4 million birds, 10 million reptiles, 500 to 600 million fish, 200 tonnes of corals, 10 million orchids, and many other species are taken from the wild. In 2000, the Convention on International Trade in Endan-

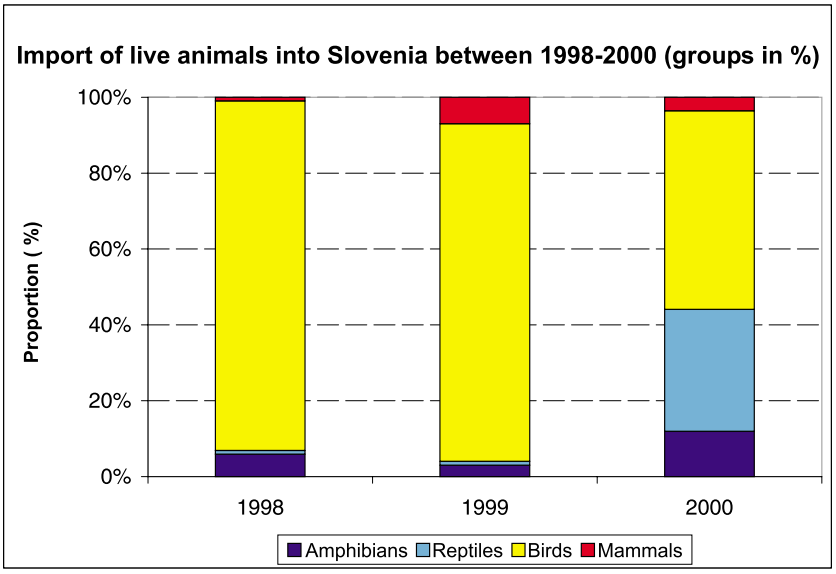
gered Species of Wild Fauna and Flora (CITES) (Official Gazette of the RS, 31/99) entered into force, which covers more than 30,000 species endangered because of the international trade.

It is estimated that approximately 1 million exotic animals are legally imported to Slovenia every year, more than half a million marine and freshwater fish, around 4000 birds, a few thousand reptiles, a few hundred mammals, a few hundred bird spiders and other invertebrates (aquatic organisms and corals). The number of imported animals is probably higher because some animals are imported illegally.

Beside a few hundred species of marine and freshwater fish, the Slovenian companies usually import reptiles and birds, in particular parrots. In the pet shops they mostly sell specimens of the following bird species bred in captivity: *Agapornis roseicollis, Melopsittacus undulatus, Nymphicus hollandicus, Platycerus eximius* and *Psittacus erithacus*, which are imported from Hungary and the Netherlands. Recently, these species are also being imported from the countries where they had been taken from the wild. In the period from 1998 to 2000, most large parrots of the genus *Ara, Amazona* and *Cacatua* were imported by the Ljubljana ZOO, only a few specimens were imported as personal or household effects, and by other traders for breeding.

In Slovenia the following reptile genera are most popular: *Iguana, Agama, Gekko* and *Varanus*. The specimens are usually taken from the wild (Madagascar, Solomon Islands, Egypt) even though they are listed in the international Red Lists of endangered species. The traders buy these species to sell them in the domestic and foreign market and to breed and sell the offspring. Mammals (reindeer, red deer) are imported for further breeding, for the entertainment establishments, educational purposes and for exhibition to the public (zoo's, tourist farms, circuses). In comparison to other animals, the import of mammals for commercial purposes is not very frequent. Almost all imported mammal species had been bred in captivity, usually in zoo's around Europe. Mammals are often not imported live, but as hunting trophies of animals shot in Africa (wart-hog, various antelopes and gazelles, wildebeeste, buffalos, zebras). With a few exceptions these species are not threatened by trade.

With regard to trade in plants included in the CITES Appendices, Slovenia only has the data of other Parties to the Convention which have included Slovenia in their annual reports on imports and exports of CITES species. Slovenia's Management Authority has not yet issued any CITES document for the import, export or re-export of any species included in Appendices to the Convention. This does not necessarily mean

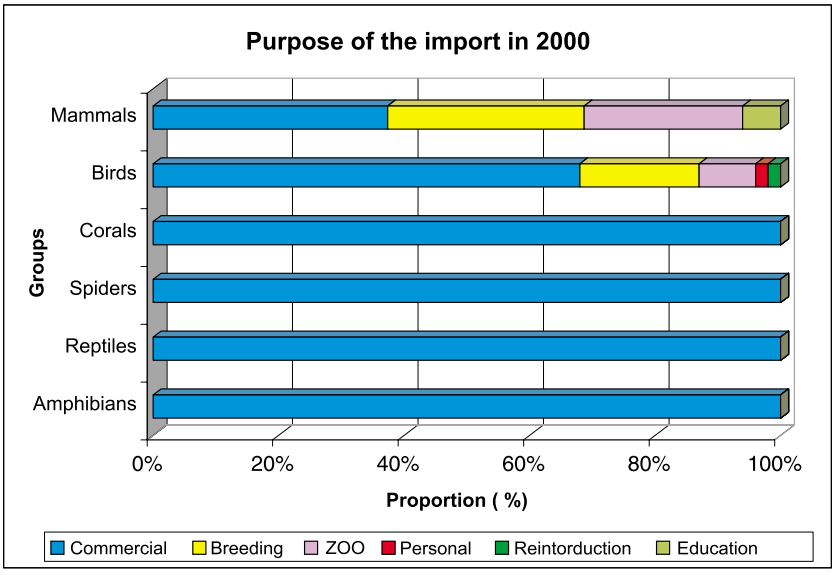


Graph 46: *Import to Slovenia between 1998 and 2000.*

that there is no trade in rare and endangered plants in Slovenia. On the contrary, almost every flower shop sells plants covered by CITES, such as various orchids, euphorbias, cycads, pitcher plants and cactuses. The majority of these plants have not been taken from the wild but have been artificially propagated in nurseries, and most probably legally imported into Slovenia. On the basis of indirect data on the export it can be concluded that 17,116 plants taken from the wild were imported from Turkey for commercial purposes in 1992-1994 and in 1999. The majority (67%) were snowdrops (*Galanthus spp.*) and cyclamens (*Cyclamen hederifolium*). Also for commercial purposes, 1,664 kg of the extract of wild growing *Prunus africana* were imported in the period from 1996 to 1998. All plants originated from Africa and Madagascar (95 %).

The import and breeding of the non-indigenous species represents an unpredictable threat to the natural environment of Slovenia. The survival of rare species is directly threatened by their being taken from the wild on various conti-

Graph 47: *The purpose of import of live animals in 2000.*



(Photo: Robert Boljesić)

Figure 181. *Endangered animal species for sale on a street in Barcelona.*

nentsyet, yet at the same time these poisonous and dangerous animals pose a threat to domestic wild fauna, domestic animals and even to humans. Animals which are intentionally released from the breeding farms, fish farms and similar facilities, or those which had escaped, directly compete for food and the living space with the indigenous animal species. In some cases even the gene pool of the indigenous species is threatened. The illegally imported animals which have not been examined by a veterinary, and for which the potential adverse effects on the indigenous animal species are not known, pose a threat with regard to the transferral of diseases and parasites to other animals and humans (zoonosis).

An example of the harm caused by the intentional release of non-indigenous species which threatens the existence of an indigenous species is the red-eared slider (*Trachemys scripta*). It populates many standing water in Slovenia and thus threatens the indigenous European pond turtle (*Emys orbicularis*). Therefore, the import of the red-eared slider to Slovenia, and to the EU countries, was prohibited in 1997. Animals of certain non-indigenous species, such as muskrat (*Ondatra zibethicus*) and racoon dog (*Nyctereutes procynoides*), which had escaped from breeding farms in other countries, have populated the territory of Slovenia. In the neighbouring countries, populations of eastern chipmunk (*Tamias striatus*) have appeared.

Many dealers, collectors, researchers and designers of nature protection plans are attracted to Slovenia due to its diverse and conserved flora and fauna. At the global level the demand for fire salamander (*Salamandra salamandra*), which is widespread in Slovenia, is rather exorbitant. Bird preparators, collectors of bird eggs and falconers are interested in various bird species. Among the collectors of invertebrate species the demand for cave animals (in particular for cave beetles) and butterflies is excessive. The interest of certain foreign research institutes and museums around the world in the karst endemic species *Proteus anguinus* should not be neglected. With regard to the reintroduction and repopulation projects, the brown bear (*Ursus arctos*) plays the main role.

Ministry of the Environment and Spatial Planning, Environmental Agency strives for the conservation of the indigenous fauna and for the protection of the globally endangered species by adopting international conventions and EU directives and regulations; by implementing the national legislation and by informing the public. To prevent illegal trade on endangered species, Environmental Agency successfully cooperates with various governmental offices (customs office, police, INTERPOL, inspections, etc.).

Water management

The introduction of the system of concessions has defined and harmonised in detail the conditions for the use of natural resources. That is reflected in the increased cost-efficiency of the utilisation of these resources and the better biodiversity conservation. According to the Environmental Protection Act, a natural or legal person is obliged to obtain a concession for the use and exploitation of water from watercourses, aquifers and sea, if the exploitation of water is registered as an activity or when water is a dominant component of the concessionaire's activity. The concessions are granted for the following activities:

- household drinking water supply;
- bottling of drinking water;
- exploitation of thermal, mineral or thermomineral water in the health sector or for recreational purposes (swimming pools);
- generation of electricity in hydroelectric power plants (small and large power plants);
- irrigation of agricultural land;
- breeding of freshwater and marine fish;
- artificial snow-making in ski centres;
- exploitation of sediments.

Biotechnology and biosafety

There are several laboratories in Slovenia which have been conducting basic research in the field of molecular biology for years, in particular the research on gene structures and their expression:

- the laboratory of molecular genetics of the Department of Biology at the Biotechnical

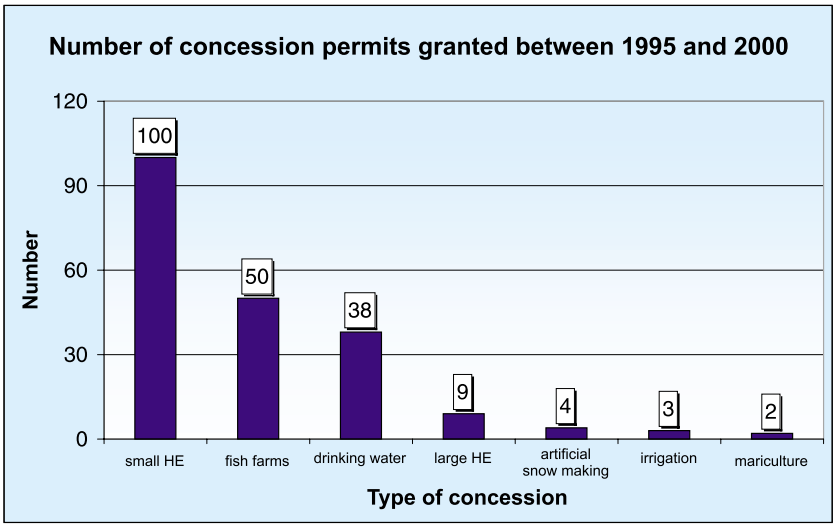
Faculty, which started with the gene research on bacteria in the 1970s;

- the Institute of Biochemistry at the Medical faculty, where the first bacterium gene was cloned and expressed in 1986;
- the Department of Biochemistry and Molecular Biology at the Jožef Stefan Institute where the first synthetic gene was designed and expressed. In these laboratories a number of microbe genes and genes of higher organisms have been cloned, thus facilitating the study of the relation between structure and function in many important proteins.

The Zootechnical Department at the Biotechnical Faculty is interested in animal biotechnology and the use of recombinant DNA in animals. The work is oriented towards the analysis of an animal genome, the production of molecular markers, gene-based diagnostics and research into the basic mechanisms regulating gene expression. Genome analysis is focused on discovering genes which affect the productivity of an animal (milk proteins, fat content, growth rate) and on characterising the domestic indigenous species and breeds (marble trout, Lipizzaner horse, Krško polje pig). Such activities will facilitate the planning of effective programmes for the conservation of these species and breeds. In the laboratories the methods necessary for the insertion of foreign genes in the heritable material of an animal are being introduced. The gene-based diagnostics of specific hereditary diseases of animals and of infections caused by microorganisms is an every day routine task. Similar diagnostic approaches are being introduced at the Veterinary Faculty in Ljubljana.

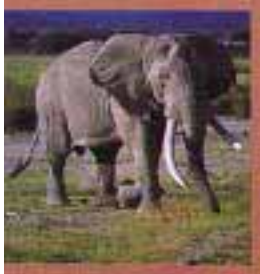
Basic genetic research into human hereditary diseases and disabilities, and genetic research for diagnostic purposes have been conducted at the Medical Faculty in Ljubljana since 1988. The activities include research on genes and mutations of 8 to 10 genetic diseases or gene malfunctions. The procedures comprise the following: clinical and prenatal diagnostics of certain monogenetic diseases, such as cistic fibrosis, hemophilia A and some muscular distrophies; diagnostics of limfoms; determination of the presence of infection agents (AIDS virus, hepathitis B); DNA typization for tissue transplantation, and for personal identification in forensic medicine and criminology.

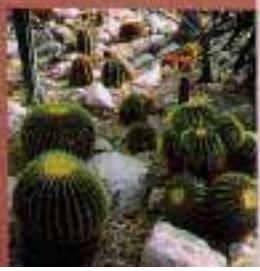
Slovenia has not yet been directly or indirectly threatened by the GMOs. All the relevant activities are focused on the scientific research in containment. Slovenia should be aware not only of the globalization processes in science and economy, but also of the fact that the country is not a closed system and is therefore exposed to the influences from the neighbouring countries.



Graph 48: *Number of concession permits granted between 1995 and 2000.*

Mednarodna trgovina z ogroženimi vrstami





Živalske in rastlinske vrste so ogrožene predvsem zaradi izginjanja njihovih življenjskih prostorov in trgovanja z njimi, kar lahko pripelje celo do njihovega izginotja. Eksotične živali in rastline privabljajo kupce s svojo nenavadno in enkratno obliko ali preprosto zato, ker so redke. Na leto je iz narave odvzetih okrog 40.000 opic, 15 milijonov drugih sesalcev, 4 milijone ptic, 10 milijonov plazilcev in orhidej ter mnoge druge živalske in rastlinske vrste, ki se nato prodajajo na vse konce sveta.

CITES

Kaj je CITES?

CITES je angleška okrajšava za Konvencijo o mednarodni trgovini z ogroženimi prostoživečimi živalskimi in rastlinskimi vrstami (Convention on International Trade in Endangered Species of Wild Fauna and Flora), znana tudi kot Washingtonska konvencija. Zajema več kot 30.000 živalskih in rastlinskih vrst, ki jih ogroža mednarodna trgovina.

Kaj je osebek CITES?

Katera koli živa ali mrtva žival ali rastlina, ki je obravnava konvencija CITES, ter vsak prepoznaven del ali izdelek iz njih.

Kaj je osnovno načelo CITES?

Za vsak osebek CITES potrebujemo dokument CITES.

Kako lahko prispevate k ohranjanju ogroženih vrst?

Ne kupujte eksotičnih živali in rastlin, izdelkov iz njih in turističnih spominkov iz njihovih delov. Mogoče pripadajo prav eni izmed ogroženih vrst. Pozorni bodite pred nakupom kož in izdelkov iz velikih mačk, kitov, tjulnjev, krokodilov, aligatorjev in velikih kač, izdelkov tradicionalne orientalske medicine, ki vsebujejo nosorogov rog, medvedji žolč, mošus ipd., kaviarja, izdelkov iz slonovine, želvovine in koral, izdelkov iz ebenovine, mahagonija, iz narave vzetih kaktusov, orhidej, mesojedih rastlin itd.

Na potovanje se odpravimo s fotoaparatom in beležko, domov prinesimo le spomine v obliki fotografij in vtisov.

Kaj se nam lahko zgodi, če ob prestopu državne meje nimamo dokumenta CITES?

Carinski uslužbenci lahko ob odkritju pošiljke z ogroženimi vrstami na vseh mednarodnih mejnih prehodih zasežejo kateri koli osebek CITES (npr. torbico iz krokodilje kože). Sledi visoka denarna kazen, kršitelj pa mora poravnati še vse stroške postopka, npr. oskrbe živih živali ali rastlin in transport pošiljke nazaj v državo izvoznico. Marsikje v svetu enačijo nelegalno trgovino z ogroženimi vrstami s tihotapljenjem mamil ali orožja.

Kaj moramo storiti pred nakupom rastlin in živali v tujini?

Pred potovanjem ali nakupom se posvetujmo s strokovnjaki Agencije RS za okolje, ki nam bodo dali napotke in svetovali, kako pridobiti ustrezne dokumente. Dobimo jih na:

Agenciji RS za okolje, Sektorju za ohranjanje narave
Vojkova ulica 1b, Ljubljana
telefon +386 (0)1 478 00 00

IMPLEMENTATION OF THE PRINCIPLES OF SUSTAINABILITY THROUGH STRUCTURAL ECONOMIC REFORMS

The principle objective of the macro-economic policy in the field of economic development is the maintenance of stable economic conditions for the conclusion of the process of market transition and accession to the European Union by continuous growth of added value (4-6 % growth in GDP). The most important goal of the micro-economic policy are the reforms oriented towards the increase of competitiveness on the European single market. In the field of economic structural reforms which directly affect biodiversity the reform of the enterprise sector, in particular agriculture, the state and regional development should be carried out. These are the priority development fields according to the SEDS06 and the National Development Programme.

(Photo: Peter Skoberne)

Figure 182. *Tradition and skills are needed to make a lace pattern. In the same way, linkage and cooperation at local, regional and national levels are vital for sustainable development.*

ENTERPRISE SECTOR

In order to guarantee sustainable economic development the following key structural reforms will have to be implemented for the transformation of the enterprise sector: privatisation, entering/exiting of sectors, establishment of an undiscriminatory state aid system and incentives for innovations.

Company privatisation and restructuring

Companies may be divided into three groups (Simoneti, Rojec, Rems, 2000):

- concentrated ownership companies (foreign, private, daughter), which have been established as private;
- dispersed ownership companies (public companies with the majority stake held by institutional owners and non-public companies with the majority stake held by internal owners) which have been privatised; and
- non-privatised companies.

The concentrated ownership companies are much more successful than other companies. With regard to the investments and employment these companies have achieved higher growth, and the differences are increasing for the capital profitability, value added per employee, value added, number of employees and assets. The dispersed ownership companies have been increasing their level of success but at the expense of defensive restructuring and at a slow pace. The non-privatised companies still generate losses but the trend is slowing down. With regard to the

operating cash flow and the value added per employee positive trends have been recorded.

In order to improve the level of competitiveness the following should be done:

- conclude the transitional restructuring of the enterprise sector by consolidating the ownership;
- solve the issue of companies with operating losses and no future;
- create conditions for the fast development of competitive enterprise sector, in particular by enabling the domestic and foreign companies more rapidly to enter the market, nullifying the administrative obstacles for investments; stimulating the internationalisation of the economy; stimulating the development of small and medium-sized enterprises.

Bankruptcy legislation

The relevant bankruptcy legislation and the effective implementation of bankruptcy procedures are the two mechanisms for regulating the entering into or exiting from the market of unsuccessful companies and for their restructuring. In Slovenia this field is regulated in accordance with the modern directions concerning the restructuring of unsuccessful companies, thus protecting the rights of creditors, owners and employees.

In the future, the further training of official receivers will be necessary. They will have to be familiar with the legalities of the bankruptcy procedure, the operating procedure, the finances and the financial statements. The bankruptcy procedures, formally conducted by the courts, should be sped up together with the reduction of other court backlogs.

(Photo: Peter Skoberne)

Figure 183. *A fence typical of the Topla valley is made of wood off-cuts.*

State aid

State aid is an instrument of macro-economic redistribution of financial resources to specific companies and groups of companies. Such redistribution causes distortion of the market and is thus strictly regulated.

In Slovenia the share of state aid in the GDP is higher than in the EU countries. The reason is that in Slovenia the value added per employee is several times lower than in the EU. Without taking into account the municipal level and agriculture and fisheries, the share of state aid in the GDP was 2 % in 1998 and - 1.7 % in 1999 and the annual average in 1996-98 was 1.12 % GDP (without taking into account the agriculture and fisheries).

The state aid used to function as a mechanism for solving social-related issues in big unsuccessful companies and its purpose was to cover regular operation costs. To a lesser extent it was used for promoting development related activities (research and development, environmental protection, training, etc.).

Regional aid is a category of less restricted aids, but the inadequate regional policy in Slovenia has to a great extent prevented its allocation.

Transition to the innovation based economy

According to the estimates of the International Institute for Management Development (IMD) for 1998, Slovenia is ranked among the first half of the developed countries (close to Ireland) with regard to the share of GDP intended for research and development (RD) (1. 48 %) and to the number of employees in R&D per 1,000 (4,15). In the IMD Report for 2000, Ireland is ranked 17th with regard to the Science and Technology criteria which assess the innovativeness of a country. However, Slovenia is ranked 40th. It is evident that researchers and finances do not guarantee the regeneration of Slovenian companies in view of application of innovations.

The obstacles which innovativeness faces in Slovenia are primarily the insufficient R&D staff, the excessive costs of prototypes, the financially demanding cooperation with the institutes and the university, and the distrust and hindrances in relation to the cooperation of companies in a consortium. The explanations for such low efficiency of the transformation of financial inputs into successful innovations lie in the analysis of the components of these criteria which show that Slovenia lags behind in the impact of the basic research on long term economic and technologi-

cal development (ranked 43rd), the suitability of the system of mandatory education (44th), and the interest of youth in science and technology (47th). In the short term Slovenia could improve the management of technology, in particular by technological cooperation (now ranked 32nd), the transfer of R&D from university to companies (45th), as well as by limiting the lack of funds allocated to development (34th), improving the application of technologies (36th) and limiting the danger of reallocating R&D units (44th).

STATE SECTOR

The developmental processes in the operation of the state have been restricted by globalization and by the market founded independence of other autonomous social actors. So far, the progress in this field has been minimal. The main unsolved issues, which hinder the developmental success of the state, are:

1. Inadequate management organisation. Hierarchical organisation prevails; the efficiency criteria do not play an important role in management; no motivational mechanisms for human resource management are available; the opinions of the users of administrative services are not acquired systematically.
2. The solutions for the long term harmonisation of policy measures have not yet been found. In 1993 the Government adopted a planning programme which provided for four-year budgetary projections and the drawing-up of sectoral regional programmes, the spatial plan and the Strategy of Economic Development of Slovenia (SGRS). Since the planning programme did not provide a binding long-term harmonisation of the decisions concerning public finance, we now have numerous sectoral development documents which generally have the status of an act, but it is impossible to realise them within the framework of realistic public finance allocation. The problem of non-harmonisation had been 'solved' by the negotiations on the budget appropriations, and thus the substantive issues concerning the allocation of funds were not considered important and have not been taken into account.

   In such circumstances, when the technical and financial arguments had prevailed in the allocation of budgetary funds, the "soft" and unconventional sectors of economic development - whose budgetary proposals were not technically supported - lost most. The Strategy of Economic Development defines this as an implementation deficit. It has been established that the implementation deficit is one of the structural factors of (non)development which has extremely asymmetric effects.

   The regulations in the field of public finance, adopted in the last two years, incorporated the principles of the programme planning and the planning documents in the system for the preparation of the current budget. This reduced the significance of the budgetary negotiations and emphasised the substantive arguments. The annual budget represents only a part of the entire economic and developmental policy since many state measures do not have direct impact on the budget, or else their impact is less important than their economic and developmental consequences. Even after the reform of the public finances the decisions about the distribution of budgetary funds for different purposes can not be taken on the basis of the fiscal criteria. The impacts on all development actors should be taken into account, not only the impact on the state budget.
3. The centralisation and over-concentration of the responsibilities and tasks in public administration. The state often directly manages the companies in the field of public services and the economy, even though the operators could be more effective if they had been autonomous. The institutes of the developmental partnership with the civil society, the economy and regions are too weak to exploit all the available developmental potentials.

All the mentioned issues form the reasons for the reform of public administration and public services.

Public administration reform

The European Commission, which monitors the progress in the administrative institution building, considers that the reform of public administration has not been successful since the basic acts concerning the Government, administration, public agencies, inspections and civil servants have not yet been adopted. As a result the priority development directions have not been implemented and the new fields and sectors of public administration suffer the implementation deficit.

Public utilities reform

In principle the State's involvement in the economy should be limited. In the market eco-

nomy, competitiveness and thus self-regulation of the market should be ensured. The analyses of the economic status show that the market structure in Slovenia is defective.

The two main instruments of the reform are the regulatory roundup and privatisation. The companies operating in the field of water management, the generation and distribution of electricity and road construction have been partly privatised. In their case the relevant capital injections have been transferred to investment firms.

Energy sector

The main burdens from the past faced by the energy sector are the high energy intensity of the economy and the high level of dependency on the import of oil and natural gas. Domestic facilities for the storage of oil and natural gas are not sufficient. The issue of stranded investments in the energy sector can only be addressed by substantial redistribution of prices.

The implementation of the Energy Act will bring substantial change in the field of energy. This field is managed as a public service and it comprises the distribution of electricity and gas. The generation of electricity is considered to be a market-oriented activity and the electricity market has already been liberalised for domestic producers. In 2003 it will be liberalised for foreign companies. With the designation of the status of unauthorised consumers to all who consume more than 41 kW of electricity, around 64 % of the supply will be competition-based and the consumers will have unrestricted access to the network.

It is expected that the unfavourable composition of the electricity resources will increase the share of stranded investments (Šoštanj, Trbovlje) and thus induce higher prices for unjustified consumers. In compliance with the EU regulation the market will be opened for the purchase of natural gas in 2003. The control over the energy sector is carried out by a special supervision body - the Energy Agency. This Agency will be responsible for determining the prices of electricity and gas, the utilisation of the network and the supervision of the operation of this economic sector.

Telecommunications

With more than 40 telephone main lines per 100 inhabitants Slovenia has reached a relatively high level of penetration, but the quality of services lags behind the developed countries.

Except for the mandatory public service for the transmission and emission of the radio and television programmes (RTVS), the telecommunication services, which are based on the use of the radio frequency spectrum, have been liberalised. The frequencies for such services are being allocated on the basis of concessions (licenses).

(Photo: Marko Simić)

Figure 184. *Mount Nanos. Telecommunication towers are a disturbing element in a natural landscape, and can cause additional problems when erected in a botanically important area.*

With the adoption of the Telecommunications Act, the foundations for the liberalisation of the telecommunications sector have been set up. At the same time these services have lost the status of a public service. The sector will be regulated by an independent agency with an administrative, technical and financial autonomy.

Transport

The completion of the construction of the motorway network has been the principle investment project in recent years. The project had been based on the fact that transport flow has been mostly concentrated on the roads. As a consequence, the transport safety in Slovenia is inadequate and the burden on the environment is difficult to control. The reasons for the economically insufficient utilisation of the railway system are of an economic and political nature, but the geography of Slovenia and the technological characteristics of the rail transport also contribute to the problem.

In the last decade progress has been made with regard to the reform and commercialisation of the transport sector. The liberalisation of road transport is reflected in the increased number of small-scale transport operators which caused an

imbalance between the demand and supply in the market of transport services and thus forced the operators to orientate towards international transport, in particular to freight transport. The railway transport services are provided by a public undertaking. Despite the staff reductions and the rationalisation of other operating costs the sector is still greatly dependent on the transfer of budgetary funds. The state budget provides funds for the passenger and combined transport subventions, and funds for the maintenance and construction of infrastructure.

In compliance with the EU guidelines, the reorganisation of the Slovenian Railway Company is planned. This undertaking will most probably remain united, although two separate companies will operate within it - one in the field of infrastructure and the other in the field of transport.

Public utility sector

Of all the infrastructure sectors, public utility has recorded the highest surplus of the needed investments with regard to the realised investments: at the beginning of the decade, the needs surpassed the executed investments by 4.5 times, which clearly shows that the public utility sector was under-invested in the past. The reasons are of a systemic nature:

The construction of the public utility infrastructure (waste water treatment, waste, gas, district heating) and the provision of public services fall under the responsibility of a local community and state (dual responsibility). Although at first all the responsibilities were to be transferred to the local level, the actual systemic solutions concerning the financing of local communities do not guarantee the provision of sufficient funds for the implementation of the plan. Many local communities are too small to manage the public utility sector successfully and they lack technical knowledge.

The responsibility for fixing the prices of services has been transferred to the local communities and as a result the prices differ significantly. These differences could induce the re-centralisation of the regulation system, which would support competition in the public utility services.

AGRICULTURE

The two reforms that affect the development of the sector are the implementation of the new Rural Development Strategy and the restitution of the agricultural land and forests within the denationalisation reform.

In order to meet the objectives of the agricultural structural policy and the development policy, three sets of measures have to be implemented:

- improvement of the structure of agricultural land;
- modernisation and adaptation to progress of the food processing industry;
- integrated rural development.

In order to fulfil these tasks the state has acquired pre-accession aid for rural development - SAPARD.

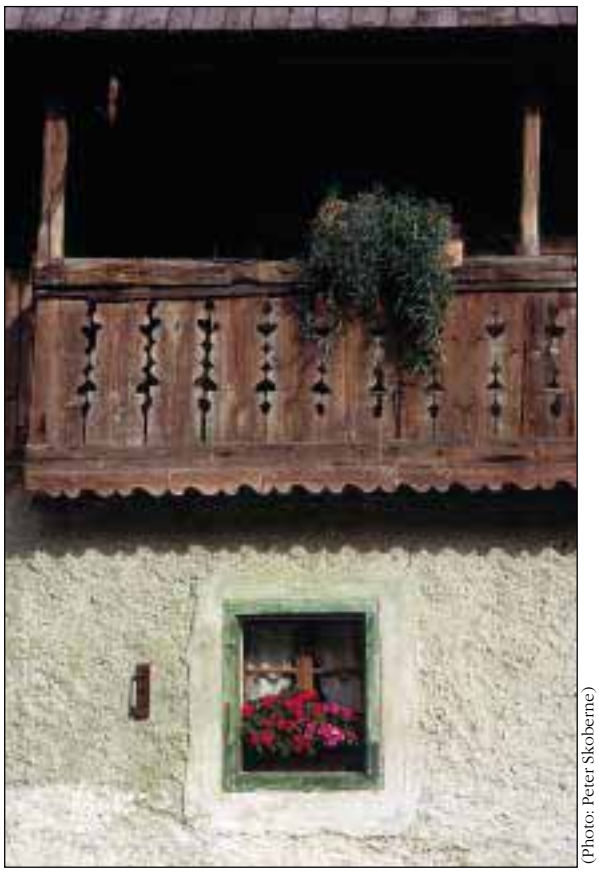
In 2001 the trial implementation of the second pillar of the agricultural reform - the agri-environmental programme started. Its purpose is to maintain agricultural activities and to popularise sustainable agricultural production which conserves biodiversity and protects the landscape while the rural area is developed. The agri-environmental programme is extremely important, in particular from the point of view of the low intensity of agricultural production. The comparative advantages of Slovenian agriculture lie in the intensification of agricultural production. Therefore, the implementation of the programme should be strengthened in the future.

The restitution of agricultural land and forests is currently under way: in the first half of 2000 in total 38,000 denationalisation requests were submitted for 127,000 ha of agricultural land and 167,000 ha of forests. The decisions on 44 % of agricultural land and 62 % of forest land have already been issued. According to these decisions 86 % of the considered agricultural land and 92 % of the considered forest land have been restituted.

REGIONAL DEVELOPMENT

The main goal of the regional policy is to reduce the differences between regions with regard to their economic development. The development potentials of the regions should be improved, in particular those which are directly related to the local development actors. The most significant are the differences in the demographic conditions, human resources, economic structure and the success of local companies, the availability of infrastructure, environmental problems and various developmental problems. The differences are also reflected in the irregular distribution of new undertakings. Growing differences in the rate of development are often the result of the unexploitation of the endogenous developmental potentials of specific regions.

Furthermore, the natural resources are also unevenly distributed. There are no rich and various natural resources available in Slovenia. Of fossil fuels only the low-quality coal deposits can be exploited. Important renewable resources are



(Photo: Peter Skoberne)

Figure 185. *Aesthetic harmony is part of everyday life, and a reflection of our balanced relation with nature.*

water and biomass, in particular wood. However, Slovenia is rich in environmental services which arise from high biodiversity and thus in the diverse land use and the utilisation of natural wealth.

Forests cover more than a half of Slovenia's territory. Agricultural land covers nearly 40 % and around 7 % is taken up by urban areas and infertile land. In the recent years the land use categories have been subject to many changes. and the conflict of interests concerning the land use categories and the degradation of the environment has escalated. The destruction of the traditional way of life poses a serious threat to the efforts for the wise land use and for the protection of the natural resources and the natural and cultural heritage. The most serious problems are caused by lavish use of the natural resources, the pollution of (drinking) water and air, the degradation of cultural landscape and the increased pressure on the architectural heritage and nature. The consequence is the loss of biodiversity.

In Slovenia the 'urban-industrial' type of regional development is enforced. Urbanised industrial areas cover one third of the territory, and there four fifths of the population live. This type of regional development is defined by the imbalanced spatial distribution of infrastructure and the structural disproportions between centres and their hinterland. That is evident in the every day mass migrations which incur negative external costs. Illegal building is an example of the increased pressure on the rural hinterland and high quality landscape with regard to the urbanisation. In the areas between settlements, dispersed urbanisation is taking over. Its main feature is the excessive land use , the undefined settlement pattern and the disturbed landscape which are all the result of the deficient regional organisation and spatial planning. The recent polycentric development has emphasised the importance of municipal centres, which in turn led to the duplication of activities and excessive land consumption. A tendency toward the establishment of new municipalities is apparent. It is promoted by the current system of financing, but in fact the establishment of municipalities, which are financially independent of the state and act on their own initiative, should be advanced.

On the other hand the traditional 'rural-agricultural' type of regional development, which is dominant with regard to the total surface area, only moderately contributes to the number of population in total as well as to the creation of its welfare. From the development standpoint these are problem areas where there are not enough jobs available and the educational level of the active population is low. These are large undivided areas where the emigration processes are distinctive and long lasting. Slovenia is a rather small country and the development problems arising from the current regional differences are

(Photo: Marko Simić)

Figure 186. *Valuing life in figures is impossible, whether for a bird or any other living being. The problem is that we become aware of that value only when it is lost.*

emphasised by the fact that border areas where the development lags behind cover a rather large share of the territory; besides, it has been some time since agriculture in rural areas played a decisive role in Slovenia's economy. It is more and more dependent on the nearby urban core where jobs can be found. In the future it will be necessary to protect the environment of a significant proportion of the national territory (30 % instead of 5 %) which has been economically utilised until now. However, the establishment of protected areas should be economically justified so that the expenses of the protection of the natural resources and valuable natural features would not be covered by the slowing down of the development of municipalities. The economically justified protection of the natural resources and valuable natural features is the best guarantee for their conservation.

In the EU the development policy is realised through the incentives for harmonised regional development and since Slovenia is in the process of accession to that union, such a policy will have to be adopted. The regions functioning as development actors have long been neglected even though the polycentric development has been the main direction of Slovenia's regional policy for decades. In order to make changes concerning the stimulating of regional development, three reforms have to be carried out: designation of regions and local administration units; spatial planning; regional policy.

Designation of regions and local administration units

Currently, the Constitution of the Republic of Slovenia is being amended and as a result it will be possible for the National Assembly to adopt a Framework Regions Act. By this act the foundations for the designation of regions as local governmental units will be set up. There are different internal and external reasons for the establishment of regions functioning as mandatory local communities. The most meaningful reason is the widening gap in the level of development in various parts of Slovenia which causes the marginalization of a large share of the territory. The institute of region should be placed between the level of small municipalities and the State and thus mitigate the position which the State holds in relation to the weak municipalities. The regions will take over the matters which can not be transferred from the state level to the level of (too) small municipalities. At the same time the State will be decentralised and the principle of subsidiarity enforced. The preservation of the specific features of development in certain region, and thus the diversity of the state, would benefit from the decentralisation and deconcentration of public decision-making in matters which would more successfully and/or rationally be solved at a lower administrative level.

Spatial planning

Slovenia is a small, transitional and extensively inhabited country where spatial component is a more decisive development factor than in large counties, in particular because of its outstanding biodiversity and value. In the field of spatial planning many issues have been raised in the last decade; the balance of means allocated to new municipalities has not been settled; the urbanistic documentation on permitted land use is obsolete; tax incentives are not available because the costs of the supply of utility services are incorporated in the market prices of the real-estate instead of being partially converted into higher util-

Figure 187 (below). *The Divje jezero (Wild Lake) in the commune of Idrija has been protected for its natural values since 1967.*

Figure 188 (bottom). *Goričko (NE Slovenia). Regional development is based on natural characteristics, considered also in a proposal for the establishment of a landscape park.*

(Photo: Marko Simič)

(Photo: Peter Skoberne)

ity services prices through financing with local bonds intended for the construction of the infrastructure; etc. Consequently, the prices of the real-estate are high and the relevant market is paralysed. There is a lack of furnished sites intended for the construction of industrial complexes and there are no direct (foreign) investments in the industrial sector. In general, the space is not a highly valued feature, in spite of its scarceness, diversity and the transitional nature of the country.

Regional policy

The Regional Development Agency is the central institution responsible for the implementation of the programmes for stimulating harmonised regional development. Slovenia has been granted economic and social cohesion funds within the PHARE programme for three pilot (statistical) regions: Pomurje, the Savinja region and Zasavje. Within the PHARE progra-mme a number of joint transboundary development programmes are being carried out.

ORGANISATION OF THE BIODIVERSITY CONSERVATION

At the national level the nature and biodiversity conservation is the responsibility of the National Assembly, the Government, the Ministry of the Environment and Spatial Planning, the Environmental Agency, the Institute for Nature Conservation and its organisational units which operate in seven regional institutes for the protection of the natural and cultural heritage and in the institutes responsible for the management of protected areas established by the state. In total 139 civil servants employed at various administrative and technical organisations are professionally involved in the nature conservation at the governmental level. The implementation of the Nature Conservation Act is directly supervised by 8 inspectors.

NATIONAL ASSEMBLY OF THE REPUBLIC OF SLOVENIA

The National Assembly adopts the laws, programmes and other documents which are important for the biodiversity conservation.

Pursuant to the Environmental Protection Act it has established the Council for Environmental Protection whose tasks concern the biodiversity conservation. The Council is a civil society institution and it deals with the protection of the environment and nature.

The Committee for Infrastructure and the Environment is, as a working body of the National Assembly, responsible for the preliminary reading of the material covering the field of nature conservation and thus biodiversity as well.

GOVERNMENT OF THE REPUBLIC OF SLOVENIA

Pursuant to the adopted legislation and in compliance with the national policy and programme decisions the Government adopts the executive regulations and directs and harmonises the implementation of policy decisions through the competent ministry. In 1997 the Government established the Council for Sustainable Development whose tasks also include the nature conservation issues.

Ministry of the Environment and Spatial Planning

Nature conservation is the responsibility of the Ministry of the Environment and Spatial Planning. The Nature Conservation Department within the Ministry formulates decisions, implements the nature conservation policy and harmonises the intersectoral projects and strategies which have an impact on the nature conservation (7 employees).

Administrative and technical organisations

The Environmental Agency is a body within the Ministry of the Environment and Spatial Planning and it implements the technical and administrative tasks concerning nature conservation and the protection of valuable natural features in compliance with the provisions of the Nature Conservation Act. Pursuant to this Act the Institute for Nature Conservation has been established. As a technical organisation it is responsible for the implementation of the legally determined tasks which are carried out as a nature conservation public service. These tasks are in part carried out by seven organisational units involved in the nature conservation within the regional institutes for the protection of the natural and cultural heritage. The reason lies in the fact

that the established institute has not yet begun functioning. The nature conservation public service is performed by the managers of protected areas. Beside them, another three public institutes and one concessionaire perform these tasks in compliance with the legislation, and one contract on the stewardship of a protected area has been concluded.

Environmental Agency of the Republic of Slovenia

The Environmental Agency is a body within the Ministry of the Environment and Spatial Planning. It covers various working areas of the ministry (nature conservation, environmental protection, water management, hydrology, meteorology, monitoring of the state of the environment, geophysics, rehabilitation). Specific work areas are organised in five offices and this guarantees the harmonised operation of various sectors.

The Nature Conservation Department is a constituent part of the Office for the Environment which is one of the 5 offices mentioned. Its tasks are to keep nature conservation registers; issue permits and consents with regard to nature conservation; draw up proposals of programmes and measures for nature conservation; monitor the state of valuable natural features; carry out expert tasks with regard to the international obligations concerning nature conservation; supervise the work of public services related to nature conservation; perform tasks concerning the establishment of protected areas; keep records concerning nature conservation control and records of real-estate located in protected areas which are the property of the State; provide training courses for civil servants employed in the field of nature conservation; carry out procedures for asserting the right of pre-emption in protected areas, and to decide on the amount of compensations. There are 21 civil servants employed in the field of nature conservation which is 5.3 % of all the Agency's staff.

(Photo: Marko Simič)

Figure 189. *Information Centre of the Triglav National Park at Log in Trenta. Information and education centres in protected areas are playing a crucial role in the conservation of natural values and in raising public awareness.*

Nature Conservation Institute of the Republic of Slovenia

The Nature Conservation Institute performs the nature conservation tasks stipulated by the law which are mainly of a technical nature. The Institute has been conferred powers to issue environmental protection consents and guidelines, to keep the register of valuable natural features and the records and data bases in compliance with the law, to guarantee the uniformity of methods and procedures, to implement the technical supervision and direct control of the designated areas and to grant consents in the procedure for obtaining consent for legal transactions on the real-estate located in protected areas. Until the official start of the operation of the Institute, these tasks are performed by the nature conservation units of the regional institutes for the conservation of the natural and cultural heritage. Currently 40 experts are employed at these institutes. In compliance with the new legislation these public services are planned to be reorganised.

Management institutes

Large protected areas are usually managed by public institutes. However, for their management a concession may be granted or a contract concluded. By 2001 three management institutes had been established (the Triglav National Park, the Škocjanske jame Regional Park and the Kozjansko Regional Park), and one concession granted (the Škocjanski zatok Nature Reserve). These three public institutes have 71 employees. The manager of the protected area carries out the management, protection, technical and control tasks in the protected area. Beside the mentioned tasks he/she also draws up a management plan proposal, cooperates with local communities, and manages real-estate located in the protected area, if stipulated by the instrument of protection; guarantees the protection of valuable natural features; presents the protected area and carries out other tasks in compliance with the Nature Conservation Act, the document on protection, the document on the establishment of a public institute, the document on the granting of a concession or the concession contract.

Stewardship of valuable natural features

On the basis of a public tender the steward of the Sečoveljske soline Landscape Park has been

selected. The protection of this valuable natural feature has been ensured with the concussion of a stewardship contract and money for 6 employees has been allocated.

Control

Inspection

Environmental inspection

Inspection of the implementation of the provisions of the Nature Conservation Act is carried out by the inspectors responsible for the nature conservation at the Inspectorate for the Environmental and Spatial Planning. If the provisions concern the competencies of other ministries their implementation is supervised by the competent inspectors. Special authorisations have been granted to the customs authorities. With regard to the stipulated measures concerning the import, export and transit of plants and animals and other goods these authorities may order the seizure of animals when they are treated contrary to the stipulated regulations; the seizure of plants and the handing-over of these plants or their sale; and the seizure of other goods when they are treated contrary to the regulations. They may inform the competent inspector and store the goods and propose the institution of proceedings and impose a mandated penalty pursuant to the Nature Conservation Act.

In compliance with this Act the Inspectorate for the Environment and Spatial Planning is responsible for the inspection of the entire nature conservation sector. Other inspectorates are authorised to inspect the specific working areas. At the Inspectorate 23 inspectors are employed. They supervise the implementation of the Nature Conservation Act and the regulations issued pursuant to it. It is planned that 8 inspectors will be additionally trained. The actual specialisation of the staff requires supplementary education and training programmes which cover specific nature conservation fields. So far, the Inspectorate has not carried out a systematic control but it responds to the reports and participates in joint campaigns. The inspection data are annually discussed in reports but the specific data on nature have not yet been statistically processed.

The implementation of the provisions of the *Act Regulating Urban Planning and Other Forms of Land Use* and other spatial planning acts is supervised by the inspectors responsible for spatial planning who are employed at the Inspectorate for the Environment and Spatial Planning. When an urban inspector establishes pollution of, damage to or degradation of the environment, a risk to the environment or damage caused to the valuable natural features and cultural heritage which had occurred during the construction activities or any other activities carried out without a location permit being granted, or contrary to other stipulated conditions, he/she informs the competent body of the situation.

Inspection in the field of agriculture, forestry, fisheries and hunting

The Inspectorate for Agriculture, Forestry, Hunting and Fisheries is a body within the Ministry of Agriculture, Forestry and Food. The agriculture, phytosanitary, forestry, hunting and fisheries inspection is carried out within the Inspectorate.

The implementation of the provisions of the *Agriculture Act* is supervised by the agriculture inspectors. However, the implementation of the provisions on the control of the production of and trade in agricultural products and on the customs procedure for the export of agricultural products and specific foodstuffs is supervised by inspectors responsible for control of the quality of agricultural products and foodstuffs.

The implementation of the provisions of the *Agricultural Land Act* is supervised by the agriculture inspectors, except for the provisions on forests which are supervised by the forest inspectors.

The enforcement of the *Seeds and Propagating Materials Act* is supervised by the agriculture inspectorate which also controls the quality of seeds and propagating material (objects and other material needed for the production). When the forest seeds and propagating material are concerned the control is carried out by the forestry inspectorate.

Pursuant to the *Plant Protection Act* the bodies and public services responsible for the protection of plants have to control and inspect plants, plant products, land, storage facilities, the processing and storage of plants and plant products and other controlled objects. The purpose is to identify the harmful organisms, to report about them and to exterminate them. The implementation of this Act is supervised by the phytosanitary and forest inspectors.

Pursuant to the *Freshwater Fisheries Act* the fishing organisations, which manage fishing districts, have to organise a breeding and guarding service which is carried out by the fish wardens so that all waters are appropriately supervised. The implementation of the provisions of this Act is ensured by the fish inspectors.

The implementation of the provisions of the *Marine Fisheries Act* is supervised by the fishery inspectors. In the implementation of the tasks of fish inspection the bodies of the Ministry of the Interior and the Maritime Transport Administration in Koper participate.

The enforcement of the provisions of the *Forests Act* is supervised by the forest inspectors. The activities affecting forests are also inspected by the competent hunting inspectors, fishery inspectors and construction and urban inspectors. The enforcement of the provisions of this Act related to the prevention of fires and their extinguishing are supervised by the fire inspectors and the bodies of the Ministry of the Interior. The main rights and obligations of the forest inspectorate are to survey activities in the forest and document them; review and monitor the enforcement of the general provisions of the forest management and silviculture plans; stop all activities which do not comply with the provisions of this Act and the regulations issued pursuant to it; in emergency situations order the provisional measures to prevent damage; review and monitor the enforcement of the forest protection measures and verify that the conditions for carrying out activities in forests have been met by the operators.

The enforcement of the provisions of the forestry legislation and other acts, which stipulate the rights and obligations of the forest inspectors, is supervised by 17 forest inspectors. They operate in 12 units: Murska Sobota, Maribor, Celje, Dravograd, Novo mesto, Kočevje, Krško, Ljubljana, Kranj, Postojna, Nova Gorica and Koper. The Head of the Inspectorate Office coordinates and supervises their work.

The forest inspection supervises the implementation of the provisions of:

- Forests Act;
- Decree on the protection against fire in the natural environment;
- Decree on the prohibition on driving vehicles in the natural environment - 31 reports and 7 proposal to institute misdemeanour proceedings;
- Decree on the protection of wild fungi - only 30 inspections have been carried out because of the short and slow season (except in Prekmurje and Dolenjska).

The implementation of the provisions of the mentioned decrees is not regularly supervised, only at the time of most frequent violations and often in cooperation with the police.

The hunting and fishing inspectors are organised in the inspectorate of ten dislocated unites. Sixteen inspectors are working on the field. The hunting inspectors *inter alia* control hunting, implementation of hunting management plans, administration of hunting organisations, as well as check on holders of protected animal species and interference of the life cycles of protected animal species.

Trade inspection

The Trade Inspectorate is a body within the Ministry of the Economy. It supervises the implementation of 17 acts and more than 50 executive regulations covering trade, hotel management, small business and other activities. It is responsible for the inspection of the quality of products and services, the labelling of products, prices, consumer protection and competition, the prevention of moonlighting and the observation of the copyright and other related rights.

The trade inspection is not authorised to perform inspection in the field of nature conservation. Within its competencies the trade inspection:

- Supervises the exploitation of the gravel pits in the territory of Slovenia in accordance with the provisions of the Small Business Act. With regard to the entities, which perform the mentioned activity, it establishes whether the conditions stipulated by the law are met but it does not ascertain whether the activities affect nature and valuable natural features or whether these are protected.
- After the amendments to the Decree on the protection of wild fungi had been adopted, the Trade Inspectorate supervised the trade in fungi in 2000. The Trade Inspectorate determined whether fungi have been purchased by the registered natural or legal persons, inspected the records kept by the purchasers and the quantity of fungi placed on the market. The inspections have been carried out at the registered purchasers, on markets and at the fungi exporters. On the basis of reports that individuals had been purchasing fungi on the field an inspection party was organised in cooperation with the forest inspectors and the police. Unfortunately, the unregistered purchasers have not been found.
- During the regular checks on the operation of hotels and restaurants the trade inspections control the purchasing, selling and mediating in the selling of endangered animals species in compliance with the Decree on the protection of endangered animal species.

These tasks are carried out within the framework of the annual plan drawn up by the Main Office of the Trade Inspectorate or on the basis of potential reports. The main objective is to ensure equal opportunity to operate for all the parties present in the market and the protection of consumers.

Direct control

Direct control in nature is to be carried out by the nature conservation and voluntary wardens. However, the Government and the Minister have

to issue the relevant executive acts. Nevertheless, the managers of protected areas do already inspect these areas. The Institute for Nature Conservation will guarantee the inspection of nature outside these areas. The supervision of the implementation of the provisions of the Nature Conservation Act is also the responsibility of the Slovenian Forestry Service personnel who meet the conditions stipulated by the law.

Police

The police is responsible for the supervision of the implementation of specific regulations which guarantee the conservation of biological and landscape diversity in Slovenia. These are as follows:

- Penal Code of the Republic of Slovenia;
- Nature Conservation Act;
- Animal Protection Act;
- Forests Act;
- Road Transport Safety Act;
- Decree on the prohibition on driving vehicles in the natural environment;
- Decree on the protection against fire in the natural environment;
- Decree on the protection of wild fungi.

Customs Service

The implementation of the nature protection measures is not the primary concern of the customs authorities but is nevertheless an important part of their work. Its importance will only increase with the accession of Slovenia to the EU. In compliance with the Customs Act, prohibitions and restrictions may be introduced for the movement of goods out of or into the customs territory of Slovenia, in particular with regard to the protection of public morality, safety, protection of health and lives of people, animals and plants, protection of the environment, protection of the national values of artistic, historic or archaeological nature or the protection of intellectual property rights. However, they are not covered by the Customs Act but by other regulations.

The tasks and responsibilities of the customs authorities are covered by the following regulations:

- Environmental Protection Act:
  - Order on the prohibition of sale and import of vehicles without catalytic converters;
  - Decree on CO_2 Tax;
  - Order on the management of ozone-depleting substances;
  - Decree on the protection of wild fungi;
  - Order on the export, import and transit of wastes;
- Nature Conservation Act;
  - Decree on the protection of endangered animal species;
- Convention on International Trade in Endangered Species of Wild Fauna and Flora:
  - Order on the implementation of Resolution No. 10.2 of the Conference of the Parties to the Convention on International Trade in Endangered Species of Wild Fauna and Flora:
- Forests Act;
- Animal Protection Act:
  - Rules on the conditions and method of transport of animals.

The regulations concerning nature conservation have not often been breached. In most cases the breaches concerned the illegal trade in endangered birds. Due to the global increase in the illegal trade in endangered species of wild fauna and flora, and because the relevant legislation has been adopted, the customs officials participated at numerous meeting and training courses in 2000 and 2001. The events concerning the combating of the illegal trade in endangered birds were organised by the DOPPS - BirdLife Slovenia and the events concerning the implementation of the CITES by the Environmental Agency.

In 1998 the customs service participated in the drawing up of the Decree on the protection of wild fungi pursuant to which the export of fresh or processed mushrooms from Slovenia is prohibited. It is permitted to export processed mushrooms which have been bought in Slovenia and the purchase can be proved by the trader's receipt.

In general, the customs authorities control the passenger transport at the border crossings and the goods transport on the entire territory of Slovenia. All live animals, raw materials of animal origin (all types of game hides and skins, hunting trophies) and other shipments by which contagious diseases could enter Slovenia may be imported at specific border crossings where the veterinary inspector carries out the documentation and identification inspection and physically inspects the goods. The same applies to the shipments of plants, parts thereof and plant products by which pests could enter Slovenia. These shipments are inspected by the phytosanitary inspectors at specific border crossings. The border customs authorities do not permit the use or utilisation of goods which have been permitted in accordance with the customs regulations until the competent inspector has issued an import permit. With regard to the transport of goods it is

mandatory to check whether a consent or permit pursuant to the Decree laying down import and export regimes with regard to certain goods is needed for the import of goods or whether other prohibitions and restrictions are laid down in other regulations (for example in compliance with Article 24(6) of the Veterinary Service Act, the importer of non-indigenous wild animals has to obtain an consent issued by the competent minister).

Information systems

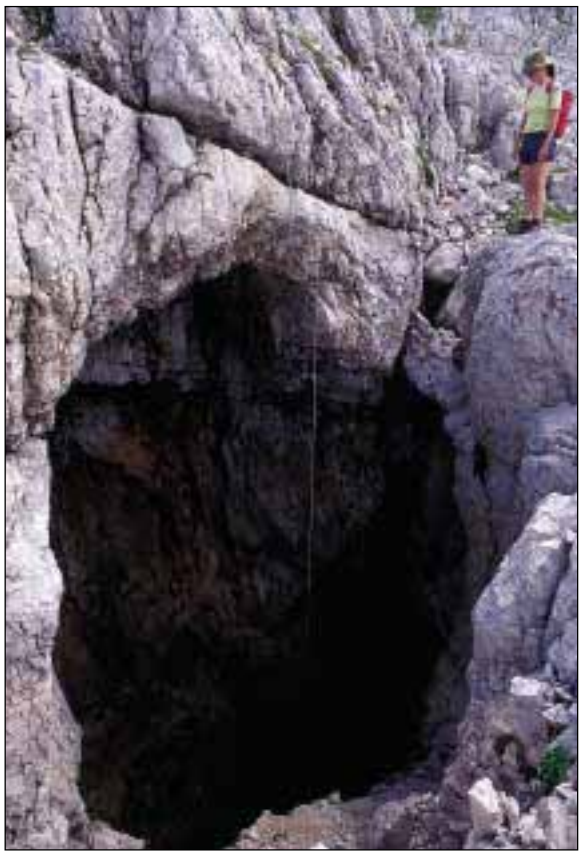
The information systems are vital for ensuring the basic support to decision-makers. They affect the quality of the basic information which is vital for the formulation of the relevant policies and regulations. Such systems are indispensable in ensuring the accurate information needed for the keeping of international inventories and the drawing up of national reports. The basic problems in this field are:

- the fragmentation of data on biodiversity in different institutions; the quality of data varies and they are based on different methodologies;
- unclear or undefined conditions for accessing the data;
- lack of databases with computer support accessible by the Internet and other networks;
- temporal and topical gaps concerning the collection and processing of data;
- the lack of financial and human resources in the process of modifying old data into digital format and their management.

Clearing house mechanism

The data bases with the relevant information on biodiversity in Slovenia are mostly located at different institutions or sectors. They are organised in different ways, which makes them difficult to access and to organise them in joint data bases. With such joint data bases it would be possible to reach knowledge-based and reasonable decisions on actions to be taken. The Clearing-House Mechanism, founded as a process to be developed in the course of the implementation of the Convention on Biological Diversity, has been set up as a part of the information system.

The **Clearing House Mechanism - CHM** is an information and communication system for the exchange of information on biodiversity; it supports the implementation of the Convention on Biological Diversity at the international and national levels. At the same time it provides support to the implementation of the convention and facilitates the achieving of its goals within the framework of:



(Photo: Marko Simić)

Figure 190. *Brezno pod Velbom on Kaninski podi: it is exceptional with a 501 metre-deep entrance shaft. When discovered it used to be the deepest vertical cave-entrance in the world. Most of the underground world has been discovered by cavers.*

- collection, preparation, provision and sharing of data on biodiversity, i.e. the accessibility of the data bases or their managers, strategies, legislation, programmes, reports, projects, etc.;
- support and enhancement of expert and technical cooperation at all levels;
- participation of national bodies, expert and academic institutions, local communities, non-governmental organisations, private sector;
- communication through the electronic and other communication media with international and other national mechanisms for the provision of data, the international conventions and organisations, and individuals concerned with biodiversity.

The central Clearing-House Mechanism of the Convention, situated in Montreal, links the parties to the Convention and other users into the wide web http://www.biodiv.org/chm which contributes to the implementation of the principles of the Convention. The CHM organises other partnership projects, workshops and training programmes in the developing countries. A similar information system found at http://www. sigov.si/mop/vsebina/cbd was set up in Slovenia in June 2000. It provides the data concerning the following fields:

- national legislation on biodiversity;
- biodiversity in Slovenia;
- reports on the implementation of the Convention and other reports on biodiversity;
- addresses of institutions whose tasks are related to the biodiversity conservation;
- list of the relevant projects;
- link to the Convention Secretariat and the central Clearing-House Mechanism;
- links to the international data bases, the legislation data bases and the documents relevant for the Convention.

With the establishment of the above mentioned information system the requirements of the Aarhus Convention have been fulfilled in part.

NON-GOVERNMENTAL ORGANISATIONS

Role and importance of the non-governmental organisations in society

The term non-governmental organisations (NGO) in Slovenian praxis stands for the civil initiative of the citizens organised in societies, institutes and institutions. Pursuant to the Societies Act societies are open to the equal participation of all citizens. Each member is given the right to participate in the operation of a society. Similar societies merge into associations to achieve better organisation or to increase their influence. Institutes and institutions are organised by founders who in their own judgement control the participation of other citizens in the operation of the institute or institution. In the areas which are important for the biodiversity conservation the societies mainly participate in the field work, in the raising of public awareness and advocating their beliefs. The institutes and institutions function as non-profitable providers of services on the market (including the raising of awareness and educating) and as advocates of their beliefs.

In the past, mainly the environmental NGOs and their members made an important contribution to biodiversity conservation and the implementation of the activities concerning the *Convention on Biological Diversity*. In numerous European countries the citizens organised in societies and associations carry out an important part of the work in the field of biodiversity conservation. This potential should be properly developed in Slovenia. So far, the NGOs have helped to conserve biodiversity in the following ways:

- the collection of data on natural heritage and the state of biodiversity;

Some examples of data provided by NGOs:

DOPPS - BirdLife Slovenia: registers the nesting and wintering birds of Slovenia for the ornithological atlases; records the nesting birds in protected areas and in areas still to be protected, monitors the waterbirds and some nesting birds (corn crake, white stork, common tern, etc.);

Slovenian Odonata Society gathers data for the odonata atlas;

Societas Herpetologica Slovenica collects data on the area of distribution of amphibians and reptiles;

Speleological Association of Slovenia: most data on caves and their fauna have been contributed by speleologists organised in the Association, which keeps the Cave Register - the managed data base on caves; it is very important for successful conservation of biodiversity in subterranean habitats;

- raising awareness, educating and arousing enthusiasm of the general public - the NGOs and environmental and nature conservation organisations, especially those with direct access to the general public (via their publications, regular meetings, organised education, etc.) play an important role in the stimulating public awareness (described in Chapter on communication);
- youth camps organised for research and education of youth (Hoče 1997, Mislinja 1998);
- focusing of work and funds on the biodiversity conservation - societies focus the work of volunteers and the funds on biodiversity; the funds include finances which for various reasons are unavailable to the governmental organisations; the NGOs express the interest of a large part of the civil society and influence the policies; indirectly the funds from the state budget are allocated to biodiversity conservation.

Strategic importance of NGOs for the nature conservation

The NGOs participate in the implementation of the Convention on Biological Diversity, mainly in the field of sustainable development. Studies on NGOs which contribute to the *in situ* conservation of biodiversity (nature conservation organisations) have not yet been compiled. According to the 2001 study, carried out by the Regional Environmental Centre for Central and Eastern Europe (REC), there are 107 environmental and nature conservation organisations in Slovenia. The activities of 27 of them are focused exclusively on the environment. In total 34 organisations are mainly concerned with the en-

vironment (50 - 100 % of activities are focused on the environment), while for 23 organisations the environment is not their primary concern (less than 50 % of their activities are focused on it).

The NGOs are mainly concerned with
- providing information (70 NGOs);
- organising conferences and other meetings (68 NGOs);
- education (67 NGOs);
- environmental education (65 NGOs);
- public awareness campaigns (63 NGOs);
- publications (61 NGOs);
- environmental monitoring (45 NGOs);
- organising public events (44 NGOs);
- research (41 NGOs);
- consultancy (42 NGOs);
- organising cleaning campaigns and camps (37 NGOs);
- lobbying (36 NGOs);
- network (31 NGOs).

(Photo: Marko Simić)

Figure 191. *Kataster of the Speleological Association of Slovenia (in the picture) housing all the documentation on the discovered caves. Caving is not just visiting caves, cavers thoroughly document their work.*

The main advantage of the NGOs is their ability to implement the Convention on Biological Diversity directly by raising public awareness and their influence on the developmental decisions at the regional level. The Natural History Society is the oldest nature conservation NGO, but the one with most members is the DOPPS - BirdLife Slovenia.

With regard to the number of environmental NGOs, those stand out which are engaged in environmental education (72) and the nature conservation (71). They are followed by the organisations interested in biodiversity (39), formulation of environmental policy (39), public participation (39), tourism/eco-tourism (38), water management (34) and protection of wild animal species (32). Other fields include the environmental impact assessment (31), environmental legislation (29), waste management (26), sustainable/organic farming (25), air quality/pollution (21), agriculture/pesticides (19), forestry (18), transport (16), climate change (15), energy (15) and economic instruments (9).

A more detailed presentation of the Slovenian environmental and nature conservation NGOs is available on the REC homepage (http://www.*rec-lj.si*) which monitors and updates their information. Two data bases are particularly important:

- the list of environmental NGOs in Slovenia and the data base concerning the interest of NGOs to participate in the decision-making procedures and in the preparation of plans, programmes and policies;
- the list of environmental NGOs in Slovenia facilitates the search for information on NGOs by different keys; the data base on the interest of NGOs to participate facilitates the inclusion of those NGOs which operate in a certain field or which carry out certain activities/measures.

The areas in which other environmental NGOs are active, and which are (more or less) also directly important for biodiversity include::
- agriculture/pesticides,
- air quality/air pollution,
- climate change,
- economical instruments,
- environmental impact assessment,
- environmental legislation,
- environmental policy making,
- energetics,
- forestry,
- public participation,
- sustainable/ecological agriculture,
- tourism/ecotourism,
- transport/traffic,
- waste disposal/management,
- water management.

In 2000 and 2001 the REC supported and coordinated the drawing up of the Programme of co-operation between environmental NGOs and the

Ministry of the Environment and Spatial Planning - Partnership for the Environment. The programme serves as a basis for the establishment of the environmental partnership, the institutional strengthening of the environmental NGOs and their participation in the decision-making processes. With the adoption of the programme the governmental and non-governmental sector alike accepted the obligation to implement the environmental partnership. The programme, which is in its initial phase, sets the specific objectives, mechanisms and activities for the establishment of efficient cooperation.

In April 2001, the REC and the Ministry of the Environment and Spatial Planning organised the first environmental forum, at which the minister and other representatives of the Ministry and NGOs discussed the main environmental problems and the directions for more efficient cooperation between the two sectors and the priority directions and possibilities for improving future cooperation.

The governmental institutions and the NGOs cooperate through:

- public tenders for NGOs;
- national and international projects;
- creating the opportunities provided by granting the status of societies to organisations which participate in nature conservation (the Nature Conservation Act).

Pursuant to the Nature Conservation Act, the professional and amateur societies in the field of nature conservation carry out the activities in the public interest in that part in which the purpose of the establishment of the society and its activities themselves extend beyond the realisation of the interests of the members of the society. The act stipulates the conditions for acquiring the status of a society acting in the public interest. A society acting in the public interest has a right to act in the interest of nature conservation in all administrative procedures and adjucatory proceedings. The minister grants the status of a society acting in the public interest to any society which fulfils the conditions. It may nullify the status if the society ceases to meet the stipulated conditions.

INTERNATIONAL COOPERATION

Since 1991, Slovenia has substantially increased the level of international cooperation in the field of nature conservation. Cooperation and contacts with the international non-governmental organisations have been strengthened and various activities concerning the implementation of the international treaties - either succeeded from the former Yugoslavia or signed and ratified anew - have been carried out. Slovenia actively participates in all working bodies of the international conventions.

Accession to the EU

The central direction of Slovenia's policy is to accede to the European Union, and for that purpose its legislation has to be harmonised with that of the EU. Accordingly, the legal and organisational conditions for the implementation of the Birds directive, Habitats directive and the acquis concerning the trade in plant and animal species are currently being reviewed in the nature conservation sector. The main aim is to establish and conserve the areas included in the NATURA 2000 network.

Environment for Europe

The ministerial Environment for Europe process is important from the point of view of the implementation of the Convention on Biological Diversity, in particular in the following fields:

- the National Environmental Action Programme (NEAP) defines the objectives of and priorities for the biodiversity conservation and regulates the cooperation with the working group responsible for drawing up the NEAP within the OECD;
- the Report on the state of biodiversity, to be included in the Report on the state of the environment in Europe (Dobris Report); in cooperation with the European Environment Agency (EEA) Slovenia participates in the uniform system for collecting and reporting of environmental data, in particular through the EIONET;
- the Pan-European Biological and Landscape Diversity Strategy (PEBLDS) forms a foundation for the regional (Pan-European) implementation of the Convention on Biological Diversity. Slovenia chairs the Strategy Council from 1998 until 2003.

Ministerial conferences on the protection of forests in Europe

Slovenia actively participates at these conferences, and the Ministry of Agriculture, forestry and food cooperates with members of other states in the drawing up of work programmes.

Bilateral contacts and activities

Protected areas, protection of water sources and local developments are the main areas of

Some examples of co-operation with other international non-governmental organisations on nature conservation:

- IUCN (The World Conservation Union) - Slovenia co-operates with the organisation's headquarters, its European Regional Office, Commissions (World Commission on Protected Areas, Species Survival Commission, Commission on Education and Communication);
- REC - the Environmental Action Programme for Central and Eastern Europe, Sofia initiative for biodiversity conservation in Central and Eastern Europe;
- *UNEP World Conservation Monitoring Centre* (UNEP-WCMC) - exchange of data on protected areas and threatened species;
- *BirdLife International* - a programme of work on *Important Bird Areas* (IBA), working with the partner organisation in Slovenia;
- PLANTA EVROPA - project on botanically important areas;
- EUROPARC - participation in exchange of experience and staff working in protected areas (PHARE);
- ICOMOS - *International Council on Monuments and Sites*, its National Committe is working in Slovenia (ICOMOS/SI);
- Eurosilva - Forest Tree Physiology Research.

cooperation between Slovenia and neighbouring countries. Some examples include:

- with Austria, proposals to establish protected areas: a trilateral protected area between Goričko (Slovenia) - Raab (Austria) - Örseg (Hungary) and a bilateral protected area in the Karavanken and Kamnik-Savinja Alps (an INTERREG project);
- with Hungary and Austria, a trilateral protected area in Goričko and along the Mura River;
- with Croatia, protected areas of Žužemberk-Gorjanci; the Kolpa, Drava and Mura Rivers;
- with Italy, a protected area in Karst and Tržič/Molfoncone;
- Alpe-Jadran, an agreement of cooperation between Italy, Austria, Croatia and Slovenia.

DEFICIENCY OF THE BIODIVERSITY CONSERVATION INSTITUTIONAL FRAMEWORK

The analysis of institutional deficiency is summarised from GEF & UNEP Report (2000).

Institutional level

At the institutional level, capacity development focuses on the overall organisational performance and functioning capabilities of the single institution, as well as its ability to adapt to changes. The effectiveness of their work suffers from the overall and deep changes in the political, administrative and social system which Slovenia has been undergoing. These are, at the same time, the main causes of changes or imbalances in their institutional mandates. Management of human, information and financial resources in public institutions is influenced by the capacities at the system level, such as salary structure, budgetary allocations, procedures, responsibilities as well as skills and abilities of individuals.

Universities and research institutions are suffering from a rapid decline in funding both science and education. Fundraising efforts and the struggle for survival may have a negative impact on the fulfilment of their missions and mandates, since accessibility of funds has become a criterion overruling the needs for research in certain areas.

1. Capacity constraints in the **Management of Institutions:**

- lack of qualified and properly skilled personnel to manage institutions in the condition of a market economy, resulting in weak management, oversight and enforcement,
- lack of team work within the institutions.

2. Capacity constraints in the **Staff Management Policies:**

- salary structures and the incentives system within the public institutions not possibly affect the individuals' motivation,
- management systems do not reward individual initiative and achievements, and this does not create an environment for effective use of individual skills,
- general lack of certain professions working in the area of biodiversity due to deficiencies in education system.

3. Capacity constraints in the **Financial Resources framework:**

- public institutions in general, and particularly those of the environment, education and research sectors tend, to be underfunded to the extent that it hinders their effective functioning,
- insufficient opportunities for alternative financing through the existing institutional framework of biodiversity projects.

Institutions mandated with activities which are relevant to the conservation of biodiversity

and sustainable use of its components frequently lack effective means to co-ordinate the activities and gathering information, or even simply to communicate with other actors. The main constraint in this respect is the unclear distribution of responsibilities for activities related to the Convention on Biological Diversity among Government agencies, the private sector and civil society.

Human resources. The availability of human resources for conservation and sustainable use of biological diversity within the country is influenced by a number of factors including, but not limited to, quality of education and professional training, attractiveness of certain professions, pay and incentive systems in different sectors, etc. The main capacity constraints in this field are:

- lack of qualified staff in the public sector,
- lack of opportunities for decision makers to receive training in novel concepts relevant to sustainable development, including biodiversity conservation,
- gaps in curricula at all academic levels,
- environmental education lacks an economic background,
- education in social and economic fields lacks a background on environmental issues, hence the general level of understanding of linkages between the environment and development is low, and the consequences of biodiversity loss are not understood,
- lack of qualified lecturers in certain fields, particularly in environmental policy and economies and in environmental communication.

Individual level

The general level of knowledge and technical skills among decision makers concerning the country's environmental problems is satisfactory, however, managerial and communication skills are inadequate at all levels of administration. Scientific capacity is generally available, but there is a critical lack of certain professions working in the area of the environment - above all environmental economists, environmental lawyers and bank analysts concentrating on the economic and financial analysis of environmental and nature conservation projects. Consultation in biodiversity relevant fields is still not an established practice. An important general deficiency is also the lack of training opportunities, on the one hand, and the lack of interest in adequate training on the other. Capacity building is not based on a program approach; instead, there prevails the project approach, leading to low-priority projects and not allowing for the main capacity gaps to be bridged.

VARUJMO NAŠE JAME

V kraških jame sega le malo zunanjih vplivov, ki tako hitro spreminjajo površje. Lahko rečemo, da teče čas v jamah počasneje kot na površju. Jame nastajajo tisočletja, v njih so ohranjeni sledovi preteklosti.

Človekov obisk je lahko za izjemno ranljivo jamsko okolje usoden, še posebej v jamah, ki niso urejene za turistični obisk. Le nepreviden gib, in že polomimo kapnik, ki je rastel del človekove zgodovine, en sam nepremišljen korak nepopravljivo zabriši bleščečo površino sige.

Zato se moramo v jamah obnašati tako, da bo sledov našega obiska in delovanja čim manj. To je naša dolžnost do narave in obiskovalcev za nami.

FINANCIAL RESOURCES

Figure 192. *Partnership or any other type of cooperation between the State and the private sector - including industry and NGOs - is important for nature conservation. An example of good practice is the Helios trustfund for the conservation of waters in Slovenia. It provided funds for cleaning up the caves located in the catchment areas of the sources of drinking water.*

DOMESTIC FINANCIAL RESOURCES

Budget appropriations are the fundamental source of funds intended for the nature conservation. In total 0.07 % of the budget appropriations is available to the nature conservation sector.

Other resources:

- the analysis of the share of the funds indirectly allocated to the nature conservation through other sectors (within the framework of environmental protection, agriculture, tax reliefs) has not yet been carried out and is thus a priority;
- the analysis of the ecological funds of the economic operators and sponsors (for example Helios or Mobitel Funds) intended for the nature conservation projects or campaigns has not yet been carried out;
- the analysis of the share of the financial resources of NGOs, which are funded from the budget, by sponsors and from voluntary work, has not yet been carried out.

FOREIGN FINANCIAL RESOURCES

Several international projects, focused on the establishment of protected areas, are currently being carried out in Slovenia. The Governments of the Netherlands and Great Britain and the European Union provide financial assistance for the preparation of projects, the exchange of experience and study visits. Main financial assistance:

- **The Global Environmental Facility (GEF)** - financing of the project concerning the national biological and landscape diversity strategy; the project includes the overview of the state of biological and landscape diversity, and the strategy with the corresponding sectoral and action plans.

- **PHARE**

project name	project description	funds provided by EU	funds provided by Slovenia
PHARE CBC 1994 TIMAV/KARST PARK SL-9403.02.01-04	Technical support for establishment of Karst Regional Park (Fundaments for Management Plan, Park Management Office renovation and equipment (Škocjan 2), small funds, education)	400,000 euro	100,000 euro
PHARE CBC 1995 TRIGLAV NATIONAL PARK SL-9506.02.02	Technical support for Triglav National Park (Fundaments for Management Plan, environmental sanation of mountain posts, renovation of the Pocar's home, education - rangers)	490,000 euro	110,000 euro
PHARE CBC SLO/H/A 1995 TRI-N-NATURE PARK GORIČKO-ORSEG-RAAB 1995 ZZ - 9524.01	Trilateral Nature Park Orseg-Raab-Goričko (Inventory of the region, zonation, Development Programme, Grad castle sanation, Bicycle routes)	560,000 euro	140,000 euro
PHARE 1996 PROJECT PREPARATION FACILITY	Management Plan for recreational use of the upper Soča valley (Setting in place access points to the river, parking)	300,000 euro	60,000 euro
PHARE CBC 1997 NATURAL MONUMENT DOLŽANOVA SOTESKA SL-9702.05.04	Setting in place Dovžanova soteska trail, Infrastructure for water supply	100,000 euro	20,000 euro
PHARE CBC SI/H 2000 JOINT NATURE PARK DEVELOPMENT SI.00.08.01	Technical support for establishment of Landscape Park Goričko (Management Plan, management structure/office, education, Information Office Grad castle, promotion of old crafts)	1,600,000 euro	625,000 euro

The integral analysis of the results of the listed projects has not been carried out.

- **LIFE** - in 1994 the project concerning the establishment of the Notranjska Park and the Notranjska karst UNESCO biosphere area was carried out; the LIFE financial support amounted to EUR 169,000, the contribution of Slovenia to the financing of the project was equal to the EU support.

  In 2000 Slovenia became equal to the EU member states in responding to the calls for expression of interest. In the past it was granted funds from the LIFE-third countries programme but in the period from 2000 until 2004 it can also draw funds from the LIFE-nature and LIFE-environment programmes. The general objective of the LIFE is to offer support to projects which contribute to the implementation and development of the Community environmental policy, the integration of the environment into other policies and to sustainable development. The specific objective of LIFE III-nature is to contribute to the implementation of the Directive on the conservation of natural habitats and of wild fauna and flora (92/43/EEC) and the Directive on the conservation of wild birds (79/409/EEC). The maximum rate contributed for the project by the Commission is 75 %.

  The European Commission has received 310 project proposals from 5 accession candidate countries in the total amount of 80.6 million. Among the projects, those have been selected which in the Commission's opinion significantly contribute to the nature conservation at the European level, in particular to the implementation of the 'Natura 2000' network. Of 94 projects, 3 have been proposed by Slovenia. In total they

amounted to 849,835 Euro. The projects are:

- peat bogs in the Triglav National Park;
- restoration and protection of habitats and the protection of birds in Škocjanski zatok;
- management plan for dry grasslands in the mountain pastures of Oslica and Vetrnik (Kozjansko Regional Park).

- **PIN MATRA** - The Netherlands Government has financed and co-financed two projects:
  - the project concerning the establishment of the Sežnik Regional Park (from 1996 to 1999) in the amount of 92,500 Euro, and
  - two projects concerning the Communication support to the nature conservation (1999 and 2001) in the amount of 5,220 Euro.
- **AVALON** - The Netherlands' Government financed the project concerning the introduction of organic farming in the Triglav National Park in the amount of 41,030 Euro.
- **EUROPARC EXPERTISE EXCHANGE.**

MAJOR DEFICIENCIES OF THE FINANCIAL FUNDS

The main capacity constraints are:

- government funds allocation to activities relevant to the implementation of the Convention on Biological Diversity is insufficient due to environmental matters having received less attention than production sectors,
- lack of transparency in financing actions to conserve and sustainably use biodiversity since the Convention on Biological Diversity is implemented through different sectors,
- low incentives, or none at all, for the private sector to finance actions addressing global environmental challenges,
- banking sector insufficiently involved in financing environmental and sustainable use projects,
- lack of alternative financing opportunities,
- insufficient co-ordination of external aid and its projected direction,

(Photo: Marko Simić)

- lack of capacities in all sectors and in local communities to identify, draft and implement biodiversity projects and negotiate relevant agreements,
- lack of schemes which would provide grants or soft loans to non-governmental stakeholders,
- lack of project management skills at all levels,
- lack of knowledge, interest and skills for raising international financial resources.

Figure 193. *Animals are used as motifs on all Slovenian tolar coins.*

Gljive

Gljive so obsežna skupina organizmov. Poleg živalskega in rastlinskega sveta sestavljajo samostojno, tretje kraljestvo živih bitij. Ocenjujejo, da na svetu živi več kot 1,500.000 vrst gliv. Do danes so jih opisali le okoli 70.000. Pomembne so za delovanje kopenskih, zlasti gozdnih ekosistemov. Kot gniložívke so poleg bakterij nepogrešljive pri razgradnji organske mase in s tem kroženju snovi v naravi. Parazitske vrste gliv lahko zajedajo rastline ali živali.

Za vitalnost in odpornost dreves ter stabilnost gozda so pomembne mikorizne vrste, ki živijo v sožitju z višjimi rastlinami. V ugodnih razmerah zrastejo iz podgobij trosnjaki, ki jih navadno imenujemo gobe. Med njimi je precej užitnih vrst, ki so pogosto na našem jedilniku. Gobe nabira in prodaja vedno več ljudi, zato številne vrste postopoma izginjajo.

Z Uredbo o varstvu samoniklih gliv (Uradni list RS, št. 57/98) je med približno 2000 vrstami, kolikor jih poznamo pri nas, zakonsko zavarovanih le 70. Te je prepovedano nabirati povsod po Sloveniji.

Ko se podajate v gozd po gobe, upoštevajte naslednja pravila:

- vzemite s seboj košaro, ker je gobe dovoljeno prenašati le v trdni in zračni embalaži;
- gobe očistite že na rastišču;
- pri nabiranju je prepovedana uporaba tistih pripomočkov, ki lahko poškodujejo podgobje ali rastišče;
- nabirajte gobe z jasno razpoznavnimi znaki in le tiste, ki jih dobro poznate;
- na dan lahko naberete le dva kilograma gob;
- namerno uničevanje trosnjakov in podgobja vseh vrst je kaznivo;
- v osrednjih območjih narodnih in regijskih parkov ter v naravnih in gozdnih rezervatih je prepovedano nabiranje vseh vrst samoniklih gliv.

Dodatne informacije o zavarovanih glivah daje:

Agencija RS za okolje, Sektor za ohranjanje narave
Vojkova ulica 1b, Ljubljana
telefon +386 (0)1 478 40 00

COMMUNICATION, PUBLIC AWARENESS AND ENVIRONMENTAL EDUCATION

A key element in the area of nature conservation and environmental protection is raising the awareness of every persons right to live in a healthy environment and both their individual responsibility and societies responsibility to that end. Only then can the public play an active role in decision-making processes which change consumer activity and production patterns. The active involvement of society in the process of shaping and implementing specific policy is a prerequisite for real advancement towards sustainable development.

Strategic role of environmental education and communication is emphasised above all in following international documents and conventions:

- Global Biodiversity Strategy, WRI, IUCN, UNEP, 1992;
- Caring for the Earth. A Strategy for Sustainable Living. IUCN, NEP, WWF, 1991;
- Convention on Biological Diversity (Rio de Janeiro, 1992);
- Agenda 21 (Rio de Janeiro, 1992);
- Pan-European Biological and Landscape Diversity Strategy (PEBLDS, Sofija, 1995)
- The Aarhus Convention (Aarhus, 1998).

In spite of the general support that environmental education enjoys, being regarded, for one thing, as important groundwork for the implementation of international conventions and other documents, the actual political will to carry this out is demonstrated only through a modest share of financial, technical and human resources.

No scientific literature or studies on biodiversity and the communication of broader nature conservation issues exists in Slovenia. The data that has been collected, based on the knowledge and the experiences of environmental and other organisations and individuals, barely allows evaluation of the existing position, although this evaluation ought to be thoroughly analysed in future.

The ratification and implementation of the Aarhus Convention will bring fundamental modifications to the field of environmental communication and public participation in environmental issues. The recommendations of the convention are of crucial importance in that they will enable higher efficiency of governmental and non-governmental organisations and assure efficient participation of non-governmental organisations in the preparation of environmental protection guidance and laws.

> The State stipulates nature conservation and environmental policy, implements corresponding regulations, co-ordinates interministerial co-operation, provides finances and similar, although it cannot be efficient in doing this without both political consensus and public support.

Sustainable development requires co-operation between all social and economic sectors. Biodiversity conservation issues are complex and only manageable if all concerned are capable of either efficient inter-sectoral co-operation or, of assuring public participation in the development and implementation of nature conservation and environmental policy.

Improvement of the environment, nature conservation, economic development and democratisation are closely connected. Democratisation is one condition for sustainable development as, only in a democracy, can the public express its desire for healthier surroundings and the preservation of biological diversity.

Non-governmental organisations can be successful mediators between the general public, State and other stakeholders. A strong environmental movement influences the formation and realisation of government policies. The role of

non-governmental organisations can be crucial in stimulating the general public into accepting a lifestyle more compatible with biodiversity conservation.

Actions aimed at environmental education and raising the awareness of the general public to the significance of biodiversity conservation, play an important role in this process. Human beings generally change their behaviour only if the change brings them health, financial, moral, ethical or any other benefits. That is why communication and education plays an important role in motivating people towards biodiversity conservation. This directly follows on from the opportunity to participate in decision-making processes and have access to justice, as the Aarhus Convention foresees.

Slovenian strategic documents on environmental protection and nature conservation convey, in principle, the need for public awareness and education, but do not in any way - neither politically, strategically nor institutionally - address this issue. They lack statutory or formal foundations as well as organisation, human resources and finances.

Generally speaking, planned and targeted environmental education and communication about biodiversity and other environmental issues are still in the early stages of development in Slovenia. There is a significant deficiency in background information, training programmes and their implementation, especially in vocational and technical education as well as all other communication activities. The situation is a little better in the field of education about pollution.

The reasons for the current unsatisfactory communication about biodiversity conservation are above all:

- Insufficient awareness by political and nature conservation management staff that strategic and planned communication is a key efficiency factor for implementation of a particular policy;
- Conservation of biodiversity is not perceived as being a high national priority. This is demonstrated by the tendency to reduce the natural science element of the curriculum, as well as through a reduction in the state budget funds allocated for nature conservation as a whole;
- Insufficient awareness of professional vocational services - as the general subject of biology has been reduced or eliminated. This subject, with its ecological content, allows the comprehension of biodiversity and its relation to sustainable development whereas the more 'academic' subjects do not consider sustainable development and the use of natural resources;
- Insufficient knowledge by government and non-governmental organisation employees about the methods and effectiveness of proper communication. There are currently limited possibilities for such training, as supply and demand regarding this subject has not yet been quantified. Even though there is an obvious need for such knowledge, only an ad-hoc training approach exists in this area providing limited opportunities for either the gaining of theoretical and practical knowledge or through 'follow up' training;
- Profile the inadequacy and limited capability of educational organisations and organisations to provide different types of training courses on biodiversity conservation, environment protection and sustainable development. For example the Slovenian Adult Education Centre, Academy of Administration and other similar organisations. The Nature Conservation Service has no educational facilities, while its modest budget merely allows ad-hoc opportunities for occasional training, which is mostly dependant on foreign financial aid;
- Although there is an opportunity to obtain the legal status of a "society acting in the public interest", the State has not developed appropriate methods for co-operation with non-governmental organisations in the field of biological diversity and preservation of natural values. This co-operation currently only functions through individual projects giving isolated or partial results that lack any overall evaluation of achievement;
- The lack of a common business and communication culture as well as the presence of 'conventional views' on co-operation, partnership and public participation;
- Insufficient co-ordination between development and conservation activities - although this directly affects the efficient use of current institutional capabilities and the corresponding positioning of the activities in the environment;
- Communication between the government and the stakeholders is fragmented or insufficient;
- Only moderate experience regarding public debates and efficient integration of the public in the decision making processes (for historical reasons there has always been an underestimating the importance of communication in the process of achieving social consensus);
- Insufficient institutional capability and interest by local authorities in forming local sustainable development policies - success

in achieving the goals of the Convention on Biological Diversity relies on fulfilment of demands at the local level, where people directly influence biodiversity. With regards to biodiversity there is a marked absence of a regional level in the country's organisational framework.

ENVIRONMENTAL COMMUNICATION

Environmental communication is a two-way process of social interaction (Oepen & Hamacher, 2000), allowing people to understand key environmental issues, their mutual co-dependence, and is aimed at their active involvement in solving environmental problems. The purpose of environmental communication is not merely in providing information but involves shaping a common vision on a continuous future as well as in strengthening social capacities for solving or avoiding nature conservation and environmental problems.

One-way communication (top down) prevails in Slovenia. This originates from a 'traditional' model of communication, based on centralised decision-making by a small group, informing the general public and defending decisions. The general public plays a relatively passive role in this model of communication. Governmental and non-governmental organisations use the so-called **'instructive model of communication'**, assuming that the general public need additional knowledge following which their behaviour will automatically change.

Research and experience indicate that people do not tend to change their behaviour and lifestyle solely based on knowledge. Communication represents a mechanism for achieving goals, being highly efficient in combination with other instruments, financial, economic and technological, all of which can lead to different behaviour patterns and desired changes.

The contemporary communication approach is **two-way**, based on the active public participation in the decision-making process. This approach allows us an opportunity to avoid obstacles which may lie in the path to solutions. This **'constructive model of communication'** is based on the existing knowledge of individuals and communities and is derived from an understanding and assessment of their needs. The aim is to expand on existing capabilities and develop current potentials. This form of communication is still in its early development stages in Slovenia, but a good example of this model (despite its initial problems) was the establishment of the Snežnik Regional Park, a project co-financed by the Dutch government through the MATRA programme.

The use of adequate communication methods and resources is of crucial importance in achieving success. Typically the combination of the following proves to be most efficient:

- Direct communication (hearings, group discussion, telephone calls, conferences, workshops, symposiums, round tables, exhibitions etc.);
- Communication through mass media - printed or electronic (newspapers, reviews, press conferences, brochures, manuals, radio, television, internet etc.);
- Raising awareness, education and training.

(Photo: Branka Hlad)

Figure 194. *In 1996, in Črna na Koroškem the State Authority for Nature Conservation and the Losehill Study Centre from England organised a workshop on nature conservation for school teachers.*

Direct communication

Regardless of which mode of communication is necessary for achieving efficient results on the preservation of biological diversity, it is crucial that basic conditions are met. These conditions are primarily: appropriate problem analysis; analysis of the factors generating the problems; definition of the communication goals; identification of concerned parties (target groups); selection of appropriate methods and communication channels; and promotion, assessment and upgrading of results.

The most frequent types of direct communication are:

- Conferences and consultations, e.g. the Conference on the Drava-Mura biosphere reserve; the annual conference of the EUROPARC Association; the Ramsar Conference;
- Workshops, e.g. "*The foundation of the Snežnik Regional Park*", "*Revitalisation of quarries in the Karst region*", "*Sustainable development in the Karst region*", "*Instructive workshop on ways of governing and managing protected regions*", "*Prevention of criminal activities involving birds in Europe*", an expert and inter-ministerial workshop on the preparation of "*Biodiversity Conservation Strategy*", "*Farming, nature conservation and tourism along the Mura river*" and agri-environmental programmes

for agricultural consultancy services, nature conservation services and non-governmental organisations;

- Information line - a telephone number available to future residents of the Snežnik Regional Park which will allow them to ask questions and offer suggestions;
- Media and internet contacts to support direct communication.

Although it has often been found that there is insufficient inter-ministerial co-operation in Slovenia, conditions are improving in this area. This is especially the case in forestry, which has traditionally incorporated nature-preservation principals into its legislation and programmes. Even though other areas of the agricultural sector are still insufficiently represented by inter-ministerial co-operation, successful co-operation has been established between the Ministry of Transport and the Ministry of Environment and Spatial Planning with respect to the highway network, at consultancy meetings with individual ministries in the framework of preparing the "*Biodiversity Conservation Strategy*" and in related action plans. Initial steps have also been taken by the nature conservation service on co-operation in the preparation of the state development programme (regional development programme), and noticeable progress has been reported in the area of inter-ministerial co-operation in the mining sector.

Mass media communication

According to the data from Netherlands about the impact of mass media on viewers or readers (Rientjens, 2000), we learn that the average citizen can currently choose from 35 television channels that broadcast on average 20 hours of programmes a day. Viewers, however, watch only 0.4 % of everything that is on offer. For newspapers, the figures are a little better, but on average we read less than 10 % of all the information provided. We tend to read, listen or watch those items that interest us and does not upset us. In this respect the impact of the mass media on changing our behaviour patterns regarding nature conservation or environment issues is rather limited. But, nevertheless, the mass media is indispensable and powerful at:

- Giving factual information to a large audience;
- Drawing attention to an issue;
- Stimulating discussion;
- Putting pressure on politicians and industry;
- Getting people to do something if they are already virtually convinced it is a good thing.

Despite unrealistic expectations, mass media cannot resolve problems and conflicts of interest, radically change people's attitudes or behaviour and develop consensus within society, but they can and do help. These are tasks to be undertaken by nature conservation staff and politicians and that requires planned - analytical and strategic - direct communication with stakeholders groups who have the power and means to make the changes.

Mass media messages are effective only in combination with direct communication. An additional problem with mass media communication is that people rarely have the chance to say anything back. There is usually no easy way of knowing whether the message reached them, whether they understood it, or whether they agreed with it. Respecting these limitations the effect of communication remains unclear.

The issue of nature conservation is reasonably well covered by Slovenian means of communication and the coverage and quality of the messages can be categorised as:

- News and reports;
- Articles demonstrating the inadequate verification of sources on 'both sides' and a sensationalist approach (focusing on extreme events). The 'eco-fundamentalist' approach can be seen only in rare instances;
- The subject of nature conservation usually makes the headlines during crises, giving the impression that nature conservation and biological diversity are considered a problem and not primarily an opportunity;
- Articles and reports aimed at raising awareness.

Since biological diversity is lagging in significance in regard to the problems relating to nature conservation (i.e. there are public surveys regarding environmental questions, but no surveys on biological diversity), a detailed analysis is necessary regarding the methods, content and effects of communicating information about biological diversity.

Printed media

Newspapers and periodicals. None of the Slovenian newspapers or periodicals has a column or a page dedicated to the subject of environment protection or nature conservation and biodiversity. Articles covering these issues are published irregularly, with short news reports predominating. The subject matter may be noticed from time to time in "letters to the editor" and a few newspaper supplements, for example in the supplement "Knowledge for Development" in the newspaper *Delo*.

Technical and popular science publications. There are no specialist publications dedicated to bringing together professionals and public to ensure a steady circulation and flow of information about nature conservation. This task was performed, years ago, by the magazines "*Nature Conservation*" and "*Our Environment*".

Technical and popular science magazines which occasionally cover topics related to nature conservation are "*Acta Carseologica*", "*Karst*", "*Our Caves*", "*Forestry Herald*", "*Environmental Upbringing in Schools*", "*VITRina*", *etc.* Other periodicals are published by numerous non-governmental organisations, even though their circulation is somewhat limited and heavily reliant on both public interest and the availability of financial resources.

Publishing houses periodically issue monographs and similar literature involving nature conservation issues. For example, "*A hundred natural curiosities of Slovenia*", "*Natural curiosities of Posočje*", *etc.* There are no manuals or textbooks covering biological diversity in Slovene, the closest being "*Protective Biology*" and "*Nature in Slovenia - its condition and perspectives*" (Society of Ecologists of Slovenia, 1996).

Bulletins. The Ministry of Environment and Spatial Planning has regularly published a free bulletin since 1994, occasionally including information on topics related to nature conservation, including biodiversity. It is circulated internally as well as to other ministries, the media, non-governmental organisations, etc.

The Slovenian Environmental Agency publishes a free bulletin that is primarily designed for local residents of the future Snežnik Regional Park. This introduces them to the significant ideas behind of the establishing of the park, advising them about the natural features, giving examples of good practice and providing them with answers to their questions.

Electronic media

Radio and television. Periodic coverage of current events related to biodiversity and nature conservation is limited to daily news programmes. Certain TV and radio programmes, such as "*Gore in ljudje*", "*Sprehodi v naravo*", "*Tednik*" and "*Studio ob 17-ih*", are characterised as being more thematic. Numerous documentary programmes associated with biodiversity or other nature conservation issues are imported (animal programmes prevailing), the majority of these are of superior quality. Particularly noticeable are programmes produced by the BBC. This kind of television production is in short supply in Slovenia.

(Photo: Marko Simič)

Figure 195. *The State Authority for Nature Conservation - since 2001 the Environmental Agency of the Republic of Slovenia - issues publications addressed to different target groups.*

Radio (like all other local or regional media) can be of great support in disseminating ideas and information to a precisely defined (target) region for a precisely defined (target) public. Local (regional) media has a large audience, as it reports from a familiar domestic environment. Postojna's *Radio 94* is a typical example of an insufficiently used opportunity to gain support for the founding of the Snežnik Park. The radio station covers the entire park region, it has no competition, and it is popular and has a team capable of producing programmes which people like to listen to.

The Internet. An increasing number of governmental, research and other professional institutions, private companies and non-governmental organisations have their own internet homepages, thus contributing their share of information and promotion related to biodiversity conservation.

Principal limitations of mass media communication

Some limitations of mass media communication are:

- Insufficient awareness or media interest in pursuing problems related to the importance of biological and landscape diversity as well as their association with socio-economic development. The current coverage is insufficiently systematic and sometimes even biased;

- There is no systematic approach to environmental training of journalists or journalistic/media training for environmental professionals. There are only a few authors capable of covering nature conservation issues amongst environmental themes in Slovenia;
- There is no investigative journalism covering topics on nature conservation, including biodiversity;
- Lack of skills as well as insufficient personnel and financial resources of nature conservation services being assigned to media campaigns, as well as insufficient interaction between the nature conservation sector and journalists and the media in a broader sense.

PUBLIC AWARENESS

Awareness raising is based on the notion that experiential learning and both spiritual and intuitive perception can trigger an emotional involvement (Oepen, 2000). In practice this approach is often used rather unsystematically. This is characteristic of nature conservation effort in Slovenia too.

Our public is quite positive towards species diversity conservation. The protection of different plant species during the last hundred years has helped to raise awareness of the need for nature conservation in general. But public perception concerning the protection of animal species is highly sensitive (for example, there are negative attitudes towards reptiles, "vermin", etc.).

(Photo: Peter Skoberne)

Figure 196. *Natural trails and description of natural values can help raising the awareness of the general public.*

In essence, protection of animal species has sufficient public support although the situation is a volatile one. The relationship that people have towards large animals such as bears, is typical. The public almost unanimously condemned the culling of bears in 1999, while the same public vigorously demanded and accomplished the killing of a female bear and her cubs in 1997 after the bear accidentally caused serious personal injuries to a human being.

An improvement of awareness regarding nature conservation has been accomplished in the last decade by enhancing the awareness of the protection of birds which, incidentally, largely enjoy a positive emotional public response. This positive response is primarily accomplished by campaigns aimed at broad population segments. For example, the campaign, run by DOPPS - BirdLife Slovenia and the company Mobitel, intended for mobile phone users). This original approach attracted people (e.g. a compact disk about Slovenian birds aimed at schools and Slovenian birds being displayed on urban transport buses in Slovenian cities).

Indigenous cultivated plants and domestic animal breeds are parts of biodiversity but the public has been aware of them only recently thanks to the Convention on Biological Diversity. Issues regarding genetics are not usually perceived or viewed in the context of biodiversity conservation.

Activities aimed at public awareness

In recent years, The Nature Conservation Authority of the Republic of Slovenia and Regional Institutes for the Protection of Natural and Cultural Heritage have published, on average, two brochures annually, plus leaflets and posters. For example, a brochure on "*Landscape Park Dragonja*", a leaflet on the banning of driving in the natural environment, thematic posters about "*The pearls of the Slovenian natural environment*" and "*Richness is in diversity*", etc. The Nature Conservation Authority has also co-financed the production of some publications on the initiative of local communities or other institutions and non-governmental organisations. For example "*Encountering the bear*", "*Natural heritage in the Črnomelj municipality*", "*Water richness of the High Karst*", "*Pathways by mills*", etc.)

Public institutes that manage protected areas play an important role in awareness raising. One of the primary objectives of parks is the task of introducing nature and nature conservation activities to their visitors. Messages that are con-

veyed to visitors by park authorities have a significant influence on the general public since large numbers visit these areas.

One of the most successful proponents of public awareness raising and promoting nature conservation is the Triglav National Park, which has an exemplary information centre at Log in the Trenta valley. This is visited by more than 20,000 visitors per year, with school groups foremost. Protected areas authorities publish brochures and leaflets. They co-operate with schools located in the park regions and co-operation with local residents has been intensifying lately. Regardless of this success, however, there is still insufficient use of parks in promotion of nature conservation and biodiversity.

In addition to publications, there are special nature conservation actions dedicated to public awareness raising (for example, interpretation of natural monuments or other protected areas, nature trails like the Karst nature trail from Lebica to Krupa, the water trail along the Temenica river, and the natural science trail in Rakov Škocjan), observation points and information centres (for example, the information centre in Paštba and in the former school near Dovžanova soteska and the presentation room in Jelševnik).

A number of important leaflets about biodiversity have been contributed to, or published by, highly active non-governmental organisations (thematic publications by DOPPS - BirdLife Slovenia, for example "*Bee-keeper*", "*Slovenian agriculture and birds*", thematic publications of the Society for Ornithology and Nature Conservation like "*Hedges in cultural landscape*").

Campaigns and theme days

- **European Nature Conservation Year:** Non-governmental organisations, public institutes and individual experts participated in the European Nature Conservation Year. At the end of the campaign the Ministry of the Environment and Spatial Planning published a booklet gathering data on projects that have been carried out during this campaign.
- **Geotrip:** Since 1995 the Ministry of the Environment and Spatial Planning (Environmental Agency) has co-ordinated the "Geotrip" campaign which was launched by The European Association for the Conservation of the Geological Heritage (ProGEO) and aims to make the public aware of the meaning of geology and need for conservation of the geological heritage as well as highlighting the links with other nature conservation issues and sustainable development. The Geotrip campaign started in European Nature Conservation Year.

(Photo: Baldomir Svetličič)

Figure 197. *Kočevski Rog on Kopa. In the centre of a large forest area a natural stand of Abieti-Fagetum, an old growth forest, has been protected as a forest reserve. It is important for research and education purposes.*

- **Europe, a common heritage** campaign (Council of Europe 1999/2000) aimed to make people aware of their natural and cultural heritage, strengthening the feeling of common European citizenship and tolerance towards different groups. One of the objectives was to strengthen the status of natural and cultural heritage and to use their economical and social development potential. Amongst other numerous projects and activities were examples such as, a Pan-European network of natural heritage interpretation centres, a Landscape Award from the Council of Europe, an International photographic competition, Industrial heritage events, a Day of European Heritage, a Pan-European colloquium about tourism and environment (natural, cultural and socio-economic shares of sustainable tourism), an international conference entitled "Sustainable development and tourism", etc.
- **The International Year of Bats** (Secretariat of the Eurobats agreement at the Bonn Convention, 2001): the purpose of this campaign is to raise public awareness of bats, their significance and endangered status.
- **European (World) Bird-Watching Day:** the purpose of this campaign is to raise public awareness of the importance that birds have for humans, as well as about the implementation of measures aimed at nature conservation.
- **Theme days** are dedicated to awareness raising as well, concentrating on a specific issue. For example, the International Day on Biodiversity, Wetlands World Day, Earth Day, World Water Day, and European Park Day.
- Some institutions organise **traditional days or "open door" days**. The forestry sector, for example, prepares an annual forestry week which is primarily intended to introduce forestry themes to schoolchildren. Schools have as part of their regular

curriculum the "Environmental Education Day" and a number of environmental organisations participate in an annual week of "general life studies", etc.

- **Non-governmental organisations** play an active role in public awareness raising either through organising field trips, public lectures and activities or by co-operating with companies such as Mobitel (staging competitions such as "Bird of the year" and photographic contests), the Natural Science Society of Slovenia (promoting the plant of the month/year, animal of the month/year, and biotope of the month/year) and the Society of Biology Students' section for bat studies (preparing various activities and co-ordinating European Bat Night in Slovenia).

Key capacity constrains in the field of awareness raising

The most significant constrains are:

- Lack of public awareness programs and of managerial experience in biodiversity awareness campaigns;
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- Lack of qualified environmental journalists to cover nature conservation issues and investigative reporters in the field of biodiversity;
- Insufficient promotion of positive demonstration biodiversity and sustainable development projects;
- Lack of available data regarding biodiversity and natural values. .

BIODIVERSITY EDUCATION

Biodiversity is a complex of large systems, natural, human or a combination of both, with many elements and processes, often complex and difficult to comprehend. Most people have insufficient or no training to handle these issues as a whole (even at the 'expert' level). The most effective way to address all these issues is through teamwork which is not practiced sufficiently.

An important message that should be integrated into the educational and communication system more often is the fact that our existence highly depends on the condition of natural diversity and natural resources. Values and attitudes are direct results of experience and learning, while education and communication are the means that allow this process to be guided.

Target groups range from highly specialised groups to the general public, while the learning contexts for biodiversity education are home, community, formal education, post-school education, workplace, and recreation and leisure.

One of the firm attempts to have active and continuous co-operation between the Ministry of the Environment and Spatial Planning and the Ministry of Education, Science and Sport was the conference entitled "Environmental Education - a Way Towards a Change". The Ministry of Education, Science and Sport has also organised some other conferences and round table discussions in the field of environmental education, such as "Trends in environmental education".

Formal education allows the acquisition of elementary knowledge and the understanding of physical, chemical and biological links that exist between complex ecosystems and their response to human intervention at local, regional and global levels. Individual agendas on biological diversity exist in curricula relating to environmental upbringing and education as follows.

Definitions of Environmental Education

IUCN 1970: Environmental Education is the process of recognising values and clarifying concepts in order to develop skills and attitudes necessary to understand and appreciate the inter-relatedness among humans, his culture and his biophysical surroundings. Environmental education also entails practice in decision making and self-formulation of a code of behaviour about issues concerning environmental quality.

UNESCO 1977: To foster clear awareness of, and concern about, economic, social, political and ecological interdependence in urban and rural areas; to provide every person with opportunities to acquire the knowledge, values, attitudes, commitment and skills needed to protect and improve the environment; to create new patterns of behaviour of individuals, groups and society as a whole towards the environment.

Recently in international terminology we can also meet terms like "biodiversity education and public awareness", "learning for sustainability", "education and sustainable development", "education for sustainability".

Elementary schools

Environmental issues in elementary schools are entirely represented and implemented in the subjects of natural history and biology and partially in the subjects of chemistry, physics and geography. Topics related to environmental education are discussed also by study groups of teachers teaching the subject "ethics and society".

Environmental issues in the new nine-year elementary school curriculum: environmental education is defined as having a universal character, represented in all subjects. The curricular team responsible for environmental education has proposed its formal representation in the curriculum.

Subjects that are linked to environmental education are introduction to the surroundings, natural and technical science, natural science, biology, physics, chemistry and geography.

The above subjects, biology in particular but with physics and chemistry contributing substantially, provide the basic knowledge necessary for identification, understanding and addressing of environmental problems.

Secondary schools

Gymnasiums. Environmental education is defined as cross-curricular program represented in all subjects. The curricular team responsible for environmental education has reviewed its formal representation in the curriculum. In addition, the optional subject of environmental research has been confirmed. Even at this educational level, biology and other natural science subjects play an important role. Equally important are the subjects of geography and sociology, which cover certain environmental topics. Environmental issues are formally covered in different documents, but precise data on the implementation of environmental education is not yet available.

Vocational schools. In the vocational education system the required number of biology and other natural science classes has either been reduced or eliminated after curricula reform. This action is decreasing the level of basic knowledge required for identification, understanding and addressing of environmental problems, while some renewed educational programmes do not even provide the basic knowledge. All this reduces or, in some cases, even eliminates the groundwork that has been designed to achieve the objective - environmental awareness in vocational behaviour.

Project work. In the framework of different projects, one of the most noticeable and widely accepted was the project named "The eco-school as way of life" (FEEE) which unfortunately received insufficient support from both the Ministry of the Environment and Spatial Planning and the Ministry of Education, Science and Sport.

Undergraduate study

Nature conservation issues are represented in a few individual subjects in undergraduate studies on landscape (for example natural heritage protection) and forestry (for example protected areas). Particular conservation issues are included in different subjects within biological studies, for example, ecology, eco-sociology, taxonomy, etc.

Postgraduate study

Postgraduate study in protection of natural heritage at the Biotechnical Faculty, started in 1996/1997, is the only comprehensive and oriented postgraduate study programme on natural heritage protection in Slovenia. The purpose of this study programme is to raise awareness of natural heritage issues and to integrate nature conservation principals in all activities that influence it. It includes natural science and sociological content. Strengthening ties to economic aspects might be considered more as well.

Postgraduate studies in environmental protection are organised through the Faculty for Environmental Science in Gorica. The purpose of these studies is interdisciplinary education in areas of basic and applied environmental research. Interdisciplinary study on environmental protection is organised at the Faculty of Civil and Geodetic Engineering since the basic purpose of the study programme is to provide detailed education on environmental issues in the framework of natural sciences, technology, physical planning, pollution standards, management training, public relations, processing complex projects and environmental impact assessment.

In the area of education about the environment and biological diversity the following **weaknesses and negative trends** can be identified:

- The cross-curricular programme on environmental education covers only a narrow part of the environmental protection subject, bi-

(Photo: Marko Simić)

Figure 198. *A group of post-graduate students on their field-work at Sv. Kirik above Sočerba.*

ological diversity and wider nature conservation content is not evident;

- The optional subject of 'environmental education' formally indicates the usage of this topic, but it is still not being confirmed in practice. This activity requires teamwork, not only from natural science teachers but from sociology teachers as well, and this is not sufficiently developed or stimulated. Not a single school carries the subject yet;
- Pressure on reducing the number of hours of the natural science curriculum or even its elimination, particularly in vocational schools;
- Biological diversity and its significance on nature conservation and its sociological importance as well as the relation to human health and quality of life have been insufficiently addressed, with a few exceptions related to biology;
- Excessive emphasis and 'intrusion' of 'environmental education' causes negative consequences, as it deals with a sensitive environment where goals are in correlation with personal decisions made by each individual in a certain cultural and social milieu (in the area of transformation of values, ethics, acknowledgement of personal rights, etc.). The same goes for teachers and their motivation in emphasising environmental education goals. Existing documents formally contain an environmental agenda, but there is no data on whether this agenda is being implemented;
- The interdisciplinary approach of undergraduate and postgraduate studies insufficiently incorporates sustainable development issues;
- The relation between biological diversity and economic and social development is insufficiently emphasised;
- Lack of strategy and systematic support for projects such as "The eco-school as way of life"; an integral part of this complex agenda is played by the modest supply, demand and interest demonstrated for specific training in this area;
- Lack of adequate literature.

Training

In-service training in nature conservation organisations

Employees currently working in the nature conservation field mostly have qualifications in the natural sciences. The number of legal experts is insignificant while there are no sociologists or economists in positions relating to nature conservation.

Training of employees in nature conservation organisations is basically limited to computer and language-related courses. However, training is not sufficient in the other skills required for nature conservation. There is a particular deficiency in skills training for: project management, implementation of statutory duties, planning, economics and financial matters, and stakeholder communication, etc.

In practice there is an increasing deficiency of training in the following fields:

- Integrated planning;
- Project management;
- Strategic and planned communication - use of communication as a tool to achieve nature conservation goals. This should be integrated into projects from the very beginning of all nature conservation work;
- Communication with the stakeholders;
- Crisis management, negotiation skills and lobbying;
-

External training

The role of the state is increasingly committed to co-ordinating and steering actions, while their implementation is contracted out to different professional institutions, non-governmental organisations, individuals, etc. Due to this, different types of training programs are necessary. For example, for mapping, for campaigns aimed at boosting the popularity of nature and environmental protection for management of direct means of communication, for education related to the environment and biological diversity, and adequate training of different target groups such as teachers, tourist services, agricultural advisers and farmers, water management services, etc. The nature conservation service has no independent organisation covering this field, nor does such exist elsewhere, therefore all activities concerning planned training about the preservation of biological diversity and nature in general, remain only coincidental. One of these activities was a seminar designed for teachers on the subject of "Environmental Education - methods and techniques for teachers" organised by the Slovenian Nature Protection Authority and Field Study Centre Losehill Hall, Peak District National Park in Great Britain.

All other activities are solely based on the personal initiative of nature conservation professionals , who respond to invitations of individual schools and the Institute for Education of the Republic of Slovenia or participate in campaigns and theme days.

Teachers are one of the most important mediators of knowledge and values; therefore they are one of the principal target groups for training on nature conservation. Another significant target group consists of non-governmental organisations as they have, at least in principle, a good knowledge of local environments.

It is widely thought that environmental and biological diversity education lies solely within the remit of educational institutions, yet according to the natural conservation service, interdisciplinary collaboration is essential. An institutional form of collaboration is essential and in particular, one that focuses on the education and training of different target groups - decision makers, lawyers, border control authorities, prosecution bodies, inspectors, reporters, nature conservation supervisors, teachers and instructors, field trip organisers and other employees in tourism, etc. Furthermore, specialised nature conservation organisations are considered to be appropriate fora to convey nature conservation ideals to experts, whose basic education has insufficiently considered nature conservation issues. The Biotechnical Faculty co-operates in the European project LEONARDO (TOPAS), dedicated to nature conservation training intended for employees working in protected regions.

OTHER FORMS OF CO-OPERATION AND PUBLIC PARTICIPATION

Environmental communication is a dialogue between people who are interested or affected by environmental or nature conservation issues enabling them to understand key elements and the co-dependency thereof.

Co-operation and partnership

Perhaps the main value of the Convention on Biological Diversity is that it directly links biodiversity conservation to other human activities such as farming, public health, energy, education, recreational activities and tourism. Efficient conservation depends on adequate public understanding and support for the implementation of particular policies and on their individual involvement in these events.

Companies play a crucial role in dealing with problems relating to nature and environmental protection. People are dependent on companies as they provide them with income, while on the other hand the state is interested in economic growth. This is why companies play an important role in society and are considered as being a potential partner in striving to preserve biological diversity. Both government and non-governmental organisations have to communicate with companies and an increasing number of companies in Slovenia are becoming aware of the necessity for nature and biological diversity preservation making them actively participate in different programmes relating to this matter. Companies, which are aware of the fact that their production is more competitive by applying nature conservation standards, are becoming particularly active. Some of them financially support the activities of non-governmental organisations, thus exercising a direct influence on a higher degree of environmental and biological diversity awareness.

Inter-institutional co-operation

In the opinion of some experts who have been reviewing the state of affairs in individual areas of biological diversity, there is a lack of interest in co-operation in projects of a more intra- and inter-disciplinary nature. Scattered data located in different institutes represents another hindering factor with access to this data being difficult, sometimes even impossible.

(Photo: Peter Skoberne)

Figure 199. *Many problems in nature conservation are due to lack of communication. A workshop on communication organised at Brdo in 1998, as part of an IUCN project in the framework of the European Biological and Landscape Diversity Strategy (PEBLDS).*

The following reasons are given:

- Fear that data, once conveyed to the central database, might be misused;
- Mistrust about the agreed distribution of finances;
- Fear of being in a subordinated position in a larger group and lack of democratic professional dialogue;
- Insufficient international recognition;
- Bureaucratic obstacles;
- Complications often arising, as the legal status of data ownership is not clearly defined. Data obtained through projects financed by state budget funds should be available at least to all interested parties in the public sector.

Public participation

Public participation is essential for satisfactory and efficient preservation of biological diversity as well as for wider nature and environmental protection, as in this way people can identify themselves more with proposed solutions. People have the right to co-operate in decision making regarding every topic that affects their lifestyle and their environment - legislature formation, private initiatives, infrastructure construction, etc. (Hesselink et al., 2001). In this context, nature conservation policy should include a communication strategy on problem solving, stipulating adequate methods and implementation timetables. Such planning, focused preparation and implementation of a particular nature conservation policy is poor, problems raised, for example, during the establishment of nature parks are tackled more or less on a 'crisis' basis.

(Photo: Marko Simič)

Figure 200. *Dolenje Jezero. Vekoslav Kebe has made a model of the Cerknica lake which represents the complex system of the intermittent lake.*

The reasons that public participation is not sufficiently used as a potentially efficient instrument are:

- Lack of tradition in the field of participative democracy; lack of practical models for public participation;
- The complexity of nature conservation issues and lack of adequate training for solving problems;
- Insufficient role of non-governmental organisations in bridging the gaps in knowledge and finding solutions through education, awareness, public debates, etc.;
- Lack of financial funds at state level, insufficient use of international financial funds;
- The belief that the costs of nature and environmental protection provisions represent an unacceptable burden to industry and companies;
- Inadequate recognition of the benefits of such an approach offers by preventing accumulation of unsolved problems and their final, unmanageable proliferation;
- Fear of conflict with local inhabitants and other concerned parties;
- Inadequately trained staff for planning and managing different types of communication activities, including suppression of crisis situations;
- The influence of citizens and non-governmental organisations that are familiar with local areas and local conditions is often ignored while signals sent from the field are not taken seriously;
- Insufficient interest and qualifications of the non-governmental public in the planning process, due to the lack of knowledge on the legislature and consequently the insignificant influence on these matters;
- Insufficient endeavour in what concerns ratification and implementation of the Aarhus Convention on Access to Information, Public Participation in Decision Making and Access to Justice in Environmental Matters;
- Insufficiently profiled structure of non-governmental organisations in the social environment and at times their imprecise role, although they represent a strong ally in achieving nature conservation goals;
- Neglect of the communication aspect in implementation of nature conservation projects.

BIODIVERSITY RESEARCH

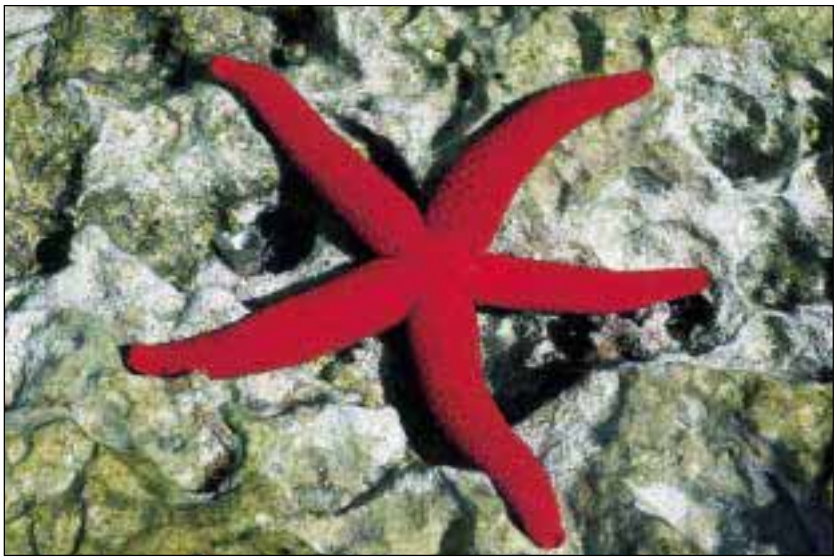
The Convention on Biological Diversity fosters the research which contributes to the conservation of biodiversity and the sustainable use of its components and taxonomic research. The relevance of cooperation between the research and expert training of other participants has been emphasised.

In Slovenia, research on biodiversity is facilitated by the state through the financing of research staff and the relevant projects. The budget funds are primarily allocated by the Ministry of Education, Science and Sport, in cooperation with other ministries when the multidisciplinary research is concerned. The Slovenian research institutions which have been granted funds in the last five years are listed in table 66. The number of institutions which conduct research and studies in the field of biodiversity and sustainable use of its components is undoubtedly higher than indicated in the table but the complete central register has not yet been completed. The institutions which participated in the drawing up of this publication are listed at the CHM home page. In part, the funds intended for the research into biodiversity are acquired from abroad and from certain development oriented undertakings. The manner in which the research and studies are financed has changed substantially over the years.

Since 1999/2000 the major part of the State funds for the financing of the research has been intended for research programmes conducted by the programme groups of the research institutions. A research programme covers a certain field which is expected to be globally topical for at least another decade and is relevant to Slovenia, and for which the interest at the national level is such that the programme group operates on a long-term basis.

Many researchers participated in the preparation of this publication, and as a result many new proposals for the future research projects have been presented. Globally speaking, there are not many efficient approaches to the biodiversity conservation, and the fact that the funds are extremely limited inevitably leads to the selection of discoveries needed for its conservation. Knowledge is essential to formulating the methods applied in the conservation of biodiversity and the sustainable use of its components and in the study of the characteristics of biodiversity components (species and ecosystems). Multidisciplinary knowledge is becoming more and more important. However, certain basic research works and studies still have to be conducted:

- basic research in the field of systematics, evolution biology, biogeography, ecology and genetics;
- research into factors which affect biodiversity (time and spatial changes in communities, ecological demands of endangered species; successional stages with the highest number of endemic and characteristic species);
- research and studies on *in situ* biodiversity conservation;



(Photo: Marko Simić)

Figure 201. *Flora and fauna of the Slovenian sea need further detailed research.*

Table 66: *Overview of the research projects and programmes on biodiversity and its components funded from the State budget (Source: IZUM, Ministrstvo za šolstvo in znanost; 2001)*

Project	Research institution	Period
Biodiversity of microfungi in the saltpan water	Kemijski inštitut, UL-Faculty of Medicine	1998-2001
Biodiversity of the polyploid complex Dactylis glomerata in Slovenia	UL-BF-Dept of Biology, NIB	1999-2001
Biotope and biocenosis valuation of the river Mura and its surroundings	ZRC SAZU, UM-PF	1998-2003
Flora, fauna and vegetation of the Škocjanske jame Regional Park	ZRC SAZU	2000-2002
Grassland management, floristic diversity and plant durability	UM-Faculty of Agriculture, UM-PF	1999-2001
Taxonomy, evolution biology and biodiversity of the selected animal groups	PMS	1996-2001
Biodiversity and phylogenetic and biogeographical samples in karst	UL-BF- Dept of Biology	1997-1999
The biodiversity of fungi endophytes in biochemically defined spruces, their ecophysiological characteristics and antagonistic activities	UL-BF-Dept of Forestry, GIS*, ZRC SAZU	1997-1999
The recording, evaluation and management of natural heritage outside protected areas	ZRCRS, Koper	1996-1999
The natural heritage of threatened wetland habitats	NIB	1998-2002
Computer system for the evaluation of ecological factors on the aquatic environment	NIB	1997-1999
Forest sustainability and biodiversity	UL-BF- Dept of Forestry UL-BF- Dept of Biology	1998-2001
The implementation of the spatial aspects of habitats agenda in Slovenia	Urbanistični inštitut RS (Planning Institute)	1998-2000
Geographic microregionalisation of Slovenia	ZRC SAZU	1996-2000
The landscape heritage of Slovenia and its contribution to the national spatial identity	UL-BF-Dept of Agronomy	1996-2000
The impact of the quality of the environment and environmental awareness on the balanced development of urban landscape	Inštitut za geografijo (Institute of Geography)	1997-1999
Programme		**Period**
Genetics, varietal selection and testing of technologies in agriculture	KIS	1999-2003
Forestry and renewable forest resources	UL-BF- Dept of Forestry	1999-2003
Ecology and the protection of the environment	UL-BF- Dept of Biology	1999-2003
Ecotoxinology and ecotoxicology	NIB	1999-2003
Forest biology, ecology and technology	GIS*	1999-2003
Interdisciplinary aspects of the Mediterranean Slovenia and the European contact areas	ZRSRS, Koper	1999-2003
Research on the sea and coastal area	NIB	1999-2003
Plant production	UM- Faculty of Agriculture	1999-2003
Applied botanics, genetics and ecology	UL-BF- Dept of Agronomy	1999-2003
Bioreactor engineering and fungi biotechnology	KIS	1999-2003
The composition and functioning of ecosystems	NIB	1999-2003
Zoological and speleobiological research	UL-BF- Dept of Biology	1999-2003
Landscape planning and environmental protection	UL-BF- Dept of Agronomy	1999-2003

Abbreviations:

ZRSRS, Koper	The Science and Research Centre of the Republic of Slovenia, Koper
ZRC SAZU	The Scientific Research Centre of the Slovenian Academy of Sciences and Arts
UL	University of Ljubljana
UM	University of Maribor
NIB	National Institute of Biology
GIS*	Slovenian Forestry Institute
BF	Biotechnical Faculty
PF	Pedagogical Faculty

- research and studies on the methods applied for the sustainable use of biodiversity;
- research on the pressures caused by economic activities on biodiversity;
- social and economic advantages of biodiversity conservation;
- research on the legal, economic and sociological mechanisms for solving nature conservation issues and their increased efficiency;
- research on the landscape features, the relation between landscape composition and the comprehension of its diversity.

It has often been difficult to acquire the research results which would fit the needs of the nature conservation service, in particular for correct interpretation of the data. The applicability of the research data will improve with their adequacy in the planning of environmental protection or development directions for specific areas.

O hranjanje narave

Kakšna je naravna podoba Slovenije?

Slovenija je majhna in raznolika država, po površini nič večja od jezera Ontario v Kanadi. Zaradi burne geološke preteklosti je njen relief zelo razgiban in upravičeno smo ponosni na izjemno bogato geološko, geomorfološko in hidrološko dediščino.

Lega na stičišču sredozemske, panonske, alpske in dinarske biogeografske regije je razlog za veliko pestrost ekosistemov ter rastlinskih in živalskih vrst, med katerimi so mnoge endemične, torej živijo le pri nas. Njihov posebno značilen življenjski prostor so gozdni, podzemni in vodni ekosistemi, mokrišču, morje, alpski in gorski svet, suha travišča ...

Kaj pa varstvo narave danes?

Prizadevanje za ohranitev narave, ustavljanje okolja in zmanjšanje nezaznetne rabe naravnih virov je povsod po svetu večje kot kdaj prej. Dokaz za to so čedalje številnejše mednarodne konvencije, zahteve zakonodaje Evropske unije in druge oblike odpravljanja naravovarstvenih in okoljevarstvenih vprašanj. V Sloveniji je celovit sistem varstva naravnih vrednot in ohranjanja biotske raznovrstnosti vzpostavil Zakon o ohranjanju narave, sprejet leta 1999. Ventar le napisati zakon ni nikoli dovolj. Ljudje ga moramo upoštevati in tudi kaj storiti, npr. spremeniti svoj življenjski slog.

Odgovorni smo za ohranitev narave, njenih medsebojno povezanih in soodvisnih delov in naravnih procesov.

Od kdaj imamo pri nas varstvo narave?

Začetki varstva narave na Slovenskem segajo v konec 19. stoletja. Leta 1908 je grof Auersperg izdal ukaz o gospodarjenju s 305 ha kočevskih gozdov. Leta 1907 je bila na Gorjušah, v tedanji Avstro-Ogrski monarhiji, ustanovljena - pravilo (ravnokar-dium objavljeno). Prvi program varstva narave je 1920. upravelika Spomenica Odseka za varstvo prirode in jelenskih spomenikov Muzejskega društva Slovenije. Pobuda iz Spomenice se bila uresničena leta 1924 z zavarovanjem alpskega varstvenega parka Dolina Triglavskih jezer, ki je bil med prvimi narodnimi parki v Evropi. Naravovarstveni gibanja so vse bolj krepilo, pravi so se novi aktivni, nastajali so novi zavarovana območja in organizacije so je strokovna skupina, o zahteve ljubiteljev so bile vedno vodila in so aktivno se skrbeli.

Kljub hitremu povečevanju nacionalnih in mednarodnih okoljevarstvenih in naravovarstvenih zahtev in dokumentov, rastlinske in živalske vrste izginjajo, naravna območja pa se zmanjšujejo in drobijo. To lahko primerjamo s sežigom knjižnice, saj je pestrost živega in neživega sveta neprecenljiva zakladnica podatkov. Edini način in prava, četudi zelo dolga pot k zmanjševanju pritiskov na naravno okolje sta povezanost in sodelovanje vseh nas.

Odgovorni smo za ohranitev narave, njenih medsebojno povezanih in soodvisnih delov in naravnih procesov. Od razumne rabe naravnih virov ter varovanja naravnih vrednot in biotske raznovrstnosti sta odvisni tudi kakovost našega življenja in podoba Slovenije. V tem duhu so temeljni cilji ohranjanja narave predvsem:

- ohranjanje narave in zagotavljanje uravnoteženega delovanja naravnih procesov;
- ohranjanje biotske raznovrstnosti;
- ohranjanje in varovanje naravnih vrednot;
- ohranjanje različnih tipov krajin in ustrezne rabe prostora;
- obnavljanje prizadetih naravnih vrednot in drugih naravnih površin oziroma življenjskih prostorov rastlinskih in živalskih vrst.

BIODIVERSITY MONITORING

In general, monitoring is defined as a periodic and standardised observation of the state of the selected indicators at the sampled areas which shows the changes in the country. The monitoring results are fundamental for the formulation of activities to be carried out and measures to be taken to meet the relevant objectives. Subsequently the results measure our success in the attainment of the objectives. Monitoring is thus a means of improving the efficiency of activities and measures focused on the attainment of the objectives. The main goal of the Convention on Biological Diversity is biodiversity conservation, and the measures needed to meet this goal form its constituent part. In order to increase the efficiency of these measures, the decisions and recommendations of the Convention stipulate the selection of indicators which give the state of biodiversity and the indicators which show the processes and activities with adverse effects on biodiversity conservation.

MONITORING OF THE STATUS OF BIODIVERSITY

Monitoring of the status of biodiversity in a certain country is based on the knowledge about the components of biodiversity (ecosystems, habitats, species, populations, genes) and the availability of human resource and funds. In most countries the funds are extremely limited, which hinders the establishment of wide monitoring networks. In its accompanying documents the Convention recommends the collection of data which form a basis for the introduction of the relevant activities and measures and their monitoring. Within the process of the **monitoring of species** the main indicators are the endangered and endemic species and the species which are of medicinal, agricultural and other economic, social, scientific or cultural importance. The **monitoring of ecosystems** should be oriented towards: ecosystems with high biodiversity; those with numerous endemic or endangered species; ecosystems which support migratory species; ecosystems of social, economic, cultural or scientific importance; ecosystems which are representative and unique, or where the key evolutionary or other biological processes are present. **The genetic monitoring** should be focused on the described genomes and the genes of social, scientific or economic importance.

(Photo: Peter Skoberne)

Figure 202. *Papaver rhoeas, its survival depends on compatible agricultural practices.*

In general, the species and ecosystems are not limited to a certain country, and it is necessary that the monitoring results be comparable at the international level.

Monitoring of species

In the past, the monitoring of species was spontaneous. It reflected the interest of the na-

(Photo: Marko Simić)

Figure 203. *Research and monitoring is urgently needed on the large and ecologically most important grasslands where vegetation encroachment is causing considerable and rapid changes.*

ture scientists who conduct research on specific species, or of nature lovers, individuals and organised groups. It is considered that a species is monitored if that species had been inventoried at least twice while taking into account its distribution pattern, and if the population density and the relevant trends can be assessed. The data enable scientists who are familiar with the biology of the species to assess its endangerment. Monitoring is a useful tool for determining the species' area of distribution and the population size or density. In Slovenia the monitoring of population density is carried out for one bat species, game species, in particular hoofed game, certain endangered bird species, certain freshwater species, plankton, nekton and benthic marine organisms (summarised according to Kryštufek, 1999 and Lipej, 1999; supplemented by the monitoring reports for CHM, 2001). The national data on species' area of distribution can form a basis for conclusions about the changes in the size of the territory occupied by a specific species. In Slovenia the species' areas of distribution (point data or data according to the UTM system) have been defined for mammals, birds, reptiles, odonates and endangered butterfly species (source in Kryštufek, 1999), endangered flowering plants and the ferns (Wraber & Skoberne, 1989), tree species (Research report on Slovenian forestry and wood technology, No. 52) and other specific species or lower taxa.

Figure 204. *A grassland under Morež in the Julian Alps. Due to the short growing season, the alpine grasslands are the most colourful in early summer.*

(Photo: Marko Simić)

The status is similar in other European countries, and the main reasons are the shortage of trained and organised surveyors and the lack of funds. In comparison to the environmental monitoring, the monitoring of biodiversity can not be automated by the use of various automated measuring stations. For this reason the European countries (for example Great Britain, Finland, Hungary, the Netherlands) apply only a few indicators in the monitoring of the status of biodiversity. These are usually the species or taxonomic groups which clearly indicate the status of biodiversity in a certain ecosystem or habitat and which are monitored by many amateurs or professionals (species of mammals, birds, fish, butterflies, beetles, dragon flies, higher plants).

Monitoring of ecosystems

The monitoring of ecosystems should be focused on the indicators which provide information about the ecosystem's surface area in the country, its use categories, the changes in the structure of the leading species and the quality (degradation or conservation) of an ecosystem.

In Slovenia similar monitoring activities have been carried out in some protected areas, for example in the Triglav National Park and the Škocjanski zatok Nature Reserve. The status of a specific ecosystem within the entire protected area and the presence or density of a selected species are being monitored (Source: the monitoring reports for the CHM, 2001).

In the monitoring of the dry and semi-dry grasslands in North-East Slovenia and of the Triglav lakes those indicators are applied which show the quality of the ecosystem and the presence of selected species (Source: the monitoring reports for the CHM, 2001).

The quality of surface waters is monitored at the national level at more than 100 sampling points (Source: the Hydrometeorological Institute). Although the indicators used in this monitoring have not been selected to implement the Convention, they do partly indicate the quality of an ecosystem (the basic physical, chemical and bacteriological parameters, saprobiological parameters, the content of selected metals in water, suspended particulates and sediment, the content of the selected organic compounds, wa-

ter levels and flows) and the composition for the saprobe index of the indicator species. Some of these may be defined as leading species. For the monitoring of Blejsko jezero and Bohinjsko jezero, those indicators are used which show the process of eutrophication and determine the lakes' productivity and the structure of the plankton species. In addition, Cerkniško jezero and some large reservoirs are regularly monitored. The indicators used in the monitoring of the underground water and karst springs show the quality of an ecosystem but they are merely abiotic (physical and chemical indication, heavy metals, organic micropollutants and selected organic compounds). In the national monitoring of the Slovenian sea and coastal habitats, those biotic and abiotic indicators are included which show the quality of an ecosystem to a certain point.

The national monitoring of the status of forests at the habitat level is one of the monitoring processes which has lasted longest and includes the highest number of selected sample areas covering the entire territory of the country. Its purpose is to monitor the effects of the air pollution and other environmental factors on forests and to obtain information on the development of forests. In order to implement the Convention the monitoring data include the data on the surface area of forests, different use of forests, the changes in the structure of the leading species (the indicator is a population density of approximately 50 tree species) and the quality of the ecosystem.

Monitoring of genetic diversity

The Convention is focused primarily on the monitoring of the species of economic importance, mainly those used in agriculture, forestry and medicine.

LISTING THE STATUS OF BIODIVERSITY

The accompanying documents of the Convention stipulate that the lists of species, the lists at the ecosystem level, and the lists of genes have to be kept as the **next level of data** which facilitate the establishment and monitoring of the activities and measures. The **list of species** which are distributed in Slovenia is almost complete with regard to vertebrates, echinoderms, most genera of insects, myriapodes, crustaceans, molluscs, cnidarians, sponges, flowering plants, ferns, algae and blue-green algae (summarised according to Mršić, 1997 and Kryštufek, 1999) and lichens (Suppan et al., 2000). The gap between the number of the recognised and expected species is widest with regard to the mosses, numerous lower taxones of *Diptera* and *Hymenoptera, Lingua tulida, Nemerteans, Aschelminthes, Protozoa* and *Bacteria* (Mršić, 1997).

The **list of ecosystems** present on the territory of Slovenia has been compiled. The communities which form the basic types of ecosystems are classified in detail by the PHYSIS classification of habitats. The ecosystems in Slovenia have been reviewed (Dobravec et al., 2001). The European Union has defined habitats with many endemic and endangered species, and the relevant overview has also been conducted in Slovenia (Skoberne 2000).

The **list of genetic variability** is focused primarily on the monitoring of species of economic importance, mainly those used in agriculture, forestry and medicine. The genetic variability has been described for several species used in the mentioned sectors (forest trees, agricultural cultural plants, domestic animals, medicinal plants, marble trout).

MONITORING OF THE IMPACTS ON BIODIVERSITY

In order to formulate appropriately the objectives of the biodiversity conservation and the sustainable use of its components it is of utmost importance to be familiar with the processes and activities whose impact on biodiversity is detrimental. Together with the monitoring of the selected indicators the fulfilment of the stipulated objectives is monitored.

(Photo: Marko Simić)

Figure 205. *The Sava river at Hotiče formed this magnificent meander - a natural value in itself - while the river dynamics support rich habitat diversity.*

As the first step towards obtaining the relevant data, the Convention proposes drawing up **the inventory of the activities with a detrimental impact on biodiversity**. The activities which cause the decrease in biodiversity are listed in Beltram and Skoberne, 1997 and Pirc-Velkavrh, 1998. Certain indicators showing the develop-

ment of main polluters which are listed in Pirc-Velkavrh, 1998, may also be used to monitor the processes and activities with a negative effect on biodiversity. The development of specific indicators concerning biodiversity and its monitoring is closely related to the attainment of the objectives. These indicators must be clearly formulated when the strategic and action objectives of the conservation of biodiversity and the sustainable use of its components have been defined.

In Slovenia the keeping of lists and monitoring results has not been organised, thus the public does not have free access to the relevant data. This weakness is partially remedied by publications which are accessible to the public (technical magazines, books, occasional publications) and in which such data are published (the overview of the zoological contents can be found in Kryštufek, 1999).

EXPLANATION OF ABBREVIATIONS AND PARTICULAR TERMS

APP - Agencija za plačilni promet (Agency for Payments Transactions)

BF - Biotehniška fakulteta (Biotechnical Faculty)

BS - Banka Slovenije (Bank of Slovenia)

GDP - gross domestic product

CAP - Skupna kmetijska politika EU (Common Agriculture Policy of the European Union)

CEC - Komisija za okoljsko komuniciranje in izobraževanje pri IUCN (IUCN Comission on Education and Communication)

CHM - posredovalnica informacij Konvencije o biološki raznovrstnosti (Clearing House Mechanism)

CITES - The Convention on International Trade in Endangered Species of Wild Fauna and Flora

CKFF - Center za kartiranje favne in flore (Centre for the Mapping of Fauna and Flora)

CORINE - Co-ordination of Information on the Environment

CWEU - Conventional Wisdom Scenario of the EU

DABA - database of algae species

DOPPS - Društvo za opazovanje in proučevanje ptic Slovenije (DOPPS - BirdLife Slovenia)

ECP/GR - European Cooperative Programme for Crop Genetic Resources Networks

EEA - European Environmental Agency

EECONET - European Ecological Network

EAGGF - European Agricultural Guidance and Guarantee Fund

EIA - Environmental Impact Assessment

EIONET - European Environment Information and Observation

EPO - ekološko pomembno območje (ecologically important area)

EUFORGEN - European Forest Genetic Resources Programme

FAO - Food and Agriculture Organization

FGG-IZH - Fakulteta za gradbeništvo, Inštitut za zdravstveno hidrotehniko (Faculty of Civil and Geodetic Engineering, Institute of Sanitary engineering)

FGG-LMTE - Fakulteta za gradbeništvo, Laboratorij za mehaniko tekočin (Faculty of Civil and Geodetic Engineering, Laboratory for the mechanics of fluids)

GEF - Global Environment Facility

GIS - Geographic Information System

GIS* - Gozdarski inštitut Slovenije (Slovenian Forestry Institute)

GMO - genetically modified organisms

GSI - Genuine Savings Index

IBA - Important Bird Areas

IDA - Internationaly Depositary Authority

IMD - International Institute for Management Development

IPGRI - International Plant Genetic Resources Institute

IZUM - Inštitut informacijskih znanosti (Institute of Information Science)

IUCN - World Conservation Organisation

IZRK - Inštitut za raziskovanje krasa (Karst Research Institute)

KIS - Kmetijski inštitut Slovenije (Agriculture Institute of Slovenia)

LJM - Herbarij Prirodoslovnega muzeja Slovenije (Herbarium Collection at the Slovenian Museum of Natural History)

LJU -Herbarij Biološkega oddelka Biotehniške fakultete Univerze v Ljubljani (Hrbarium Collection at the Department of Biology of the Ljubljana Biotechnical Faculty)

MAB - UNESCO Man and Biosphere programme

MF - Ministrstvo za finance (Ministry of Finance)

MOP-ARSO - Ministrstvo za okolje in prostor, Agencija RS za okolje (Ministry of Environment and Spatial Planning, Environmental Agency of the Republic of Slovenia)

MOP-ARSO, Urad za monitoring - Ministry of Environment and Spatial Planning, Environmental Agency of the Republic of Slovenia - Monitoring Office

MOP-ARSO, Urad za meteorologijo - Ministry of Environment and Spatial Planning, Environmental Agency of the Republic of Slovenia - Meteorological Office

MZKI - Mikrobiološka zbirka Kemijskega inštituta (Microbiological Collection of the Chemicals Institute)

NEAP - National Environmental Action Programme

NIB - Nacionalni inštitut za biologijo (National Institute of Biology)

NGO - Non Governmental Organisation

OECD - Organisation for Economic Cooperation and Development

PHARE - Trade Agreement of the European Union and Central and East Europe

PHYSIS - Database of Palaearctic Habitats

PMS - Prirodoslovni muzej Slovenije (Slovenian Museum of Natural History)

RTG - Road transport of goods

SGGB - Slovenska gozdna genska banka (Slovene Forest Gene Bank)

SGRS - Strategija gospodarskega razvoja Slovenije (Strategy of Economic Development of Slovenia)

SKOP - Slovenski kmetijsko okoljski program (Agri-Environmental Programme of Slovenia)

CAP - Common Agricultural Policy

SAC - Special Area of Conservation

SNH - Scottish Natural Heritage

SPA - Special Protection Area

SSC - IUCN Species Survival Commission

SURS - Statistični urad Republike Slovenije (Stistical Office of Republic of Slovenia)

TEMPUS - Trans European Mobility Sheme for Higher Education

UMAR - Urad za makroekonomske analize in razvoj (Institute for Macroeconomic Analysis and Development)

UNEP - United Nations Environment Programme

URSVN - Uprava RS za varstvo narave (Nature Conservation Authority or Republic of Slovenia, since 2001 Environmental Agency of Republic of Slovenia)

UTM - Universal Transverse Mercator Coordinates

VGI - Vodnogospodarski inštitut (Water Management Institute)

WB - World Bank

WCMC - World Conservation Monitoring Centre

ZGS - Zavod za gozdove Slovenije (Slovenian Forestry Service)

ZIM - Zbirka industrijskih mikroorganizmov (Collection of Industrial Micro-organisms)

ZON - Zakon o ohranjanju narave (Nature Conservation Act)

ZRC SAZU - Znanstveno raziskovalni center pri Slovenski akademiji znanosti in umetnosti (The Scientific Research Centre of the Slovenian Academy of Sciences and Arts)

ZRSRS - Znanstveno in raziskovalno središče Republike Slovenije, Koper (The Science and Research Centre of the Republic of Slovenia, Koper)

ZVO - Zakon o varstvu okolja (Environmental Protection Act)

anoxia - lack of oxygen

boreal - northern biogeographical region; post-glacial age with a continental type of climate

disjunction - geographical distribution in discontinous areas

ectomycorrhiza - typeof mycorrhiza in which the fungal hyphae form a superficial covering and do not extensively penetrate the root

endolithic - burrowing or existing in a stony substratum, as algal filaments

epilitic - attached on rocks

epiphyte - plant that lives on the surface of other plants but does not derive water or nourishment from them

eutrophication - the enrichment of bodies of fresh water by inorganic plant nutrients (e.g. nitrate, phosphate)

herbarium - a collection of dried or preserved plants, or of their parts, and the place where they are kept

heterothallic - cells, thalli or mycelia of algae or fungi which can only undergo sexual reproduction with members of a physiologically different strain

horological - flowers opening and closing at a particular time of day and night

ihtiofauna - fauna od fishes

interstitial - flora and fauna living between san grains or soil particles

lichenization - production of a lichen by alga and fungus; spreading or coating of lichens over over a substrate; effect of lichens on their substrates

lignicole, lignicolous - growing or living on or in wood

mesotrophic - having partly autotrophic and partly saprobic mutrition; providing of moderate amount of nutrition

'*mrazišče*' (pl. '*mrazišča*') - an extreme habitat where the cold air trapped in a depression results in temperature and vegetation inversions; these habitats clearly differ from the immediate

surrounding and are a result of specific micro- and mesoclimatic conditions

oligotrophy - the ability to live in a nutrient-poor environment, as e.g. many soil actinomycetes

ombrogenous - wet habitats arising from precipitation rather than from water of the ground

ornitofauna - fauna of birds

Pangea - the supercontinent made up of all the present continents fitted together before their separation by continental drift

parthenogenesis - reproduction from a female gamete without fertilization by a male gamete

regression - the retreat of the sea from land areas

rhizosphere - area of soil immediately surrounding and influenced by plant roots

ruderal - applied to plants that inhabit old fields, waysides or waste land

sp. - abbreviation of species

ssp. - abbreviation of subspecies

stenoendemic - narrow endemic

terrestrial - living or found on land, as opposed to in rivers, lakes or oceans or in the atmosphere

transgression - the incursion of the sea over land areas, or a change that converts initially shallow-

water conditions to deep-water conditions

zoocoenosis - an animal community whose occurence, composition and number depend on a series of ecological factors

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REPUBLIKA SLOVENIJA

MINISTRSTVO ZA OKOLJE IN PROSTOR

Dunajska cesta 48, SI-1000 Ljubljana
phone: +386 (0)1 478 7400
fax: +386 (0)1 478 7422
http://www.sigov.si/mop/

AGENCIJA REPUBLIKE SLOVENIJE
ZA OKOLJE

Vojkova 1B, SI-1000 Ljubljana
phone: +386 (0)1/478 4000
fax: +386 (0)1/478 4052

CBD

Contact person:
Gordana Beltram Ph. D.
e-mail: gordana.beltram@gov.si

Contact person (CHM):
Julijana Lebez Lozej M. Sc.
e-mail: julijana.lebez-lozej@gov.si

GLOBAL ENVIRONMENT FACILITY

The GEF Secretariat
1818 H Street, N.W.
Washington, DC 20433, U.S.A.
www.gefweb.org
http://www.rec-lj.si/gef
Contact person: mag. Emil Ferjančič
e-mail: emil.ferjancic@gov.si

The World Bank
Global Environment Division
1818 H Street, N.W.
Washington, DC 20433 U.S.A.