Global Terrestrial Observing System

GTOS Central and Eastern Europe (CEE) Programme

Regional Implementation Plan

Katalin Török
Ian Simpson
Alexandre Borde

GTOS-20
February 2000

Acknowledgements

This study was carried out over a period of ten months in 1999 by Katalin Török, Hungarian Institute of Botany; Ian Simpson, UK Institute of Terrestrial Ecology, and Alexandre Borde, GTOS Associate Professional Officer. The overall direction for the activity was provided by Jeff Tschirley, GTOS Programme Director.

The authors are grateful to Viera Straškrábová, Marek Baranowski and Pavol Bielek, the National Focal Points of the Czech Republic, Poland and the Slovak Republic, for providing useful insight into the priority environmental issues of these countries.

Valuable collaboration was provided by the EU NoLIMITS project, the International Long Term Ecological Research network (ILTER), UNEP Grid, and the FAO Sub-regional office for Central and Eastern Europe (SEUR).

Alexia Baldascini consolidated and edited the report for publication.

Contents

Acronyms

CEE	Central and Eastern Europe
FAO	Food and Agricultural Organization of the United Nations
GCOS	Global Climate Observing System
GHOST	Global Hierarchical Observing Strategy
GOOS	Global Ocean Observing System
GOS	Global Observing System
GRID	Global Resource Information Database
GT-net	GTOS System of Networks
GTOS	Global Terrestrial Observing System
ICSU	International Council for Science
ILTER	International Long Term Ecological Research Network
MAB	Man and the Biosphere Programme
NFP	National Focal Point
NGOs	Non-governmental Organizations
NoLIMITS	European Networking of Long-term Integrated Monitoring in Terrestrial Systems
RCU	Regional Coordination Unit
SEUR	FAO Sub-Regional Office for Central and Eastern Europe
TEMS	Terrestrial Ecosystem Monitoring Sites
UNEP	United Nations Environmental Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
WMO	World Meteorological Organization

Executive Summary

The need for comprehensive data to assess ecosystem changes, understand the potential impacts and adopt appropriate policies has increased dramatically during the past ten years.

The increasing number of multilateral environmental agreements, the greater emphasis on sustainable development and other forces of globalization have required countries to defend and negotiate their national interests in international forums on a variety of issues.

These developments motivated the United Nations agencies and the scientific community to create global observation systems in order to ensure that the required data and information, and the ability to analyse them, are available for informed decision-making. The Global Terrestrial Observing System (GTOS) aims at improving the quality and coverage of terrestrial ecosystem data, and integrating them into a world-wide knowledge base that will help us manage our planet wisely for future generations. GTOS was launched in January 1996 to focus on the following major issues: i) changes in land quality; ii) availability of freshwater resources; iii) loss of biodiversity; iv) climate change, and v) impacts of pollution and toxicity.

The GTOS programme for Central and Eastern Europe (CEE) is the first initiative to build a regional network of terrestrial observing sites. The first phase of the programme (January-September 1999) had four main components: a user needs assessment; detailed country studies for the Czech Republic, Hungary, Poland and Slovakia, organization of a workshop and the preparation of the regional implementation plan.

The CEE programme identified the main user needs related to data, information, data policy, capacity building and management requirements that GTOS should satisfy during its operation. According to these criteria, a management plan has been elaborated with regional coordination at the FAO Sub-regional Office for Central and Eastern Europe (SEUR) in Budapest.

Based on the user needs assessment, the CEE study identified loss of biodiversity, changes in land quality and pollution and toxicity as the major environmental priorities of the region. Although climate change was not directly mentioned as a priority issue, many of the data relating to land quality and biodiversity have direct applications to this topic, especially the GTOS demonstration project on Net Primary Productivity.

The first phase of the CEE identified the following relations between major threats and existing information:

- Pollution - data provide not only essential information on pollutants, but also on related human health problems and their inter-related influence on living systems and critical loads.
- Land quality - requires greater monitoring at the landscape level in order to take account of the effects of socio-economic changes in the region which cause differences in land usage.
- Biodiversity - monitoring should be expanded and existing observation networks must be integrated into a detailed global plan.

The strategy for coordination and information dissemination was formulated as a result of regional findings. A three-year Plan of Action was defined (see table below, detailed in chapter 5) with suggestions for further initiatives at a later date. A series of projects, discussed during the workshop of the GTOS CEE programme (September 1999), have been proposed. These will become operational when appropriate funding is found.

Table 1. Summary of Actions in the CEE Region

1 = year 1
2 = year 2-3
3 = year 3 and beyond

No.	Action	Time	Responsible
1	Establish a regional coordination mechanism	1	GTOS Secretariat
2	Identify national focal points (NFP) and establish a regional CEE Board.	1	RCU with ministries of environment
3	Organize the first CEE Board meeting	1	RCU and NFPs
4	Facilitate national inventories of relevant institutions and their data sets	1	RCU and NFPs
5	Assess capacity building needs in CEE for making terrestrial observations, including legal authorities	1	NFPs
6	Organize a working meeting to further develop regional participation in demonstration projects	1	GTOS Steering Committee and RCU
7	Elaborate project proposals for regional demonstration programmes (see chapter 6)	1	Initiated by RCU and NFPs
8	Assess the costs of CEE coordination activities and develop a funding mechanism	1	GTOS Secretariat
9	Update GTOS CEE homepage with information on the possibilities of participation	1	RCU
10	Set up an Email discussion group for GTOS CEE	1	RCU
11	Update the TEMS meta-database for the region	1,2	GTOS Secretariat with site management
12	Develop a common platform for data and information documentation and exchange (adopting one of the existing metadata standards – content standard)	1,2	GT-Net Panel and CEE Board

Table 1. Summary of Actions in the CEE Region (continued)

No.	Action	Time	Responsible
13	Assess adequacy of existing observation sites (programmes) in terms of the GHOST hierarchy	1,2	RCU with site management
14	Organize a data and information tools workshop	1,2	CEE Board
15	Maintain collaboration with existing international research and monitoring initiatives	1,2,3	RCU and CEE Board
16	Elaborate and synthesise data available for the GTOS CEE programme, produce outputs for users	2	CEE Board and national responsibility
17	Formalise key inaccessible datasets	2	NFPs
18	Identification of measurement methodologies, recommendations	2,3	Steering Committee, RCU and CEE Board
19	Establish a GTOS regional metadata centre	3	RCU and CEE Board
20	Establish National Coordinating Committees	3	CEE Board

1. Introduction

1.1 The Global Terrestrial Observing System

The world today is undergoing a period of rapid change as a result of technological advances, rapid growth in the availability of information, and political and economic restructuring. These changes have had a profound effect on the environment of the planet and its natural ecosystems. The distribution of these ecosystems and their constituent species are consequently changing, biological diversity appears to be decreasing, and the climate is being altered resulting in a shift in position of major agriculture zones. These changes are now collectively termed global change.

As the effects of global change become increasingly evident, scientists have called for more and improved data to enable them to understand the processes involved and to permit the development of improved models for more accurate and reliable forecasts of global changes and their consequences. At the same time, national planners and resource managers have been seeking reliable data and information on which to base national development policies and strategies, to manage relevant national programmes, and to achieve a wiser use and management of national renewable natural resources, including those of crop and forest lands.

Recognition of the need for good data of the right types by national planners, governments and scientists, has led to the evolution of a system for studying global change known as the Global Observing System (GOS). GOS operates as three separate systems: the Global Climate Observing System (GCOS), the Global Ocean Observing System (GOOS) and the Global Terrestrial Observing System (GTOS).

GTOS was launched in January 1996 to improve the data and information needed to better understand terrestrial environmental change in order to improve policy and decision-making. The major issues addressed by GTOS are: i) changes in land quality; ii) availability of freshwater resources; iii) loss of biodiversity; iv) climate change, and v) impacts of pollution and toxicity.

The GTOS Secretariat is currently hosted by the Food and Agricultural Organization of the United Nations (FAO) in Rome. FAO is one of the five sponsors of the programme, the others include: International Council for Science (ICSU), United Nations Educational, Scientific and Cultural Organization (UNESCO), United Nations Environmental Programme (UNEP) and World Meteorological Organization (WMO).

GTOS seeks to assist countries to strengthen their capacity for systematic environmental assessment and monitoring of terrestrial ecosystems. The aim is to use existing data and information to generate products that are useful for policy and planning at the national, regional and global levels and to identify key data gaps.

1.2 The GTOS Programme in Central and Eastern Europe

The Central and Eastern Europe (CEE) programme is the first regional initiative of GTOS. Initiated in early 1999, it aims to reinforce information exchange on terrestrial ecosystems for global and regional studies. The Sub-regional Office for Central and Eastern Europe (SEUR) of FAO has hosted the regional programme in Budapest. SEUR provides technical assistance to the region (19 countries) on nutrition, food and agriculture. The governments of the region have demonstrated their concern for environmental problems by signing several global and European conventions (Annex 3).

A main objective of the CEE programme is to improve information access and availability of data to scientists, natural resource managers, policy makers and institutions, regarding terrestrial ecosystems. GTOS aims to build up a "partnership of partnerships", formed by linking existing monitoring sites and networks on terrestrial observations. A further objective is to test the feasibility of the GTOS concept - a first attempt to implement the global initiative.

To avoid duplication of efforts, the GTOS CEE programme has developed a partnership with other relevant international projects. The European Networking of Long-term Integrated Monitoring in Terrestrial Systems (NoLIMITS) initiative, directed by the Environmental Change Network (UK), has taken a leading role in the first phase of the regional programme. The International Long Term Ecological Research (ILTER) network also has a Central European component. The participation of the GTOS CEE management team at the scientific ILTER meeting helped to find contacts and introduce the programme to institutions and researchers. The joint organization of a workshop with the UNEP GRID (Global Resource Information Database) programme also demonstrates efforts to harmonize activities related to environmental observations.

The first phase of the CEE programme (January-September 1999) consisted of four main components: a user needs assessment; detailed country studies for the Czech Republic, Hungary, Poland and the Slovak Republic; organization of a workshop; and the preparation of the regional implementation plan.

A detailed *user needs assessment* has been carried out by sending a questionnaire to approximately 250 recipients in the region, as well as organizing interviews with environmental institutions during the visits to the countries. Altogether 27 institutions were visited by June 1999 and informed about the GTOS regional activities.

Four detailed *Environmental Assessment Reports* (Annex 1) were completed. National focal points for the four countries were selected to compile the documents. Shorter Environmental Reports have also been prepared for other selected countries in the region (Estonia, Bulgaria, Armenia, Lithuania and Latvia).

The *GTOS CEE Synthesis Workshop* was organized in Budapest, Hungary (9-10 September 1999) to present the preliminary findings of the country reports. It was organized by the FAO SEUR and the GTOS CEE coordinator, the EU NoLIMITS project and the GTOS Secretariat in Rome. It was managed in collaboration with the UNEP GRID Centre in Budapest, which held the 2nd EuroGRID meeting in Budapest from 7-8 September 1999. Approximately forty participants took part in the workshop representing Armenia, Bulgaria, Czech Republic, Estonia, Georgia, Hungary, Latvia, Lithuania, Poland, Romania, Slovak Republic, the United Kingdom and the United States. International and funding agencies were represented by FAO, UNDP, UNEP and the World Bank.

2. Needs and Rationale for a Regional GTOS Programme

The CEE regional component is the first attempt to involve institutions, governments and scientists in building up a comprehensive network of participants aiming to achieve the objectives of GTOS. The first phase of the programme, similar to a feasibility study, has focused attention on problems and needs for establishing such a complex observation system.

2.1. User requirements

The participation of relevant institutions in an overall network system under GTOS is essential for a successful outcome of the programme. Clear identification of user needs on the one hand, and potential benefits for contributors on the other, is required.

The potential users of information include governmental bodies, research institutes and universities, NGOs and international organizations. Most frequently, their data and information requests have to be satisfied at specific time and spatial scales (for more detailed analysis see Annex 2).

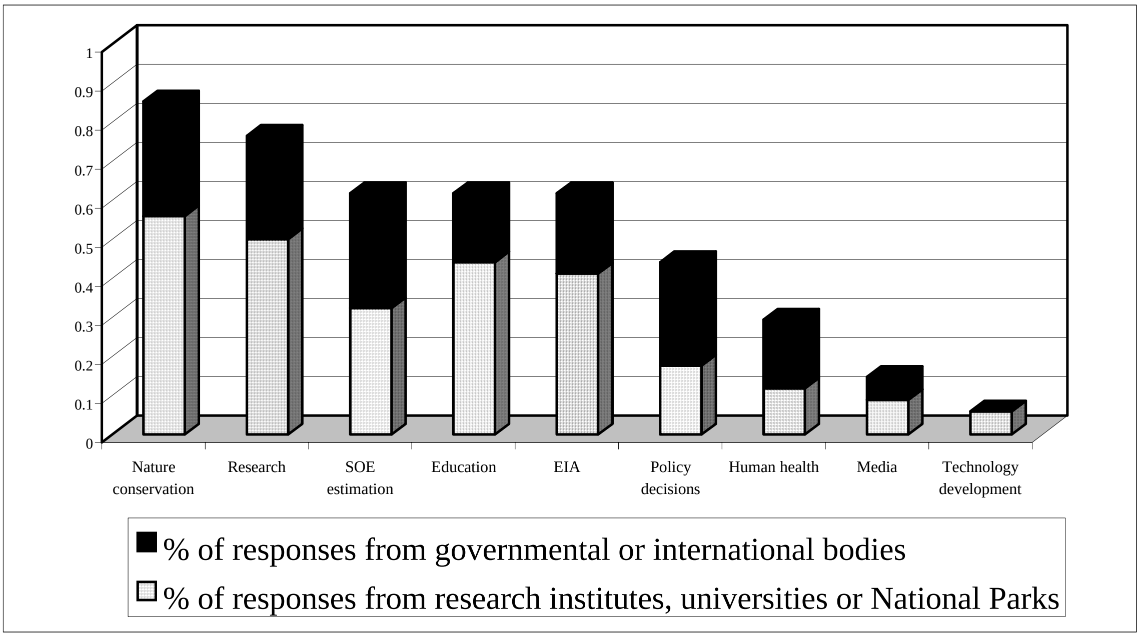
Environmental data is currently used for nature conservation and research purposes and to a lesser extent for decision-making, as shown in the analysis of the questionnaire responses (see Figure 2.1). The results clearly demonstrate that a wider use of data should be encouraged. This is where GTOS could play an important role.

The *data* requirements of potential users relate to biodiversity, land use, vegetation structure, land cover, soil quality and climate on a yearly time scale. The spatial scale of desired data ranges from local and national to regional. The need for data at a regional scale could be satisfied by GTOS CEE and it would therefore provide added value to existing systems. The first phase showed that data from a few intensively monitored sites (many variables, high resolution) is preferable to that from a large number of less intensive sites. Data must be comparable to be useful, therefore where possible it should be harmonized or at least put in a form that allows comparisons.

Despite observation activities in the region, there are gaps in data and information availability that raise difficulties in assessing regional effects of global change. The main types of information gaps are listed in the Table 2.2.

The *information* requirements relate mostly to identifying existing observation systems, on-going programmes, methodologies and contacts. Such information can be obtained by producing meta-databases, as planned by many of the Ministries of the Environment in the region. The process of building meta-databases should be facilitated by GTOS. Another type of information that would be beneficial to potential users is interpreted, analysed, synthesised results on environmental changes, effects and relations at different resolutions. This could help collaboration in environmental modelling. As providing this type of information is the main objective of the GTOS programme, the elaboration of such outputs is considered a priority issue.

Fig. 2.1. Analysis of Responses to Questionnaires



The *delivery of data and information* in an internationally standardized form raises language problems. Governments produce their meta-databases in their national language. Thus the elaboration of international internet based information systems led by national initiatives will generate political questions as well. Information must be timely and user friendly. The elaboration of expert or decision support systems is a high priority.

The CEE programme must make an early decision regarding the institution of a centralised database or the setting up of national and thematic data storage. Both solutions raise problems. In the case of national systems, governments have difficulty in hiring staff to create these systems due to high salary demands. The setting up of a centralized GTOS database, on the other hand, would require large human and financial investments.

General data and information *access and release policies* must be defined in the initial stages of the programme. As a result of political changes, both governmental bodies and independent institutes now control their own budgets and see data production as a source of income. Thus the willingness to share data is very low. A radical change must take place in order to permit this new programme to function. A Memorandum of Understanding with nations to release data might help. GTOS distinguishes between different kinds of data: i) basic data - which is available free and unrestricted; ii) conditional data - available free but with conditions of use attached; iii) bilateral exchange - freedom of use depends on agreement between parties.

Capacity building is also another priority issue in the region. Training in the construction of complex environmental databases, metadata systems, data protection, storage, in-data analysis and evaluations would be of great assistance to countries. Guidance tools in the form of handbooks and manuals would provide information on how to make observations and to manage data and information. Decision-makers must understand the importance of making environmental information available. Environmental monitoring expertise in the region seems to be adequate.

Table 2.2 Information Gaps

Information gaps	Time scale	Spatial scale
Soil quality		
Impact of management on grasslands	10-20 years	Europe
Development trends in specially protected parts of nature		
Extent of individual habitats and their dynamics		national
Aquatic biomass or production from reservoirs	Monthly-yearly	national-regional
Biodiversity changes	Yearly	national, Europe
Impact of pollution	Yearly	Europe
Indicators of biodiversity changes	Yearly	national
Soil conditions	Yearly	national
Characteristics of water quality and water management	Yearly	national
Meta-database		
Tree increment	Yearly	local
Habitat coverage and changes	Yearly	national
Species richness	Yearly	national
Spatial distribution pollution data: air pollutants, toxicity, heavy metals, VOC, radiation	Monthly	national
Changes of wetlands and oxbows	Yearly	national
Changes in water quality in wetlands		
Satellite pictures		1:100000
Global area maps of plant and animal species		1:500000 1:1000000
Species monitoring	Yearly	national
Climate	Monthly	local
Air pollution	Monthly	regional
Access to large compiled database	Yearly	national
Free access to pollution, emission and other data		national-district
Detailed database (all from 6 except climate)	Daily-weekly	local to regional

GTOS should facilitate *operational activities*, through fund raising (mostly from national sources) to maintain existing and develop new monitoring infrastructure and institutional support. Defined and effective lines of *communication* amongst data collectors, data managers and users must be solved both at the national level (between sectors and networks) and at the international level (between participants and GTOS contacts).

The user needs assessment should be on-going, with periodic surveys and consultations, taking into account new users, emerging issues, shifts in priorities and technological improvements. There is a need for a mechanism to keep these factors under continuous review and have sufficient flexibility to respond to changing needs.

2.2. Rationale for GTOS CEE

Many countries of the region have not given high priority to setting up a complex system of monitoring sites. This is due to a number of reasons. National efforts are focused on problems relating to accession to the European Union. Others tend to concentrate on separate problems bound by national or bilateral conventions. However, it became clear, during the first phase of the CEE programme, that the countries in the region undoubtedly need a system like GTOS to handle environmental issues of national and transboundary nature. It is therefore important that GTOS initiate collaboration within the programme by linking local and national requirements.

The above considerations are to some extent applicable to the scientific community. Scientists have extensive national and international contacts and participate in different projects that solve specific environmental problems. However, financial restraints and lack of Cupertino tend to isolate the results of their findings. GTOS appears to be the obvious central point where information acquired in separate projects could be collected and disseminated on a regional, as well as national, basis.

It was clearly shown, during the first phase of the regional GTOS programme, that the major environmental issues defined as key questions at the global scale are valid for the regional scale as well. However, their importance and priorities have regional features. The future CEE GTOS system has to take into account regional threats and their relation to existing environmental information. GTOS should use existing information related to these issues on the one hand, and fill gaps in knowledge on the other.

The first phase of the CEE identified the following relations between major threats and existing information:

- Pollution - data provides not only essential information on pollutants, but also on related human health problems and their inter-related influence on living systems and critical loads.
- Land quality - requires greater monitoring at the landscape level in order to take account of the effects of socio-economic changes in the region which cause differences in land usage.
- Biodiversity - monitoring should be expanded and existing observation networks must be integrated into a detailed global plan.

The strategy for coordination and information dissemination was formulated as a result of regional findings. A three-year Plan of Action was defined (see section 6) with suggestions for further initiatives at a later date. A series of projects, discussed during the workshop of the GTOS CEE programme (September 1999), have been identified and listed in Table 5. GTOS will continue to facilitate the development and identification of funding for the activities in collaboration with the national focal points.

3. Management Plan for GTOS CEE

The GTOS Secretariat at FAO Headquarters in Rome provides guidance for the implementation of regional activities. The CEE component is a regional network within the GTOS System of Networks (GT-Net). Each network will nominate an officer as a member of the GT-Net Panel, which serves as a Scientific and Technical Committee for GTOS. The member for the CEE region should only be designated when the programme is fully operative.

The FAO SEUR office in Budapest, which supported the first phase of the CEE programme, could serve as a centre (Regional Coordination Unit, RCU) for regional activities. Its main task would be to bring together existing monitoring networks that can provide relevant information to specific regional environmental problems.

The RCU has to support communication among member institutions and programmes. Being the first of its kind, the GTOS CEE programme has to handle general questions as well, such as data policy, quality and harmonization. The planning procedure should involve the Working Group and Panel on Data and Information. The need for centralized databases was rejected at the GTOS Synthesis workshop. It was agreed that basic data should be stored and interpreted at the sites. However, a certain degree of synthesis of the results, based on metadata centres is indispensable. The RCU will provide assistance to participants to obtain funding, support national monitoring systems and capacity building. RCU should ensure synergy and integration between the global and the regional programmes.

The first phase of the CEE programme included an intensive round of contacts with potential member institutions and official authorities for the environment. The group of potential GTOS members that resulted from this first stage could make up the regional core centre.

Representatives of the most active institutions met at the Synthesis Workshop in Budapest (September 1999). Finding ways of enlarging the circle of members and of completing the observation network according to the GHOST hierarchy (five tier observation mechanism) is a high priority.

National Focal Points (NFP) have been identified for the four countries that participated in the detailed environmental assessments (Czech Republic, Hungary, Poland, and Slovak Republic). Their role should consist in the continuation of national programmes, keeping contacts with environmental authorities, acting as spokesman on national requirements within GTOS. The identification of NFPs for the other CEE countries requires an agreement between national environmental authorities and the GTOS Secretariat.

The NFPs should be senior individuals with in-depth knowledge of available environmental data and information in their country and an ability to promote collaboration among more junior experts on specific tasks. NFPs should form the basis for a GTOS CEE Board that meets annually to discuss regional specific issues and provide guidance on programme priorities and implementation. The NFP board should be supported by the RCU to help coordinate activities and should be represented on the GT-Net Panel.

The establishment of National Committees for GTOS is encouraged, although these may not be essential during the earliest phases of the programme. The use of existing environmental committees with national coverage (e.g. National MAB Committees) could be an alternative. Individual nations should be left to choose which mechanism is most suitable for them.

Fig. 3.1 Global Hierarchical Observing Strategy (GHOST)

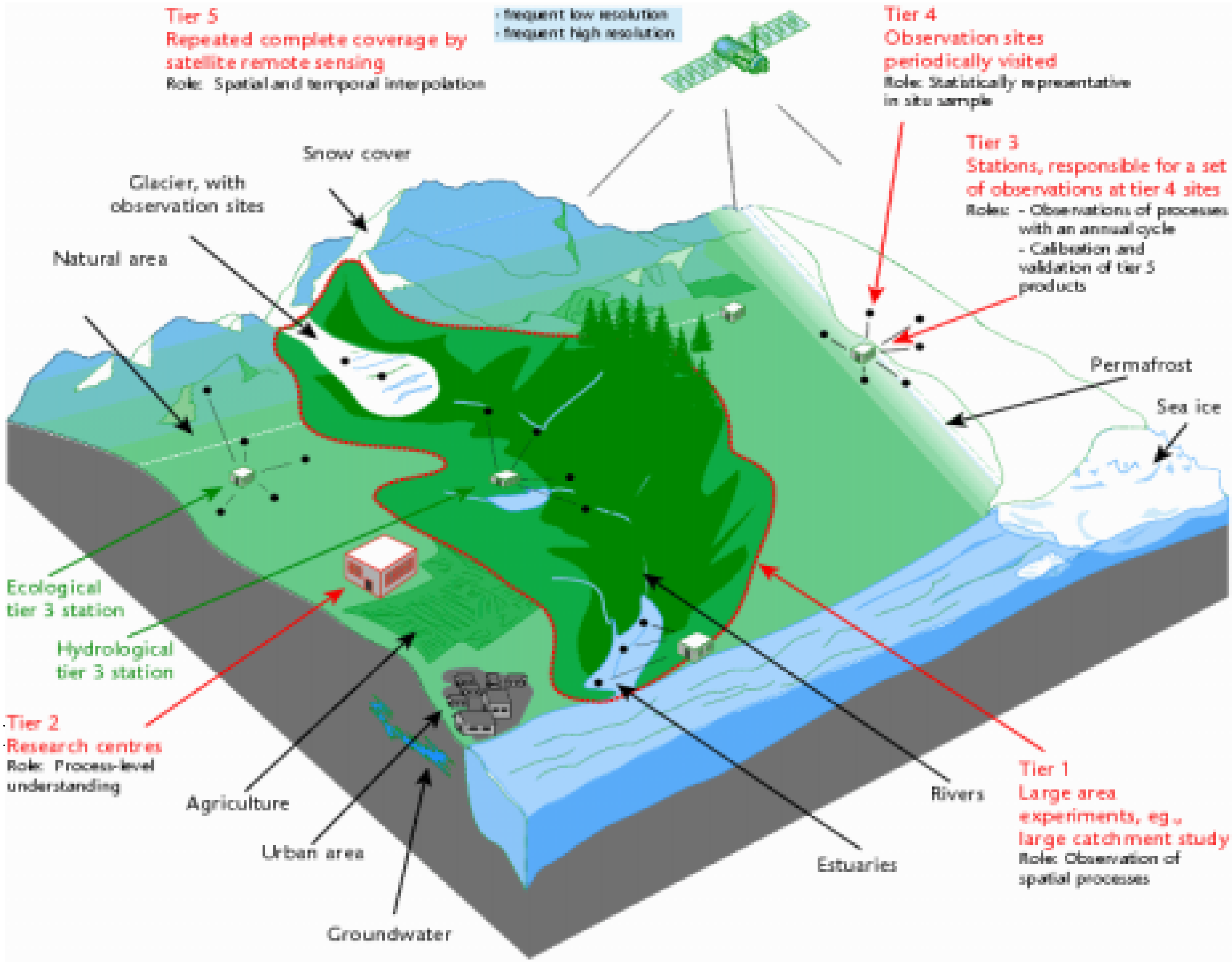
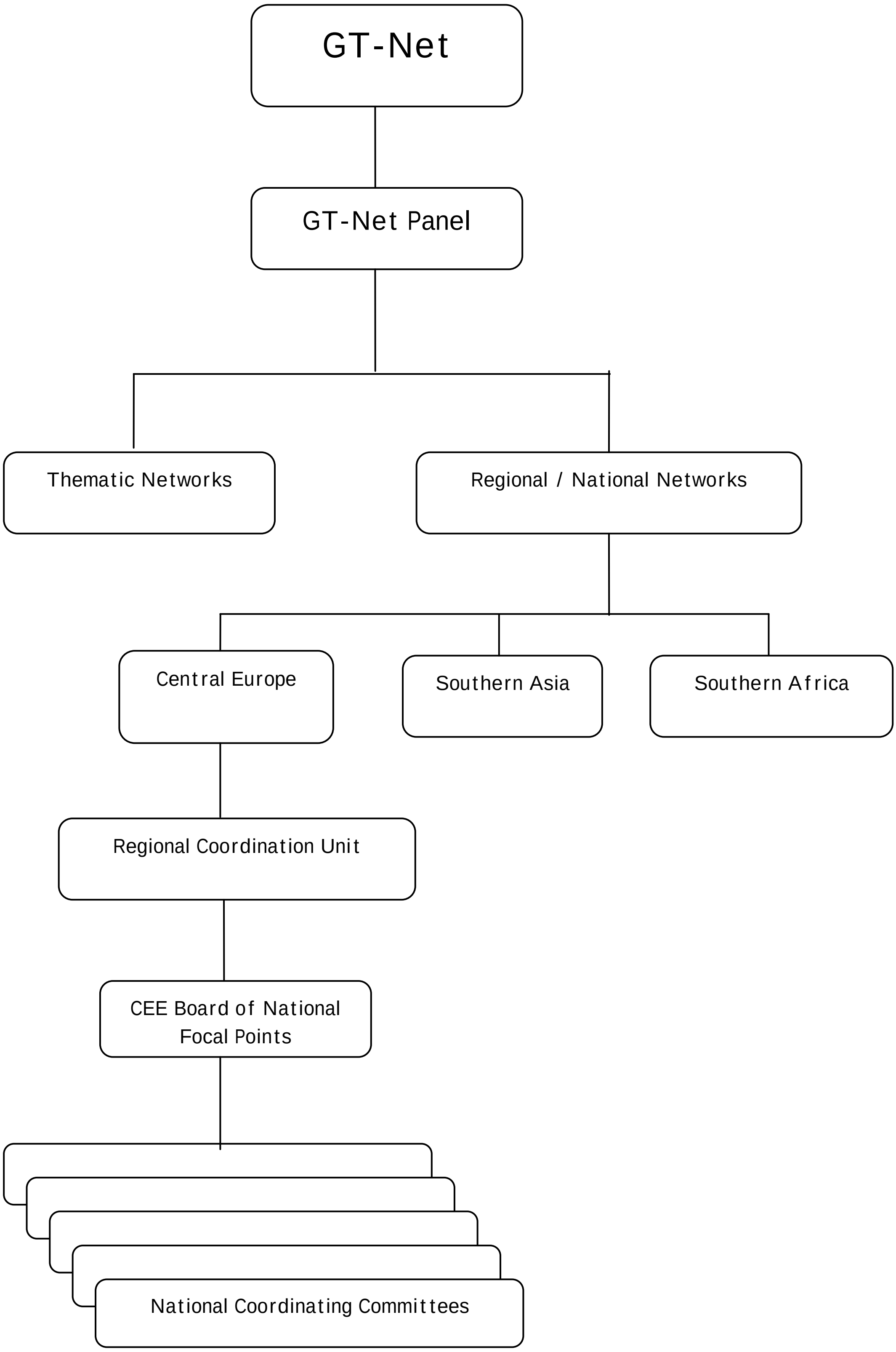


Fig. 3.2 Structure of the Central and Eastern Europe programme in the GT-Net



4. Short-Term Strategy

The strategy of the GTOS CEE programme for the coming three years should be to focus on coordination and information dissemination. Coordination, in addition to communication, covers initiation, facilitation and support of regional activities. It ensures active participation through providing useful information and support.

The *coordination* work should involve:

- promoting follow-up on the regional environmental change priorities that have been identified during the first phase of the programme (including trans-boundary issues);
- developing and using existing networks and GTOS contacts (NFPs etc.);
- developing stronger links and dialogue between the science community and policy makers on regional and global environmental change issues in order to identify data and information requirements and better match observation capacity with policy needs;
- maintaining availability of the programme achievements to other environmental initiatives;
- following EU accession procedures in target countries and contact relevant initiatives related to environmental monitoring and observations;
- facilitating links between potential collaborators and sources of funding;
- increasing demand from decision-makers for integrated regional information;
- providing funding for coordination efforts;
- assisting in retaining information management personnel.

Information dissemination should be structured along the following lines:

- distributing information on the GTOS CEE programme (how to contribute, how to benefit) at governmental, scientific and public level;
- publicizing the use of TEMS database as a common platform for data access;
- initiating demonstration projects and disseminate results;
- distributing the implementation plan and other relevant documentation to sponsors and potential further collaborators.

Resources for programme implementation will be provided by three main contributors:

- Scientific institutions representing international biodiversity programmes, such as the Institute of Landscape Ecology of the Slovak Academy of Science which provides biodiversity measurements on 13 European countries;
- National institutions responsible for policy formulation such as Ministries of the Environment;
- UN organizations such as UNEP GRID, which could provide expert support on meta-database development, and FAO, which could provide assistance on climate change and agro-biodiversity conservation.

Funding of the programme will be obtained mainly from:

- GTOS, which will facilitate the development of proposals in key areas including data and information management, land cover change and Net Primary Productivity;

- Additional financing organizations such as the European Union and bilateral agreements with Western European countries.

5. Proposed Activities

Regional participation in *global demonstration projects* was discussed during the NoLIMITS Workshop (24-26 March 1999, Oxford), at the ILTER Workshop (22-25 June, Budapest) and the GTOS CEE Synthesis Workshop (9-10 September, Budapest). Many institutions expressed interest in the project and some have already selected sites and started using the programme. CEE countries that will participate in the Net Primary Productivity project include: the Czech Republic, Estonia, Hungary, Romania, Slovakia and Ukraine. The Soil Biodiversity and Decomposition Project is planned to have sites in Hungary, Lithuania and Romania.

The role GTOS is playing in developing a Terrestrial Carbon Observations (TCO) initiative has important implications for linking national terrestrial observation initiatives with climate change studies at the national, regional and global levels.

One of the aims of the GTOS CEE Workshop was to initiate regional collaboration. Participants proposed several *regional activities.* These are listed in Table 5. Further discussions are needed to ensure multilateral participation.

Table 5. Proposed Regional Projects

Provisional title	Proposed by	Further participants
Land cover changes as a function of political changes between 1970 and 2000	Hungary (Büttner)	Slovakia (Bielek)
Integrated monitoring and mountain areas	Bulgaria (Metcheva, Vachev)	
Inventory and assessment of wetlands in the CEE countries	Czech Rep. (Kvet)	
Forest health monitoring system (ICP)(ongoing)	Czech Rep. (Roudna)	Hungary, Slovakia
Building standardized meta-database model on national biodiversity monitoring systems in the CEE region	Hungary (Török)	Estonia (Klein) (technical support by UNEP/GRID)
GIS and remote sensing as a tool for detecting pollution level and land cover changes	Georgia (Jintcharadze)	
Human Health and Land Cover Change (perhaps collate with the first proposal?)	Slovakia (Oszlányi)	
Black triangle: observation of influences of decreasing loads (ongoing)	Czech Republic, Poland, Slovakia	
Danube and Elbe Project	Hungary (Rádai)	

6. Actions in the Short Term

Year 1

1) Seek to establish a GTOS regional coordination unit

The Regional Coordination Unit (RCU) should be a driving force during the next phase of the GTOS CEE programme. The alternative would be to manage the programme centrally at the GTOS Secretariat. However, a decentralized operation system would ensure permanent communication within the region.

Assessment of the costs of managing the GTOS CEE programme is essential in order to obtain financial support. The assessment should consider RCU operational costs, working meetings on demonstration projects and CEE Board annual meetings. Provisional budgets could be proposed to potential sponsors.

2) Identify national focal points (NFP)

NFPs have already been selected for the Czech Republic, Hungary, Poland and Slovakia, and have prepared country reports. The terms of reference and tasks of the NFPs should be further detailed for the second phase of the GTOS CEE programme. The selection of NFPs for other countries in the region should be initiated by the RCU and endorsed by national governmental bodies (e.g. Ministries of the Environment).

3) Establish a regional CEE Board

A CEE Board could be set up immediately with the participation of the four NFPs, and could be enlarged as required. Possibilities for financing the work of NFPs must be considered. The CEE Board should later select the representative of the region in the GT-Net Panel. The Board should operate as an inter-governmental advisory body. As soon as funds are available, a meeting of NFPs as a CEE Board should be organized to discuss activities: 4, 5, 6, 10, 11, 12, and 16. FAO SEUR could support the arrangements.

4) Facilitate the creation of national inventories of observing sites and data sets

The first phase of the GTOS CEE programme has already made steps forward to achieve this objective with the environmental assessments in four countries and also for some others in a less detailed format (Armenia, Bulgaria, Latvia, Lithuania, and Romania). However, even these studies are not sufficiently detailed for proper analysis of regional observation capacity. Finding new sources and enlarging the scope of the investigation to the whole region should be continued. The criteria for selection has to be further elaborated according to major environmental issues.

It is essential to improve access to data held by research institutions and government bodies. Many data sets only exist on paper and are therefore inaccessible. There is an urgent need to transpose these to electronic format before the information is lost.

Problems to overcome include lack of manpower, identifying procedural standards for compatibility and establishing conditions of data access. GTOS recommendations would be useful (see also Action 12). The application of the Aarhus Convention, signed by most European countries could facilitate access to environmental data. The involvement of existing international networks is encouraged (e.g. network of Biosphere Reserves).

5) Assess capacity building needs for making terrestrial observations

The environmental assessments have demonstrated that there is sufficient expertise in the four countries for initiating environmental observations, but there is a lack of staff for data and information management; in some cases, legal authority is unclear. Studies should be carried out for other countries in the region. A training plan should be elaborated according to the results. International initiatives like ILTER, GTOS and NoLIMITS also agreed to play a part in capacity building in information management (see also Action 14).

6) Organize a working meeting to develop regional participation in GTOS demonstration projects

The GTOS Steering Committee has initiated several demonstration projects (Net Primary Productivity, Global Observation of Forest Cover, Soil biodiversity/decomposition, Human health, etc) that could represent the platforms for initial active participation as a region in global programmes. Several institutions have expressed their interest or have prepared material for some of the demonstration projects. The working meeting could be organized with representatives of these institutions, with the objective of harmonization of methodologies, the use of a bio-geographic approach and related problems. Considering the links between human health vis-à-vis land cover change or climate change would be a possible demonstration project.

7) Elaborate proposals for regional demonstration programmes

The working meeting on global demonstration projects (Action 6) could also serve as a forum for new initiatives. The projects proposed at the Synthesis Workshop by participants have been confirmed. Other programmes such as transboundary issues should however be included. Examples were given during the Synthesis Workshop on problems of bilateral exchanges of data (e.g. in the Danube Delta - Romania and Ukraine share little data). It was felt that multilateral exchange might, in fact, help to overcome some of these problems. A search for funding mechanism for longer-term activities should be carried out.

8) Update the GTOS CEE homepage

The RCU should facilitate participation in the GTOS CEE programme. To make GTOS work it is important to reach a critical number of members and ensure its long-term functioning. GTOS could initially approach possible partners. The benefits of exchange of information will be the main attraction for contributors to the network. The benefits of participating in GTOS should be stressed and added values listed. For example, access to satellite imagery is a need of regional institutions, but it is too costly. GTOS could help with negotiation for multiple users to bring down costs in exchange for *in situ* data.

9) Set up an E-mail discussion group for GTOS CEE

A discussion group for the global programme is already operational and effective. This group could help communication and harmonization of ideas and methodologies at a low cost. This could evolve into the setting up of a series of discussion groups to cater for those with general and more specific interests in GTOS.

Year 1-2

10) Update the TEMS meta-database for the region

There is a requirement for TEMS to be updated globally and the CEE region in particular. Current entries vary greatly in the quality of the information provided for individual observing sites. Updates need to be performed in collaboration with site managers preferably moving measurement resolutions and accuracy towards a greater level of harmonization. WAICENT plays a role in this process providing an acceptable standard format for updating. NFPs should be involved in contacting sites and coordinating the activities. Fusion of sites for more integration is encouraged.

11) Develop a common platform for data and information documentation and exchange

Among its many roles, GTOS will use metadata to provide pointers to the location of specific data. To achieve this, there is a need for seamless information interfaces at least at metadata level for users, even if different components are disparate. A strategy for reaching the balance of metadata availability has to be determined (cost/benefit of producing metadata).

Recommendations:

- continue the development of meta-databases at the national level;
- consider development of a region-wide meta-database (see Action 19);
- identify a metadata standard or develop the ability to translate current metadata standards in use;
- review data release and exchange policies;
- adapt old datasets from monitoring sites selected for old objectives to current priorities.

12) Assess adequacy of existing observation sites (programmes) in terms of the GHOST hierarchy

The GTOS CEE region is an area large enough to consider all tiers in the Global Hierarchical Strategy (GHOST). Tiers differ in sample numbers and areas: Tier 1 = large scale experiments and gradient studies; Tier 2 = long-term research centres; Tier 3 = field stations; Tier 4 = observation sites periodically visited; Tier 5 = frequent, low resolution remote sensing. The coverage of each tier has to be analysed and gaps identified. Spatial locations of various stations involved need to be identified in the process. Remote sensing by satellite imagery is also a national responsibility.

13) Organize a data and information tools workshop

Information management is a basic element of GTOS and also other international programmes related to environmental observations. To reduce costs and efforts, tools for data management should be elaborated in collaboration with related programmes. The workshop should be organized with the ILTER and NoLIMITS projects. Activities under Action 12 could involve preparing the materials necessary for the workshop. Information tools cover entering, searching, sorting, grouping, summarizing, graphing and exchanging of data.

14) Enhance collaboration with existing international research and monitoring initiatives

International programmes, besides national bodies, can be important to GTOS data and information users. Collaboration with various environmental conventions and inventory, monitoring and research programmes is already on-going. Contacts should be continued between the regional programme and the UNEP GRID (Global Resource Information Database) programme, the European Networking of Long-term Integrated Monitoring In Terrestrial Systems (NoLIMITS) initiative and the International Long Term Ecological Research (ILTER) network. Existing mechanisms relating to reporting systems should be applied.

Year 2-3

15) Produce outputs for scientific and policy users

The establishment of a metadata system by GTOS based on hierarchical methods is useful only if the information is integrated and evaluated at levels above the national scale. This synthesis should be undertaken with defined objectives in agreement with users. The results of Action 13 would support this work. Outputs should be prepared according to scientific requirements and also in a public format.

16) Formalize key data sets

The first two years of the programme will result in a detailed knowledge of regional observations relevant to GTOS objectives. The analysis of the tiers of the Global Hierarchical Observing Strategy (GHOST) in Action 13 may well show gaps in the coverage of sites. Action 16 will provide clear limits of data accessibility. Efforts must be made to obtain access to data or to facilitate filling in the gaps in observation coverage.

Year 3 and Beyond

17) Harmonize measurement methodologies

As GTOS relies on existing observation networks, it is extremely difficult to influence the sampling methodologies being used. However, efforts should be made to achieve higher levels of inter-comparability. GTOS should try to identify a set of preferred methodologies for the measurement/observation of core variables and provide these to participants in a manual. This activity should be coordinated at a regional and global scale.

18) Establish a GTOS regional metadata centre

The aim of GTOS is not to handle basic data, but to link monitoring systems in a single network. Information has to be collated at a metadata level. Through the harmonization of national metadata centres, regional centres could be established. If successful, the CEE metadata centre could be used as a model for the development of similar centres in other regions. The GRID centres could be potentially involved in the process.

19) Establish National Coordinating Committees

The use of the existing system of national committees and other coordinating mechanisms will be encouraged to avoid duplication of efforts and to enhance the effectiveness of available funds. When the GTOS CEE programme reaches a sufficient size, it should consider the establishment of National Coordinating Committees. These could promote the development of the programme and harmonize expert opinions at a high national level. Alternatively the existing national organizations and the CEE Board could undertake this work.

References

GTOS-7. 1996. GTOS and the Conventions. pp. 57.

GTOS-8. 1997. Report on the coordination and implementation meeting, 12-15 May, Rome, Italy.

GTOS-9. 1997. Report on the Global Observing Systems Space Panel. Third session, Paris, France, pp. 27-30.

GTOS-10. 1997. Report of the Meeting of Experts on Ecological Networks. Guernica, Spain, 17-20 June. pp. 19 with Annexes

GTOS-11. 1997. GCOS/GTOS Plan for Terrestrial Climate-related Observations. pp. 130.

GTOS-12. 1997. Report on the GCOS/GOOS/GTOS Joint Data and Information Management Panel. Third session, Tokyo, Japan, 15-18 July. pp. 27 with Annexes

GTOS-17. 1998. GTOS Implementation Plan. FAO. pp. 76.

GTOS-18. 1998. GTOS Data and Information Management Plan. pp. 29.

GTOS-19.1998. Report of the Second Meeting of the GTOS Steering Committee, Santander, Spain, 15-19 June.

UNEP/EAP.1995. Global Terrestrial Observing System (GTOS). Turning a sound concept into a practical reality. TR/95-08. pp. 97.

Annex 1

Environmental Assessments of the Czech Republic, Hungary, Poland and the Slovak Republic

Country Assessment on the Environment
Czech Republic

RNDr Viera Straškrábová DrSc
GTOS National Focal Point for Czech Republic
Hydrobiological Institute, Academy of Sciences of the Czech Republic
and
University of South Bohemia, Faculty of Biological Sciences

1. Country profile

Population	▪ Total population: 10, 309, 137 inhabitants ▪ Population density: 131 per km^2 ▪ Prague: 1, 200, 455 inhabitants; Brno: 385, 866 inhabitants; Ostrava: 323, 177 inhabitants ▪ 80% of the population lives in settlements with less than 100,000 inhabitants
National product: GDP – purchasing power parity	$111.9 billion (1997)
National product per capita	Purchasing power parity - $10,800 (1997)
Agriculture	▪ GDP in agriculture: 5% ▪ Main agricultural activities: cultivation of grains, potatoes, sugar beets, hops, fruit; animal husbandry (pigs, cattle, poultry); forest products; fish culture
Climate	Temperate, combination of continental and oceanic climate, prevailing western winds, intense cyclonal activity
Terrain	The Czech Republic is an inland country, strategically located at the crossroads of Europe. The Moravian Gate is a traditional military corridor between the North European Plain and the Danube in central Europe (as well as the migration route for animals and plants), and also a boundary between the Czech Massif (Palaeozoic Age) and the Western Carpathian (Tertiary Age) mountains. Total area: 78, 866 km^2 Lowest point*:* Elbe River 115 m a.s.l. Highest point*:* Sn ka 1,602 m a.s.l. Average altitude*:* 430 m a.s.l. Three main rivers run through its territory: the Elbe (length : 370 km; catchment area: 51, 104 km^2; outlet: North Sea), the Odra (length:135 km; catchment area: 4, 704 km^2; outlet: Baltic Sea) and Morava (length: 245 km; catchment area: 23, 058 km^2; outlet: Black Sea).
Natural resources	• Hard coal, soft coal, kaolin, clay, graphite • Water resources: upper reaches of rivers, 4 small natural lakes, artificial fish ponds and reservoirs (which provide

	70% of drinking water).
Land use	• arable land: 40% • permanent crops: 2% • permanent grassland: 11% • forests and woodland: 34% • water surface areas: 2% • other: 10% (1993) • Irrigated land: 240 sq km (1993)
Environment	• Important issues: health problems caused by air and water pollution in areas of northwest Bohemia and northern Moravia around Ostrava; acid rain which damages forests; eutrophication of drinking water sources; changes in land use; toxic substances resulting from previous industrial activities
International conventions	*Party to multilateral conventions:* Long-range Transboundary Air Pollution, EMEP (1979), Reduction of Sulphur Emissions (1979), Control of Emissions of Nitrogen Oxides (1979), Control of Emissions of Volatile Organic Compounds (1979), Protection of the Ozone Layer/Vienna/Montreal/London/Copenhagn, Control of Hazardous Wastes and their Disposal, Biological Diversity, Climate Change, International Trade in Endangered Species and Wild Fauna and Flora/CITES, Wetlands of International Importance/RAMSAR, Law of the Sea, Nuclear Test Ban, Ship Pollution, Conservation of Migratory Species of Wild Animals, Conservation of Bats in Europe, Protection of the World Cultural and Natural Heritage, Conservation of European Wildlife and Natural Habitats, Protection and Sustainable Use of the Danube River *Bilateral treaties:* Protection of the Elbe River, Protection of the Odra River, Intergovernmental Cooperation in the Protection of Environment with Belgium, Denmark, France, Russia, Ukraine, Norway, Austria, Slovakia, Germany and others. *Signed, but not ratified:* Antarctic-Environmental Protocol

2. Major Regional Environmental Threats

A panel of seven specialists from different institutions responded to the questionnaire developed by GTOS experts. Rates of 1 to 5 were attributed to the different environmental threats (1 representing the most important). Average rates assigned were: 2.1 for impacts of pollution and toxicity; 2.6 for loss of biodiversity; 2.7 for changes in land quality; and 4.0 for climate change.

Loss of biodiversity was considered the most important threat by all but one respondent. Impacts of pollution and toxicity and changes in land quality obtained the most important rating by three respondents. The importance of freshwater resources was rated from 1 to 4 by different respondents. Climate change was considered unimportant by the majority of the panel.

During the visits of the GTOS-CEE experts in June to the Ministries of Agriculture and the Environment and other institutions, the following environmental problems were identified and discussed:

- Air pollution
- Water pollution
- Land use and soils
- Toxic substances
- Loss of biodiversity
- Land degradation

2.1 Air pollution

In the period from 1950 to 1990, the emissions of sulphur dioxide (SO_2) and nitrogen oxides (NO_x) increased steadily in former Czechoslovakia but this trend has been reversed in the last decade.

Table 2.1. Atmospheric emissions in the Czech Republic (thousands of tons per annum)

Year	Solid	SO_2	NO_x	CO	C_xH_y
1987	951	2164	816	738	139
1988	840	2066	858	737	139
1989	673	1998	920	885	228
1990	631	1876	742	1055	225
1991	592	1776	725	1102	227
1992	501	1538	698	1045	205
1993	441	1419	574	967	204
1994	354	1278	434	1026	200
1995	201	1091	412	874	164
1996	179	946	432	886	176
1997	128	701	423	877	181

Carbon monoxide(CO) and hydrocarbon (C_xH_y) emissions also followed a similar, although less pronounced, trend. Greenhouse gas emissions (expressed as equivalent of CO_2) decreased from 1990 to 1993 by more than 20%. Atmospheric emissions, ozone levels and atmospheric deposition (wet and dry) of sulphur, nitrogen, several heavy metals and other substances are constantly monitored (Ministry of Environment of the Czech Republic, 1998).

2.2 Water pollution

Low quality of drinking water, due to water pollution, is a major problem in the Czech Republic. Due to insufficient supplies of groundwater, 70% of drinking water is derived from reservoirs which have high levels of nitrates originating from sources such as fertilizers.

Although 73.5% of the population is now connected to the sewage system, and 90.5% of released wastes from domestic and industrial sources is treated, the conventional treatment carried out by the sewage plants does not remove phosphorous from the water and this is released into rivers. The dissolved phosphorous proliferates algae and creates a problem of eutrophication. This phenomenon has been aggravated by the increase of phosphorous in detergents since 1987 (the polyphosphate production began in former Czechoslovakia).

The annual averages of BOD_5 (biochemical oxygen demand), COD (chemical oxygen demand), nitrate N and total P in the Elbe (D ín), Vltava (. Bud jovice) and Morava (Lan hot) rivers registered in the five years from 1992-1997 are summarised in Table 2.2.

Table 2.2. Average variation (mg l^{-1}) of chemical substances in the main rivers of the Czech Republic during1992-1997.

River	**Year**	**BOD_5**	**COD**	**NO_3-N**	**total P**
Labe	1992	6.0	37	5.5	not det.
	1997	4.0	30	4.5	0.2
Vltava	1992	3.2	31	1.8	not det.
	1997	3.9	27	1.1	0.1
Morava	1992	7.0	47	3.3	not det.
	1997	5.4	24	3.2	0.3

Significant decreases in COD at all sites documents an improved situation in the treatment of industrial wastes. However, the marginal decreases in nitrates and the high concentrations of phosphorous indicate a problem of eutrophication and secondary pollution from phytoplankton production.

2.3 Land use and soils

The forest area in the Czech Republic is about 34% of total land area and has increased by approximately 1.5% over the last 30 years. Reforestation schemes implemented over the last two centuries also determined an increase of forest land.

Czech foresters have, however, for decades, planted a monoculture of spruce which covers 54% of the total forest area. This has resulted in forests which are more susceptible to damage caused by unfavourable climatic conditions and biological pests. Furthermore, the increasing emissions of sulphur and nitrogen oxides and dry deposition of pollutants have also caused defoliation and led to a decrease in soil pH levels. As a result, forests have become more susceptible to insect pests, such as the bark beetle. Since 1989, emissions have decreased and a recovery from acidification is already noticeable in lakes and rivers (Kopá ek et al. 1997, Kopá ek et al. 1998, Vrba et al. 1998).

As a consequence of economic and political changes, considerable arable land has been abandoned. There has been a 3% decrease in agricultural area during the last seven years. This land, especially in submontaneous and hilly region, is slowly turning to shrub and woodland (Mejst ík et al. 1995). In addition, the reduction of the levels of food production required for admission to the European Union, will result in a further decrease in agricultural land .

2.4 Toxic substances

Monitoring of heavy metals and organic toxic substances (pesticides, PCB, PAH and others) has only begun recently, thus long-term data reviews are not available. Contamination of soils and river sediments by heavy metals and organic material is significant in some places and the risk of release to the environment is not know in detail. Contamination of the food chain for human use has been monitored since 1994 following the Decision of the Government of the Czech Republic No. 408 of June 10, 1992. Contaminants were investigated in more than 40 kinds of foodstuffs i.e.: Cd, Pb, Hg, As, PCBs, hexachlorbenzen, lindan and DDT (Ministry of Environment, 1998).

2.5 Biodiversity

The country is located at the crossroads of Europe and spans four bio-geographical provinces. It lies between the Hercynian and Carpathian European Highlands and on the boundaries of continental and alpine glaciations. Important continental migration routes of biota run through the territory of the Czech Republic, such as the main Eurasian bird flyways. Despite its relatively small size, the country contains six biosphere reserves, ten ramsar sites, two biogenetic reserves of the Council of Europe and sixteen important bird areas. Protected areas in the Czech Republic cover 10,869 km^2, some 13.8% of the whole territory.

Biodiversity is relatively well conserved and is characterized by diverse geological, geomorphological, geographic and climatic conditions. The country has a relatively high biological and landscape diversity, including a considerable number of animal and plant species (Plesník & Roudná 1998).

Table 2.3. Flora and fauna of the Czech Republic

Group	No. of species	No. of non-native species	No. of threatened species	No. of extinct species
Vertebrates	369	38	144	14
Insects	24,800-43,000	n.a	n.a	n.a
Other invertebrates	5,000	n.a	n.a	n.a
Vascular plants	2,520	710	1,100	110
Mosses	848	3	364	63
Lichens	1,400	0	560	210
Fungi	~ 30,000	n.a	n.a	n.a

The flora of the Czech Republic represents 25% of the total number of species known in Europe. The IUCN Red List names 36 globally threatened animal species and 52 globally threatened plant species in the Czech Republic. Cultivated plants and domestic animals (including original ancient cultivars, breeds and races) also deserve attention due to their long cultivation, selection and breeding history in the territory.

This notable biological and landscape diversity was negatively affected by historical intensive agriculture and industrial development. The main threats for biodiversity are: (i) loss or significant change of habitats (draining wetlands, increasing arable land to large areas, regulating rivers, monocultures, etc.) (ii) segmentation of natural bio-corridors (river dams, highways, etc.) (iii) acidification of water and soil (leading to extinction of species and whole trophic levels in some ecosystems) (iv) eutrophication (both nitrogen and phosphorus and other nutrients enrichments) (v) contamination by pesticides and other toxic chemicals and (vi) invasive species.

3. Status of National Environmental Observing Systems

3.1 Institutional framework

The following organizations fall under the jurisdiction of the Ministry of Environment: the Agency for Nature Conservation and Landscape Protection of the Czech Republic, the Czech Environmental Institute, the Czech Geological Institute, the Czech Hydrometeorological Institute, the Czech Environmental Inspection Agency, Geofund of the Czech Republic, the State Environmental Fund of the Czech Republic, the Research Institute of Ornamental Gardening and the T.G. Masaryk Water Management Research Institute.

The Ministry of Agriculture controls the Czech Agricultural and Food Inspection, the State Board of Veterinary, the State Board of Plant Care, the Central Control and Experimental Institute of Agriculture and the Czech Inspectorate for Improvement and Breeding of Farming Animals.

The Czech Hydrometeorological Institute (CHMI) oversees activities in the field of meteorology and climatology, hydrology and air protection. The CHMI is State funded (80%) and by external sources (20%).

The Hydrobiological Institute is funded by the Czech Academy of Sciences which covers approximately 40% of the budget, and by research projects of various grant agencies and consultancies. The Institute has three departments: Production Processes, Aquatic Microbial Ecology and the Hydrochemistry. The Institute principally carries out research on biotic interrelations and their interactions with abiotic factors in standing water bodies (ponds, lakes etc), especially man-made reservoirs in the Vltava River watershed. It alternates experimental and field approaches and basic regular long-term ecological research on selected Czech reservoirs. It works in close cooperation with the Faculty of Biological Sciences of the University of South Bohemia, through the use of researchers in teaching and students in research projects.

The institutes of the Academy of Sciences of the Czech Republic (Botany, Landscape Ecology, Soil Biology etc.) and universities (Charles, Masaryk, Mendel, South Bohemia) also carry out long-term monitoring of various terrestrial and freshwater ecosystems to assess the effects caused by changing environmental variables.

3.2. Analysis of existing observation sites

There are three National Parks in the Czech Republic(Krkonoše National Park, Šumava National Park and Podyjí National Park). In addition, there are 24 protected landscape areas. Krkonoše, Šumava and four protected landscape areas (K ivoklátsko, T ebo Basin, Pálava and Bílé Karpaty) are UNESCO Biosphere Reserves, managed by the Man and the Biosphere (MAB) programme. Integrated monitoring is carried out in the biosphere reserves, although there is a lack of human resources.

The Forestry and Game Institute, based in Prague, runs long-term monitoring programs mainly in Northern Bohemia and in the Krkonoše National Park. The quality of forests was monitored in the *framework ICP Forest.* Regional long-term forest monitoring in the Krkonoše, Šumava and Beskydy Mountains is carried out by IFER (Institute for Forest Ecology Research Ltd) in Jílové.

The Czech Hydrometeorological Institute (CHMI) is responsible for studying atmospheric and water issues. It monitors air pollution based on data gathered at approximately 40 measurement points and a report on air pollution is produced annually. It processes data on water quality collected by the River Board Authorities at 260 sampling sites on main rivers. These data are gradually being integrated with data on rainfall. Monitoring of basic chemical and physical variables has been carried out since 1963. From 1968, radioactivity has also been measured. Since 1992 data on heavy metals, organic and biological components has been collected at 82 sites. A new, more complete, monitoring system was developed this year based on the compilation of 20 profiles, including particles, organics, radioactivity, sedimentation, etc). Biological monitoring is performed at 8 profiles (saprobic and benthic fauna + indicator species of mollusca, crustacea, chironomids and fish (bream). Bio-assays and biofilm contamination analysis is carried out using molluscs exposed in cages or on artificial blocks for two months. Work in this field is limited by lack of a map of the sources of pollution. The CHMI also monitors groundwater (shallow water, boreholes and springs) for nitrate, ammonium, cations, and anions). It also operates the Košetice site in the framework of ICP Integrated Monitoring.

Long term monitoring of reservoirs and lakes is undertaken by the Hydrobiological Institute of the Czech Academy which has managed field stations in various reservoirs (e.g. Slapy reservoir of the Vltava River since 1959, ímov reservoir on the Malše river since 1979). Chemical, biological and microbiological characteristics of the reservoir are investigated. Long term monitoring has documented the deterioration of water quality in the Vltava River. Long term acidification was studied in the Šumava Mountain Lakes.

3.3. National networking

The Ministry of Environment and the Ministry of Agriculture plan, supervise and support various programmes aimed at conservation of biodiversity, sustainable use of agricultural and forest biological diversity within the framework of State Environmental Policy (adopted by the Czech Government in 1995) and of the State Nature and Conservation and Landscape Protection Programmes (adopted by the Czech Government in 1998). Conservation of biodiversity is also reflected as a priority issue in the State Agricultural Policy and in the Basic Principles of the State Forestry Policy (adopted in 1994 and 1995).

The Czech Environmental Institute (CEI) manages the data of the Ministry of the Environment and standardizes national environmental information systems. It also assesses the availability of data required for sustainable development indicators that are being developed in cooperation with OECD and UN-DESA.

The Czech Geological Institute collects, evaluates and publishes information on the geological structure of the Czech Republic. The Geofund carries out documentation and management of information activities related to the state geological survey.

The Agency for Nature Conservation and Landscape Protection was established to provide an integrated information system for nature protection (covering over 7000 species) using satellite imagery and GIS technology. It is also in charge of the central register of nature protection and land property in specially protected areas.

The Structural Policy and Ecology Department of the Ministry of Agriculture studies ecological problems such as the impact of agricultural production on ecology and the landscape and proposes policies aimed at mitigating such problems and harmonizing agricultural production with sustainable development. The Department also monitors approximately 200 biofarms (twice a year) with a view to reducing total agricultural production.

Since 1985, forestry monitoring has been carried out every two years by the Forest Management Institute and the Research Institute for Amelioration and Soil Quality. The Forest Management Institute is the data holder.

The Hydrobiological Institute is responsible for collecting and storing data on freshwater systems, with the aim of predicting trends in water quality and suggesting technological measures for its improvement. Main topics studied include eutrophication, biotic interactions, and long-term changes in ionic composition of rivers, reservoirs and lakes. The analyses focus on the effects of acid rain and fertilization.

The Hydrometeorological Institute is responsible for the collection and storing of other institutions according to standard methods. The data, in electronic and geo-referenced form, is stored in a database in the Institute. A specific department was established in 1995 to collect data on climate change, on the basis of which an annual national inventory of emissions is published. It adheres to IPCC methodology.

Various other institutes of the Czech Academy of Sciences, such as the Botanical Institute in T ebo and the Institute of Entomology in eské Bud jovice have long-term data on spreading of invasive species, fluctuations of bird populations, waterfowl counting and wetland studies.

3.4 International networking

- CORINE land cover has been **actualized** in 1997. Efforts have started to link species and biodiversity monitoring sites data with the CORINE biotopes. Biodiversity monitoring of plants is undertaken at the Institute of Botany.

- At the European level, the Czech Republic has applied to become a member of the EEA. The Ministry of the Environment is the national contact point for the PHARE Topic Link on Nature Conservation.

- The Czech Republic is party to the main environment-related Conventions (CITES, CBD, UNFCCC, LRTAP, Ramsar, etc.). In this respect, scientific and inter-ministerial committees have been set up in the country.

- For the PHARE Topic Link on Nature Conservation, data collection is undertaken by the Institute of Landscape Ecology in Bratislava, which serves as the focal point for the CEE.

- A PHARE project with BRGM has been initiated on metadata information systems, involving also NGOs. It should be finalised by spring 2000. The Informatics Department of the Ministry of Environment is responsible for the project in conjunction with the Ministry of Agriculture and the Czech Academy of Sciences.

- An international study has also carried out in the Black Triangle by Ministry of Agriculture.

- On-going projects at the Ministry of Agriculture include those on soil pollution with the OECD and on the suburbs of Prague with the JRC (Ispra). Initial contacts are underway with the MORIBID Project, for a city mapping study (contact: Mr. Carlo Lavelle, CEO, JRC, Ispra, Italy).

- An information system on the genetic diversity of cultivated plants and livestock is being set up, with links with FAO.

- International projects are underway between the Czech Hydrometeorological Institute and the University of Lancaster (contact: Pr. Bevan), and between the Central Geological Office and the UNESCO IHP program. The PHARE project on the Jizera mountain experiment was established in collaboration with the Institute of Hydrology (United Kingdom). Other ongoing projects are those on biomonitoring in the Elbe River with Germany and on intensive basin monitoring with the Netherlands (Wageningen). The Institute is also involved in a Framework 5 with international partners for a project that will focus on snow cover.

- The Hydrobiological Institute of the Czech Academy of Sciences also cooperates with an EU project on European Mountain lakes (England, Spain, Norway, Slovakia and Poland), in a research on reservoirs (Spain, Germany, Austria, England) and with two projects submitted to 5th framework EU. The Institute is the coordinator of the Czech LTER network within the ILTER (International Long Term Ecological Research).

- The Czech Agency for Nature Conservation and Landscape Protection is responsible for the implementation of the Pan-European Biological and Landscape Strategy (adopted by the 3rd Ministerial Conference Environment for Europe in Sofia 1995), which includes the establishment of the Pan-European Ecological Network.

- Historical research activities have included the International Biological Program (in the sixties) when Czechoslovakia was significantly involved in international cooperation both in terrestrial and freshwater issues. Many long-term research and monitoring plots were founded (some of them monitored repeatedly) and valuable data gathered, which could serve as a comparative base for long-term ecosystem changes. These activities were undertaken mainly by the Institutes of the Academy of Sciences and some universities.

3.5 Analysis of Legal Framework for data handling

- The Czech law regulating environmental information is the "123 - Law of May 13, 1998 on Access to Information on the Environment".

- The Ministry of Environment has access to information collected by the Institutes of the Czech Academy of Sciences. It is an important source of environmental data and has Ministry-equivalent status.

- The Czech Republic endorsed the Aarhus Convention on environmental information.

- The State of the Environment report (published annually) and the Annual Statistical report are available on the internet via the EIONET site, with free access.

- Due to the privatization of some institutes, the free access of information is often difficult and a commercial approach is frequently applied.

A significant quantity of data on the environment is issued each year in the Environmental Yearbook (Ministry of the Environment and Czech Statistical Office) together with the relevant references, including institutions which gathered the original data.

3.6 Use of environmental information

- The lack of clear directives regarding data property rules causes some discrepancies in data management.

Although reports of monitoring and research projects on the environment are available on request to the respective grant agencies, these often have little value for experts (who need to compare the ecosystem status among different ecosystems or in the same ecosystem after several years) since they rarely contain metadata and necessary method details, and often present some average values without original data and statistical evaluation. Information for the public (interested to know the quality of respective environment) is often not presented in a useful form since it does not contain evaluation on risks etc. This situation sometimes makes the use of results ineffective.

Some authors (or institutions) consider the original data their own property and are reluctant to release them to grant agencies, even if the data were financed by "tax payers". Each environmental project must set out clear rules for use of data by outside users. It is clear that many ecological data are not "routine" and the expertise of the respective author is an implicit part of the data presented.

4. User Needs Assessment - Priority Needs of Information

Priority needs should be determined by the requirements of international conventions or by the laws concerning environment and main threats (see Sections 1.2 and 2).

5. Observation and Methodologies for Data Handling and Development Needs

5.1 Need for Standard Methodologies in Integration

As mentioned in sections 3.3 and 3.4, a variety of monitoring networks exist in the Czech Republic, designed for different purposes and using different methods. At present no overall monitoring system exists; each system tends to be aimed at specific issues and in the same way the methods are specific for different networks. This also means that different monitoring sites are chosen for different purposes. Each network tries to standardize and unify its own methods.

Different networks are financed from different sources and obliged to use varying standard methods. As a result, overall unification would prove difficult. It would be useful if the following guidelines could be adopted: (i) statistical evaluation or intercalibration of precision and/or accuracy of particular methods among various networks and various institutions, (ii) possible 'fusion' of sites from different networks to achieve an effective integration of monitoring activities.

Complete integration of all monitoring activities to standard sites is neither possible nor desirable. However a multilevel approach might be introduced using a set of first-level routine analyses covering a large representativearea, as well as higher levels of more detailed and sophisticated analyses performed in selected sites by experts.

5.2 Institutional framework

- Some duplication of work occurs between the Ministries of the Environment and of Agriculture.

As mentioned previously, the approach to various types of monitoring is diverse and problems occur due to duplication and poor cooperation between certain networks. As a result of the present difficult economic situation in the Czech Republic, financing of governmental institutions (including researchers and universities) is often insufficient. Consequently, organizations and bodies tend not to divulge results and monitoring systems.

5.3 Need for a national meta-database

Metadata is one of the weakest points of monitoring activities in the country. Monitoring results are delivered mostly in three types: (i) files with data on electronic media (ii) written reports ordered by Ministries and other often containing unoriginal data without appropriate statistical elaboration (iii) publications in scientific journals where methods are not always well described or precision of results evaluated, and original data are frequently not published due to lack of space.

In cases (i) and (ii), metadata such as details of methods, sampling sites, procedures, authors etc. are not included and are lost after several years. In cases (ii) and (iii), original data are not included and therefore are not available for future comparison with situations in other ecosystems or other countries. Users should be encouraged to request original data sets and details on methods used.

The problem of storage must also be resolved. Networks usually have their databases but single institutions cannot store data from many different networks. It would, however, be useful to create a database of existing environmental data including contact addresses, information on location of original data and other metadata, and with the possibility of searching for region, ecosystem type, type of data analyzed, frequency, observation period etc. GTOS activities might support the setting up of such a database.

Some independent and simultaneous integration of data from various networks is carried out at the large sites with integrated monitoring, such as biosphere reserves, landscape protection areas and national parks. These data should contain information on monitoring and research activities performed on their territories including summaries of information by region. This process is now under development. A considerable amount of historical data still has to be preserved more satisfactorily and some recent data, elaborated by other institutions, needs to be organized in the form of original files with exact metadata.

5.4 Training Needs

The personnel and appropriate experts to carry out monitoring activities in terrestrial and aquatic ecosystems, including methods for sophisticated environmental analyses, are available and the training of students is of a good level in research institutes and universities. Monitoring activity (generating basic data) is limited by the lack of financial means, equipment, automatic analyzers etc., rather than by a lack of trained experts.

Training will be helpful in the field of constructing complex environmental databases, metadata systems, data protection and storage, and also for generating systems of basic and special (1st level and 2nd level – see section 5.1) sets of parameters and methods of integrated monitoring. These should be effective, simple and low cost wherever possible.

The elaboration and evaluation of data i.e. the effective use of information, which is hidden in data, requires further development. Often, data are collected, put into a database, simple statistics undertaken but the final result is a description rather than an explanation or evaluation. Comparison with the data gathered in other fields, other periods, other ecosystems, and a discussion of differences, are frequently lacking. In this respect, a system of international cooperation and intercomparisons would be helpful.

5.6 Identification of main potential users of a future GTOS information supply.

- The Ministry of Environment is ready to participate and support the GTOS CEE program, e.g. by circulating the questionnaire and informing people about GTOS. It considers coordination and links to international data an important task.
- The Ministry of Agriculture has expressed interest in the GTOS CEE program, and future collaboration is possible.

The questionnaires mentioned in section 2, identified researchers to be the main users of GTOS followed by governmental bodies, regional authorities, NGOs and the public.

Users of GTOS will be determined by the information generated. If information is provided in data files in different formats, then they would be valuable only for experts able to further elaborate the data. On the other hand, for public, media or educational purposes, as well as for regional administration, EIA processes etc., the data must be presented in an elaborated form. Consequently, GTOS should follow specific procedures when (i) collecting data, (ii) constructing databases and handling metadata, (iii) elaborating and evaluating data for diverse users. This latter will be extremely important for identifying potential users and obtaining possible financial support.

References

erný, M., Frauknechtová, J. & Š. Holá, (1999 submitted). *Monitoring of the state of forests* (In Czech). Silva Gabreta, submitted.

Czech Republic, 1998. *Law of May 13, 1998 on Access to Information on the Environment*. Collection of Laws No. 123/1998.

Czechoslovak Academy of Sciences and the Federal Committee for the Environment, 1992. *National Report of the Czech and Slovak Federal Republic,* for United Nations Conference on Environment and Development in Rio de Janeiro, Brazil.

European Environmental Agency (D. Stanners & P. Bourdeau, eds). 1995. *Europe's Environment; The Dob íš Assessment.* European Environmental Agency, Copenhagn, 676pp.

Federal Research Center for Forestry and Forest Products (BFH), 1998. *Forest Condition in Europe.* 1998 Executive Report, ICP on Assessment and Monitoring of Air Pollution Effects on Forests, 37pp.

Hydrobiological Institute, 1998. *38th Annual Report for the Year 1997.* Hydrobiological Institute, Academy of Sciences of the Czech Republic. eské Bud jovice.

Komárková, J. & Vyhnálek, V. 1998. *Long-term changes in chlorophyll concentration and phytoplankton structure in two canyon-type reservoirs.* Internat. Rev. Hydrobiol. 83 (Special Issue): 421-430.

Kopá ek, J. & J. Hejzlar, 1998. *Water chemistry of surface tributaries to the acidified mountain lakes in the Bohemian Forest*. Silva Gabreta, Vol. 2: 175-197.

Kopá ek, J., Hejzlar, J., Stuchlík, E., Fott, J., & J. Veselý, 1998. *Reversibility of acidification of mountain lakes after reduction in nitrogen and sulfur emissions in Central Europe*. Limnology and Oceanography 43: 357-361.

Kopá ek, J., Procházková, L., Hejzlar, J. & P. Bla ka, 1997. *Trends and seasonal patterns of bulk deposition of nutrients in the Czech Republic*. Atmospheric Environment, Vol. 31: 797-808.

Mejst ík, V., Bartoš, M., Hanousková, I. & šitel, J. 1995. *Abandoned landscapes in the Czech Republic.* In: Schoute, J.F.TH. et al. (eds): Scenario studies for the rural environment, Kluwer, The Netherlands, p. 39-45.

Ministry of the Environment, Czech Statistical Office, 1998. *Environmental Yearbook of the Czech Republic*. Ministry of the Environment, Prague, 1998.

OECD, 1999. *Environmental Performance Reviews, Czech Republic*. OECD, Paris, 1999.

Plesník, J. & Roudná, M. (eds). 1998. *National biodiversity conservation strategy and action plan in the Czech Republic. Status of biological resources and implementation of the convention on biological diversity in the Czech Republic.* 1st Report. Ministry of the Environment of the Czech Republic, Prague.

Prchalová, M. (ed). 1998. *Czech Republic. Biodiversity protection project (GEF grant TF-02-8617-CZ).* Implementation completion report – draft. Ministry of the Environment of the Czech Republic.

Se a, J. & J. Kube ka, 1997. *Long-term biomanipulation of   ímov Reservoir (Czech Republic)*. Hydrobiologia 345: 95-108.

Straškrabová, V., Brandl, Z., Hrbá ek, J., Komárková, J., Se a, J., Straškraba, M. & Straškraba, M. 1998. *Long-term changes of bacteria, phytoplankton and zooplankton: temporal coherence between deep stratified reservoirs.* Internat. Rev. Hydrobiol. 83 (Special Issue): 21-30.

Straškrabová, V. & Flousek, J. 1999. *Long-term ecological research – specific problems in Central European countries, case situation in Czech Republic.* In: P. Bijok & M. Prus (eds), Long-term ecological research; examples, methods, perspectives for Central Europe. Proc. of the ILTER Regional Workshop, Sept. 16-18, 1998, Madralin near Warsaw, Poland, Internat. Centre of Ecology, Polish Academy of Sciences, US LTER Office, pp. 21-24.

Straškrabová, V., Jelínková, E. & Kv t, J. 1998. *Czech Republic – the long term ecological research program.* In: R. Waide, C. French, P. Sprott & L. Williams (compiled by), The international long term ecological research network, US LTER Network Office, Albuquerque, N.M., USA, pp. 32-37.

The Czech Environmental Institute (ed.). 1998. *Statistical environmental yearbook of the Czech Republic 1998.* The Ministry of the Environment of the Czech Republic, Czech Statistical Office. 493 pp.

Vrba, J., Kopá ek, J., Straškrabová V., Hejzlar J. & K. Šimek, 1996. *Limnological research of acidified lakes in Czech part of the Šumava mountains: trophic status and dominance of microbial food webs*. Silva Gabreta, Vol. 1:151-164.

Zatloukal, V., 1998. *Historical and current factors of the bark beetle calamity in the Šumava National Park.* Silva Gabreta, Vol. 2: 327-357.

Zemek, F., He man, M. 1998. *Landscape pattern changes in the Šumava Region – a GIS approach.* Silva Gabreta, Vol. 2: 395-403.

List of Institutions and Contact Persons Visited.

15 June 1999 - Ministry of the Environment (Vršovicka 65, 100 10 Praha 10 - http://www.env.cz/)

Persons present	Institution	Email
Milena Roudná	Global Relations Department, MoE	roudna_milena@env.cz
Jan Plesnik	Agency for Nature Conservation and Landscape Protection	plesnik@nature.cz
Theresa Voto ková	Czech Environmental Institute	

15 June 1999 - Ministry of Agriculture (T šnov 17, 117 05 Prague 01 - http://www.mze.cz/)

Persons present	Institution	Email
Vojt ch Havránek	External Relations Department, MoA	
Luboš Babi ka	Structural Policy and Ecology Department, MoA	babicka@mze.cz
Karel Charvát	Consultant for the Forest Management Institute	charvat@topoc.cz

16 June 1999 - Czech Hydrometeorological Institute (Na Šabatce 17, 143 06 Prague 4 - http://www.chmi.cz/)

Persons present	Institution	Email
Drahomíra Leontovy ová	Dept. of Water Quality	rieder@chmi.cz
Josef Hladný	Deputy Director of Experimental Hydrology Dept.	hladny@chmi.cz
Viera Straškrábová	Hydrobiological Institute, Czech Academy of Sciences Faculty of Sciences, University of South Bohemia	verastr@hbu.cas.cz

16 June 1999 - Hydrobiological Institute, Academy of Sciences CR (Na sádkach 7, 370 05 eské Bud jovice – http://www.hbu.cas.cz/)

Persons present	Institution	Email
Zden k Brandl	Dean, University of South Bohemia, Faculty of Biological Sciences	zdbrandl@tix.bf.jcu.cz
Josef Mat na	Director, Hydrobiological Institute, AS CR	matena@hbu.cas.cz
Viera Straškrábová	Chairman of the Scientific Council, Hydrobiological Institute, AS CR and University of South Bohemia, Faculty of Biological Sciences	verastr@hbu.cas.cz

Country Assessment on the Environment
Hungary

Dr. Katalin Török
GTOS National Focal Point for Hungary,
Regional GTOS Coordinator at Sub-regional Office for Central and Eastern Europe, FAO

1. Country profile

Population	10,135,358 (January 1998)
National product:	GDP-purchasing power parity: $74.7 billion (1996)
National product per capita	Ppurchasing power parity: $7,500 (1996)
Agriculture	GDP in agriculture: 7.3% Main agricultural products: wheat, corn, sunflower seed, potatoes, sugar beets,pigs, cattle, poultry, dairy products
Climate	Temperate: cold, cloudy, humid winters, warm summers Bio-geographical zone: forest steppe
Terrain	The country is made up principally of flat or rolling plains, with low mountains on the Slovakian border. Vast flat lands, called The Great Plain (puszta) lie in the central-eastern region and form two national parks. The Bukk Mountains are also a protected area. Large caves in the north (Aggtelek) are part of the World Heritage. Central Europe's largest lake (Lake Balatan) is a popular tourist attraction but has considerable air and water pollution problems. Annual flooding occurs. Lowest point: Tisza River 78 m Highest point: Kekes 1,014 m
Natural resources	Bauxite, coal, natural gas, fertile soils, thermal springs
Land use	Arable land: 51% Permanent crops : 4% Permanent pastures: 12% Forests and woodland: 19% Other: 14% (1998 May) Irrigated land: 2,060 km^2 (1993)
International agreements	Party to: Air Pollution, Air Pollution-Nitrogen Oxides, Air Pollution-Sulphur 85, Air Pollution-Volatile Organic Compounds, Antarctic Treaty, Biodiversity, Climate Change, Endangered Species, Environmental Modification, Hazardous Wastes, Marine Dumping, Nuclear Test Ban, Ozone Layer Protection, Ship Pollution, Wetlands Signed, but not ratified: Air Pollution-Sulphur 94, Antarctic-Environmental Protocol, Law of the Sea
Environment	Current issues: a recent government study (1996) identified 179 areas that suffer from air pollution, 54 areas with polluted soil, and 32 areas with polluted underground water. The study estimated clean-up costs at $350 million, but the 1996 government budget allocated only about $7 million for this purpose

2. Major Environmental Threats

Environmental threats are discussed in relation to GTOS issues and priorities. Pollution, loss of biodiversity and land quality are all very important issues in Hungary, but setting priorities is more subjective. Since these issues interact in a complex way, it is often difficult to make distinctions and to separate them.

2.1 Pollution and toxicity

Pollution and toxicity are major environmental problems. The interaction between pollution, loss of biodiversity and land quality frequently makes prioritisation difficult. Therefore these problems must be considered together.

With regard to air pollution, the emission of sulphur dioxide and particulate matter had already decreased before 1990 as a result of the use of nuclear power, the gas programme and the introduction of new technologies in oil processing. In the 1990s further drastic reductions occurred (e.g. emission of sulphur dioxide decreased from one million to 670 thousand tons per year between 1990 and 1996 (Hungarian Central Statistical Office, 1999) when heavy industry collapsed as a result of political changes. At the same time some resources were invested to reduce pollution.

The amount of nitrogen oxide emission has not changed significantly and discharge deriving from traffic remains almost constant. A great achievement of the past few years, however, is the significant decrease in lead emission originating from the reduction in the use of leaded petrol (lead emission decreased from 634 to 126 thousand tons per year from 1980 to 1996). In 1999, leaded petrol was totally eliminated from the market and this will further reduce pollution. The use of chemicals depleting ozone layer has been reduced by 70% between 1990 and 1997 (HSCO 1999).

Methane is the only significant agricultural air pollutant. The decrease of emissions since 1990 is the result of a reduction in fuel consumption for financial reasons. The emission of methane also decreased due to a decline in stock numbers (a decrease from 29% to 54% for various livestock species from 1990 to 1997, Szabo, 1999). The stock number of cattle decreased from in 2 018 000 in 1950 to 871 000 in 1997 (HCSO 1997).

Despite improvements following economic and political changes, air quality is still unsatisfactory. 3.9% of the territory of Hungary suffers from considerable air pollution and 9.3% from moderate pollution. Nearly half of the population is living in polluted urban and industrial areas (GRID 1998).

Water pollution is another serious problem in Hungary. The country's geographical position means that it receives only 11% of the catchment area of the Danube, while 95% of surface water comes from other countries. This water is subject to considerable pollution from foreign sources. Even land use in the neighbouring countries can have a major effect on water quality and quantity (floods) in Hungary. The quality of water is directly related to the availability of freshwater (Section 2.4).

The number of sources discharging waste and used water into surface water has increased drammatically in the last few years: from 7 187 in 1994 to 56 903 in 1997 (HCSO 1999). Economic changes have brought a reduction of water consumption (877 million m^3 in 1980 and 817 million m^3 in 1997, HCSO 1997). The development of water treatment resulted in treating double the amount of water. In 1997, 60% of the population was connected to public sewerage. Among the regularly monitored discharges, 45% comes from urban areas.

In 1996, two million m^3 of waste water were discharged to surface waters transporting 430 tons of organic matter each day. This can cause eutrophication, oxygen deficiency, fishery and human health problems (GRID 1998). The high level of organic matter is partly due to poor agricultural practices leading to soil erosion (e.g. use of heavy machinery, lack of erosion control).

Agriculture activities, such as irrigation practices, the use of fertilisers or liquid manure, the application of herbicides and pesticides, exert an important influence on water quality. However, in the past few years agricultural production has taken on a more extensive, and at the same time, less environmentally polluting character (Szabó 1999). For example, the use of fertilizers has decreased from 1045 thousand tons in 1980 to 350 thousand tons in 1997 (HCSO 1997).

Human activities have a significant effect on the hydro-geological character, quantity and quality of ground water. Nitrate contamination of shallow ground water is caused by the lack of sewage treatment or inappropriate use of liquid manure (GRID 1998). Industrial areas are characterised by heavy metal and hydrocarbon contamination of ground water, especially where mining activities destroy protecting layers. On the other hand, due to improvements in drinking water supplies, the number of settlements having undrinkable water has been significantly reduced in the past 7 years, from 475 in 1990 to 33 in 1997 (HCSO 1999).

Soil quality and soil processes are influenced by human activities such as industry, traffic, urban development, landfill, mining, waste deposits and agricultural practices. These activities also exert major effects on land quality (Section 2.3).

Over 66% of the territory of Hungary is dominated by agricultural production. Agricultural practices mostly focus on improving soil in the short term. Land property rights are also important for sustainable land use: the fact that there is no link between land use and land ownership demotivates farmers to take long-term effects into consideration (Szabó 1999).

There are about ten thousand polluted localities in Hungary. Although soils have a remarkable self-regenerating, buffering and storing capacity, heavily polluted soils, such as those in the former soviet military camps and airports, need to be improved by programmes such as those under the Environmental Remediation Programme (GRID 1998).

In Hungary almost 110 million tons of waste is produced each year. Only 30% of communal landfills meet the environmental standards to varying degrees (GRID 1998). The amount of municipal solid waste has increased during the last few years (17 thousand m^3 in 1990, 19 thousand m^3 in 1997), a great part of which is discharged in an uncontrolled manner (16% in 1997). About 40% of municipal solid waste contains potential secondary raw material that is not re-used. However, the total amount of hazardous waste generated in Hungary has decreased from 4.4 million tons to 2.6 million tons between 1991 and 1996. The majority of hazardous waste (72%) is of mineral origin i.e. metal waste or waste of chemical conversion (HCSO 1999).

2.2 Loss of biodiversity

The intensification of agriculture and rapid development of industry in the 1800's in Hungary, as elsewhere in Europe, constituted a threat to biota at all levels (genetic, population, habitat and landscape). However, the extension of Hungary's land, its diversified geomorphology and transitional type of climatic zone, has ensured a relative equilibrium in nature. Secondary habitats of high natural value, such as hay meadows and the alkaline grasslands, have also been created. The variety of bed rock types provides habitats for different species groups. The present, rather low, level of industrialisation and infrastructure contribute to the protection of such habitats. Due to a certain isolation of the country during the communist period, unknown natural values were found in the early 1990's (Kiraly et al. 1999).

Although public awareness of environmental issues in Hungary has grown over the last few years, the situation is still problematic. Severe threats remain in the form of habitat loss, extinction of species less able to adapt to environmental changes, the reduction in number of variations of species and invasion by alien species. Intensive agricultural practices, poorly controlled deforestation, agricultural, industrial and human pollution are the principal direct causes for biodiversity loss. Efforts have been made recently to comply with EU regulations regarding sustainable agricultural practices but the transfer of property rights into private hands has made controls difficult to enforce. Short-term interests, with little regard for sustainability, continue to be a problem (Megyery 1998).

Agriculture is not the only reason for habitat loss. Urbanisation, industrialisation and development of infrastructure pose major threats. However, the 1995 Act on the Regulation of the Protection of the Environment (Act LIII) imposed strict regulations on the issue of building permits. Other problems for the environment arise from factors such as lowering of the water table, changes in agricultural management (e.g. cessation of mowing of hay meadows) etc. Hungary's application for admission to the European Union (see also 2.3) will probably incease preservation of natural habitats. In areas of low agricultural production, it is likely that agriculture will be abandoned and rehabilitation programmes will encourage expansion of natural habitat areas. Nature conservation in these regions will be reinforced by the recently established Ecological Network (Ministry of the Environment, 1998).

The invasion of alien species, principally from America but also from Asia, can impact significantly on nature. Despite customs regulations regarding transport of plants and soil, there has been a significant rise in the amount of non-indigenous plants which pose a serious threat to the local natural species and could result in the extinction of some species. Research is being carried out to study the reasons of different sensitivity of communities to such an invasion.

Among the alien species which have invaded Hungary are some plants which cause notable human allergic responses. In particular species of ragweed (e.g. *Ambrosia artemisiifolia*) have increased. The pollen of this plant causes allergic reactions in a quarter of the population with negative repercussions on the working force. This plant has spread over fallow lands very rapidly in the past few years and a monitoring system has now been set up to study its development.

Deterioration in different types of habitats usually results in extinction of rare species since alien species, which are more resistant, tend to take over these habitats. This can result in loss of biodiversity. The introduction of alien species, such as black locust (*Robinia pseudacacia*), into plantations can also contribute to the deterioration of habitats since it causes changes in the lower layers of the forest. Although forestry is turning towards the plantation of native tree species in clear-cut areas, the area of black locust plantations has increased by 25% since 1981 (HCSO 1999).

Fragmentation of habitats caused by different types of land use is another threat to biodiversity at all levels. It is now recognised that linear objects like railway, roads, pipelines and artificial canals separate habitats in a way that is harmful to biological diversity. Several technical solutions have been designed (such as frog tunnels) to reduce the influence of fragmentation. There are several examples for such investments in Hungary. Unfortunately these efforts are focused on new establishments.
The diversity of a particular habitat is inversely related to its size and also to the distance from other natural habitats. This rule should determine the priority setting of environmental management: few large natural habitats have a higher priority than many smaller habitats of the same total size. The future establishment of the Ecological Network by building ecological corridors, besides the natural corridors like river valleys (Gallé et al. 1995) will hopefully reduce the threat of fragmentation (Ministry for Environment 1998)

Pollution of all the components of the environment detailed in Section 2.1, causes biodiversity loss. The different sensitivity of species to pollutants results in a change of species composition: in most cases the rare species with narrow tolerance become extinct. Urban and industrial regions tend to produce high amounts of pollutants and this results in the impoverishment of surrounding habitats. For example, lichens, which are sensitive to air pollution suffer and so-called lichen deserts develop in large cities, like Budapest (Farkas et al. 1985). The biota of water courses and lakes is mostly threatened by pollution and eutrophication. The contamination of wellheads and aquifers has a detrimental effect on the surrounding water-dependent biota.

Tourism is a problem particularly in the scenic, more often hilly, areas. In the Buda and Visegrád mountains, which are close to the capital, rock grasslands are damaged by trampling. These valuable local habitats are the home of ornamental and aromatic plants which are removed indiscriminately by visitors. Rock grasslands also suffer overgrazing of moufflons (*Ovis musimon*), an introduced game species.

Hungary possesses natural sites that are unique to Europe. Efforts are being made to protest these more effectively. Tables 2.1 and 2.2 give a short summary of achievements by the nature protection authorities during the last few years (HCSO 1999, Ministry of Environment 1998).

Table 2.1 Protected areas

Conservation category	Number 1994/1998	Area in 1000 ha 1994/1998	Strictly protected in 1000 ha 1994/1998
National parks (NP)	5/9	178 /422	29 /76,7
Landscape protection areas (TK) (became parts of the NPs)	51/36	467 /341,7	56 /30,6
Nature conservation areas (TT)	145/140	26 /26,4	1,6/1,3
Natural monument	1/1	-/-	-/-

Total of national protected areas	202/186	670 /790,9	86,6 /108,6
Protected areas of local importance	1 067	35,8	-
Total	1 253	826,7	108,6
Percentage of Hungary		8,88%	1,17%

Table 2.2 Protected species

	Global sp. No.	Hungarian sp. No.	Protected 1994/1998	Strictly protected 1994/1998	Total 1994/1998
Plants	350.000	3.000	456 /463	47 /52	415 /515
Mosses	25.000	589	20	-	20
Ferns	13.000	60	38 /38	1	39
Gymnospermae	640	8	1 /1	1	2
Angyospermae	311.360	2.343	404	50	454
Animals	1 250.000	42.000	781 /771	76 /84	857 /855
Invertebrates	1 205.000	41.460	389 /389	- / -	389 /389
Vertebrates	45.000	541	383 /382	76 /84	459 /466
Cyclostomes			2	-	2
Fish	22.900	81	25	1	26
Amphibians	3.000	16	16	-	16
Reptiles	6.300	15	13	2	15
Birds	8.700	361	278	70	348
Mammals	4.100	83	48	11	59
Total	1 600.000	45.000	1237 /1234	123 /136	1360 /1370

Although these data look encouraging, insufficient funds and lack of staff means that nature conservation authorities are unable to control the frequent violations of the law in this field. Even when protection of the environment from direct human impact is achieved, habitats are often destroyed as a result of other forms of degradation detailed above. A methodology for the assessment of the state of vegetation was developed in Hungary on the basis of ecological indicators and natural conservation of species (Borhidi 1995). The application of this system provides a tool for an early assessment of vegetation degradation. A similar approach of species evaluation was developed for vertebrates (Báldi et al. 1995)

2.3 Land quality

In this report land quality refers to a review of the state of a particular terrestrial area and analysis of the equilibrium between man and nature. Such a review involves focussing on a number of environmental components, such as loss of soil productivity, landscape elements, the intensity of erosion, the sustainability of land use, the state of native biota.

The Carpathian Basin is well suited for agricultural production: arable lands and grasslands have covered the lowlands for centuries. Soil erosion on slopes, caused by precipitation and wind, occurs in the Middle-Range and in the higher parts of the Transdanubian region. Erosion causes loss of the humus content in the soil, a change in texture and reduced productivity potential. Some alluvial areas have been exposed to sedimentation during floods. This process has been halted or greatly restricted through the building of dikes in the last century.

Over the last century water and land regulation has benefited form important state subsidies. These investments, however, were reduced during periods of political change: land improvement was carried out on 200 000 ha in 1985 but on only 21 000 ha in 1997 (HCSO 1999).

During the 1960's, considerable financial resources were invested in very large arable lands which could be worked with heavy machinery. The excessive size of the plots, the changes in the water drainage system as a result of the filling in of ditches and soil erosion, resulted in severe flooding in 1998, when rainfall was unusually high. In 1999 violent rainstorms raised water levels in various small rivers, again causing flooding. It is estimated that one-third of Hungary's territory is affected by intensifying soil decay and erosion (HCSO 1999).

By the end of 1998 almost the entire former cooperative land property and the majority of state land had been transferred to private ownership (Szabó 1999). This privatisation (on a compensation basis) resulted in fragmentation of land and consequent increase in the number of landowners (up to 700 000). The majority of landowners do not cultivate the land themselves but lease out the land to others. Land can be rented out for a maximum of 10 years. This system does not encourage sustainable land use and consequently has detrimental effects on land quality.

General economic problems have influenced agricultural inputs (chemicals and energy as discussed in 2.2.), resulting in a decline of soil fertility. At the same time, the reduction in the use of chemical fertilisers is more environmentally friendly. Organic farming is also practised in Hungary and the Biocultural Association counts approximately 1500 members. Quality control is assured by the Bioculture Control Association. The total area monitored reached 21,5 thousand hectares in 1998 (Szabó 1999).

In 1985 there was a 2% reduction of land under agricultural cultivation. Further reductions were only 0.05% in following years but increased to 0.08% in 1997 (HSCO 1999). The majority of abandoned area is arable land and grassland. It is probable that, when Hungary becomes a member of the EU, further agricultural lands will be abandoned. This land is, at present, often afforested, but as forestry is also turning towards more productive areas (G bölös 1994), it is likely that further abandonment of low productive arable land will take place.

About 7% of the total area of Hungary is covered by low-fertility sandy or alkaline soils. These areas were previously used for grazing, but as livestock production decreased considerably, these territories have been abandoned. The current economic and social situation anticipates a concentration of agricultural effort to the most productive areas of Hungary, though programmes of rural development focus on underdeveloped areas. The transitional nature of development will most probably have an important influence on land quality of Hungary in the near future.

2.4 Availability of freshwater resources

There is no shortage of freshwater in the Carpathian Basin, so its use is highly dependent on its quality (see 2.1.). The main water resources consist of surface and sub-surface water. The total natural surface water resources are 2,3 thousand m^3/s and the utilisable surface water is around 1,1 thousand m^3/s. Sub-surface water production has decreased during the last few years from 4,4 thousand m^3/day in 1985 to 2,9 thousand m^3/day in 1996. The majority is produced from stratum water (46%, 1996) and bank-filtered water (34 %), karstic water only reaches 15% of sub-surface water production. Decrease in water production by the water services corresponds to the decrease in water consumption. The latter decreased from 1 888 million m^3 in 1992 to 1 230 million m^3 in 1996 (HSCO 1999).

A large part of the population is dependent on bank-filtered water (e.g. Budapest). The exploitable bank-filtred water is 7,5 million m^3 per day in Hungary, whereas the sub-surface dynamic water resources in the mountains reaches only around 1,5 million m^3 per day (HSCO 1999). Bank-filtered wellheads are endangered by river and surface pollution. Dredging of the river beds, anaerobic conditions in the sediment and increased speed of ground water flow also deteriorate the quality of this type of water (GRID 1998).

The level of the water table underwent a remarkable decrease in the 70s and 80s in Hungary as a result of overuse, drought and excessive canalisation. In the Danube-Tisza interfluvial region the water table decreased by 50 mm each year. This process has slowed down and even halted in some areas due to elevated precipitation and efforts to retain water by closing canals.

Hungary has a significant quantity of karstic water produced by a combination of mining and precipitation factors. Karstic water lifting was reduced by 50% in the 90s resulting in a positive balance, reaching a level of 1 million m^3 per day. Hungary is also famous for its thermal springs that are widely used for health purposes.

2.5 Climate change

Hungary joined the Climate Change Convention in **???** to reduce the emission of greenhouse gases. Due to economic recession, this did not require vast changes in policies.
Climate change is considered the least important among the GTOS issues in Hungary. The public has very little knowledge or interest in this problem although scientists are aware of its potential threats. This apparent indifference is due to a number of reasons. In such a relatively small area, local and regional heterogeneity and fluctuation tend to conceal global tendencies. In addition, the diversity of climate change prediction models and consequent contradictory forecasts at the regional level induce lack of confidence.

In Hungary, climate change is mostly identified with global warming. Regional characteristics of global warming were assessed for the Carpathian Basin as early as 1988 (Mika 1988, 1993). According to this prediction, the frequency of drought months would rise from 1,4 month/year to 2,2 in the lowland within 10-30 years.

Climate models predict climatic zones to shift towards the poles by 150-550 km in the mid-latitude regions by 2100 (WMO 1998). Humans and ecosystems will have to adapt to these conditions. Changes in water resources and evapotranspiration patterns will influence agricultural production and the composition of the biota.

As Hungary lies in a transitional biogeographical zone (forest steppe), these changes are likely to occur at an early stage. Forest coverage is likely to diminish in favour of grasslands. The number of different species is likely to decrease drastically. These changes would be a useful indicator of climate warming. Long-term monitoring of biota has already contributed to the detection of existing effects of climatic change, e.g. appearance of Mediterranean moth species in the last few years that were not detected earlier (Leskó & Szabóky 1997).

Ecological indicator values, reflecting the water and the temperature requirements of plant species is a useful tool in assessing compositional changes (Borhidi 1995). Ecophysiological and plant ecological research projects being carried out in Hungary seek effective methodology to assess the influence of climate change on vegetation. However, separating climate change effects from other environmental influences is difficult. New occurrence or extinction of species can be the result of multiple environmental stress (Section 2.2).

3. Status of National Environmental Observing Systems

3.1 Institutional framework

The Department of Environmental Statistics of the Hungarian Central Statistical Office (HCSO) is responsible for the collection of environmental data. A law of 1993 determines the framework of data collection. About 20-30% of the available environmental data is gathered through the Official National Data Collection Programme (OSAP). Each year, Ministries suggest which data should be collected under the OSAP. The Department then reviews suggestions to avoid duplication. The result is a regulation of data collection by the Office of the Prime Minister on a yearly basis. The non-official part of the database is gathered on a voluntary basis. Data requests of Eurostat - OECD also have to be satisfied by the Department once every two years. A central database for environmental statistics is under elaboration for different indicators. The Department produces yearbooks on aggregated environmental data that are freely accessed by the public. HCSO is permitted by law to request sensitive data from industries on their levels of emission, but this can only be distributed in an aggregate form. The HCSO collects, sorts and presents data but it does not interpret them.

The Ministry for Environment is the national reference centre for data on the status of the environment. The Ministry has a network of regional authorities responsible for the protection of the environment and nature: 12 regional environmental inspectorates and 9 national parks. These authorities have the responsibility to provide investment permissions, accept or refuse environmental impact assessments and to gather environmental data or operate monitoring networks. The Ministry has an internal electronic network with 5 locations in Budapest and the environmental inspectorates and national parks will be linked in the near future.

The Department for Environmental Information System of the Ministry of the Environment has the responsibility to manage data. A yearly report is prepared, with the help of the regional authorities, on the state of the environment based on aggregate data. There is no legal obligation to have a centralised database, however a plan has already been made to develop an environmental information system. The plan is in accordance with the Aarhus Convention signed by the Government of Hungary on data policy. Data on pressures on the environment are public; data on technology and balance of material is considered reserved and available only to the authorities. Internet access to data with time series at the level of municipalities is planned for the end of 1999, but the format still needs to be improved to make it more user-friendly. The Department has a joint task with the HCSO to develop an Integrated Environmental Economical Information System. The Department has been involved in the CORINE land cover programme and is still promoting the use of the database and the preparation of the next phase in 2000.

The GRID Center in Budapest is under the responsibility of the Ministry of the Environment. Two regional information centres have been set up to gather national data in a geographical information system, one at Székesfehérvár (environment) and one in Debrecen (nature). A GRID meta-database has been set up with 10 fields and 100 records, but, since there is no incentive to join or share data, it seems to be of little interest to potential participants. There could be a role for GTOS in promoting data sharing.

The National Authority for Nature Conservation in the Ministry of the Environment supervises the national parks that collect data on natural resources. A detailed survey of the present state of biota was carried out during the last few years, but the results have not inserted in a central database so far. While the Hungarian Biodiversity Monitoring System was launched in 1997, the full implementation of the national programme requires several more years of work. This centralised programme could serve the needs of GTOS in relation to the "loss of biodiversity" issue in Hungary.

The Institute for Environmental Management is supervised by the Ministry of the Environment and is responsible for diverse management tasks including collection and analysis of water quality data, monitoring of 241 sampling sites and the implementation of a standard methodology to assess and classify quality of water under the management of different bodies.

The Ministry of Welfare and its subordinate institutions such as the National Public Health Service (ANTSZ) and the National Institute for Environmental Health (OKI) are responsible for environmental problems relating to health, including air and drinking water quality. Basic air pollutants are monitored at 666 urban, industrial and control sites. Data are shared with the Ministry of the Environment. Air quality reports are produced twice a year covering the summer and winter seasons. The latter takes account of the effects of heating. The Hungarian Environmental Health Action programme aims to further develop the air quality monitoring information system.

The Ministry of Agriculture and Rural Development has considerable responsibilities since two-thirds of Hungary is under agricultural production. The Ministry is also responsible for forest lands and supplies information on crop yields and timber production. New agricultural regulations, based on EU accession requirements, will have a significant impact on land use changes.

The Ministry of Agriculture also operates a network of Plant Protection and Soil Conservation Services. The inspection of diseased plants is monitered through the use of a network of pest traps (mainly Coleopteran insects) in agricultural areas.

The Institute for Geodesy, Cartography and Remote Sensing (FÖMI) is the national reference centre for remotely sensed image distribution and the development of environmental and agricultural applications. The institute is interested in making its data available to potential users such as GTOS.

It is a governmental institute supervised by the Ministry of Agriculture and Rural Development. About one fifth of the staff works direcltly with remote sensing. Since 1992 this Centre has been in charge of the CORINE Land Cover programme. However, due to uncertainties regarding the thematic interpretation of the maps, these are seriously under utilized. The land cover map was prepared at a scale of 1:100 000 based on satellite images of the early 90s.

The institute participates in the Hungarian Agro-environmental Programme (in cooperation with the Ministries of Agriculture and the Environment) in the filelds of environmental policy development and monitoring of activities in environmentally sensitive areas.

The Centre has many archives of satellite images dating back to 1973, including a cadastral map series for towns and settlements (1:1000), villages (1:2000) and rural areas (1:4000). Small-scale maps are also stored with the copyright of the Ministry of Defence (from 1:130000 to 1:100000). A great collection of aerial photographs (500.000) dating from 1952 also exists. The data on geodetic triangulation network with 55000 points plus 1000 GPS points is part of the collection similar to the digitised database of the administrative boundary of Hungary. The National Committee for Technological Development for Hungary is in charge of developing a meta-database.

An important task of the institute is to forecast agricultural crop yields, including mapping of crop yields at a scale of 1:50000. A newly developed methodology for image interpretation allows to forecast with a 2-3% precision. The Institute provides expertise and support to the cadastral, land information and geo-information databases (TAKAROS and TAKARNET).

The Scientific Institute for Forestry (ERTI), also supervised by the Ministry of Agriculture, undertakes research concerning forest production and health. An important activity of ERTI, relevant to GTOS, is the operation of a forest light trap monitoring network, which was established in 1962. This institute is responsible for monitoring forest health as part of the International Cooperative Programme and for the integrated monitoring network (14 basic sites).

The Hungarian Academy of Sciences (HAS) has a network of research institutes, some of which are doing research in relation to environmental sciences in very specific fields and data on the environment is often not accessible.

The Research Institute for Soil Science and Agricultural Chemistry (RISSAC) of HAS has identified and mapped the soil types of Hungary. Information on soil quality, salinity and degradation has been stored in GIS format. The RISSAC has taken a major part in the elaboration of the concept of TIM.

Hydrobiological research of the lake Balaton has been carried out for several decades by the Balaton Limnological Institute of HAS in Tihany. Investigations of the chemical composition of the lake helped in understanding the eutrophication process. Research carried out at this site is part of the Long-term Ecological Research (LTER) network.

The Institute of Ecology and Botany has a long tradition in terrestrial and aquatic ecological research. With the help of HAS and the Ministry of the Environment, the Institute is attempting to build up a network of ecological research activities in Hungary. Phytosociological and plant ecological investigations are carried out in various terrestrial ecosystem types. Recently research activities have been concentrated in the Kiskunság region, where an LTER site with a field station is being developed. The Hungarian Danube Research Station, a department of the Institute, has gathered hydrobiological data along the Danube for over 40 years.

Several universities are undertaking research on the quality of the environment, mainly in departments for botany, zoology, ecology or rural development (e.g. Eötvös Lóránt Univesity, Budapest; Kossuth Lajos University, Debrecen; József Attila University, Szeged; University of Forestry, Sopron; Debrecen Agricultural University).

3.2 Analysis of existing observation sites

There are 14 integrated monitoring sites operating in Hungary under the auspices of the ERTI where different deposition indicators (e.g composition of precipitation and stem flow) and productivity are measured. Only one of these integrated sites is listed in the TEMS database (Méntelek). Other TEMS sites include national parks or Biosphere Reserves, where various investigations are carried out from time to time although no standard monitoring is operated. Since data from these sites are not gathered and analysed in a central data base, but stored in separate institutions, their use by GTOS would require structural reorganization.

The LTER sites of Kiskunság, Sikf kút and lake Balaton could be included in the TEMS database. Another possiblility would be to include data collected by two major environmental projects: the construction of a dam and power plant on the Danube, which has changed the hydrology of the Szigetköz region, and the initiative to protect water quality of lake Balaton. At both sites ecological, hydrological and chemical monitoring has been carried out over a period of 6-8 years with data stored centrally.

The full operation of the Hungarian Biodiversity Monitoring System will enable all national parks to be involved in regular, site based, standardised monitoring (more detail in 3.3). The System is, at present, only partly operative but should be fully active in 3 years time.

3.3 National networking

Monitoring of the physical environment is well developed in Hungary. Air quality is measured at hundreds of sites for different variables by the National Institute for Environmental Health and the National Public Health Service with an online information system on urban air quality that is publicly available. A network of sites, with a centralised geographic information system, is available for soil quality (pollution included) within the TIM programme. Water quality monitoring is carried out for selected running water bodies. An overall estimate of water quality classes is produced annually for each main river. CORINE Landcover is not a monitoring system but provides a full coverage of Hungary and aims to be updated on a fine scale based on recent satellite images.

Monitoring the biological component of the environment is labour-intensive and needs a high level of expertise for interpretation of data. Remotely sensed crop yield assessment is carried out for the whole agricultural area of Hungary with several measurements per year at a high level of accuracy. A pest-monitoring network has been operating for agricultural and forested areas for some time. Recently, lack of funds has resulted in the abandonment of several sites and the consequent decrease in number of species groups analysed. Forest health is monitored in a grid system following international standard methodology. The CORINE Biotopes programme resulted in a database of valuable habitats that provides an opportunity for periodic state assessments similar to the network of Biosphere Reserves. Currently, no standardised monitoring is carried out at these sites.

Measurement of biodiversity and assessment of the state of the biota is complex. The Hungarian Biodiversity Monitoring System (HBMS) was launched in order to fulfil the monitoring requirements of the Convention on Biological Diversity. However, it is proving difficult to monitor all species and habitats.

Information recorded at different Organizational levels (populations, communities/associations and landscapes) can be compared by focusing measurements to selected sites. A network of 5 by 5 km sampling quadrants (124) has been set up, where mapping at landscape level consititutes the framework within which the more detailed, standardised community and species-oriented repeated investigations can be carried out.

The National Biodiversity Monitoring Service was created to fulfil these tasks. Nine regional national parks coordinators, a central coordination unit and an independent Advisory Committee were set up in 1997. For the activities that do not require special expertise the cooperation of schools and nature conservation NGOs will be sought. The implementation of this programme will require extensive time.

There are three LTER sites in Hungary, which monitor principal biome types: wetland (lake Balaton), sand forest-steppe (Kiskunság) and oak forest (Síkf   kút).

Table 3.1 A summary of monitoring networks

Network name	Target component	Responsible institution	Number of variables measured	Site No. (coverage)	Establi-shment date
Emmission network	Air	National Public Health Service	4 basic + additional	666 and less	1976
Water quality	Water	Institute for Environmental Management		241	
TIM	Soil	Plant Protection and Soil Conservation Services		1236	1996?
CORINE Landcover	Land use types	Institute for Geodesy, Cartography and Remote Sensing	9 land classes	National	1992
Crop yield	Agricultural crop	Institute for Geodesy, Cartography and Remote Sensing	X species	Agriculture	1998?
Agricultural pest monitoring	Insects	Plant Protection and Soil Conservation Services	Few pest species		
Forest pest monitoring	Larger moths (and other insects)	Scientific Institute for Forestry	Over 700 species	25	1961
ICP-Forests	Forest health	Scientific Institute for Forestry		68	

LTER	Ecosystem dynamics	Institute of Ecology and Botany, Balaton Limnological Research Institute, Kossuth Lajos University	Diverse and specified indicators	3	1950s
Hungarian Biodiversity Monitoring System	Biota, habitats	National Authority for Nature Conservation of MoE	Over a dozen components organized in 10 projects	National	1997

3.4 International networking

Most conventions do not require standard monitoring activities to fulfil reporting obligations. In general the responsible officer in each Ministry collects data from subordinate institutions and compiles a report which is approved by the relevant departments. The lack of centralised databases makes the procedure time consuming and rather subjective.

An example of international networking is the CORINE Landcover programme, is a European initiative and the map produced for Hungary constitutes part of the continental map. Environmental quality measurements in relation to human health are carried out in accordance with the National Environmental Health Action Plans with the involvement of 6 European countries. The forest health and integrated monitoring is part of international networks (ICP-forests and IMP network) with specified methodology and reporting. The LTER sites are part of the International LTER network, the site requirements are gradually fulfilled (meteo station, productivity measurements etc.).

3.5 Analysis of legal framework for data handling

A detailed data policy (including price policy) has to be developed for environmental data. At present, aggregated data on monitored physical properties of the environment are published annually. The data are stored in the responsible institutions and are provided for a fee. The amount is set arbitrarily by the institution. The data policy of the HCSO is well regulated (see 3.1).

Data on natural resources are only used internally. It is recommended to set up a mechanism based on three levels of data availability: *classified* (data on protected species only available for internal use); *public* and *professional* (for exchange of data between scientists). A legal instrument for the implementation of this mechanism must also be developed.

Use of data belonging to research institutes follows general practice: data in publications are open to use by others but must be cited. All other unpublished data are considered the private property of the researcher. This often results in the loss of valuable data. It is hoped that this attitude will change as a result of current trends: funding agencies promoting the distribution of research results.

3.6 *Use of environmental information*

Decisions on environmental matters require up-to-date information at all levels. At present this information is often not available in a useful format and much data is collected only on an annual basis. The setting up of a centralised environmental information system with well-regulated access has been planned and will be implemented by the Ministry of the Environment. Data policy will need to be developed at the same time.

Information on the environment is very often cited in the media, mostly in relation to pollution events. Although this has the positive effect of increasing public awareness on problems of pollution it can also be the cause of misinformation. There have recently been public protests regarding financing of programmes for environmental protection. A programme of information and education in this field, directed to the responsibility of the individual, is required.

4. User Needs Assessment

This section is based on the results obtained from the interviews carried out druring visits to the countries in the region. Two types of user needs can be identified: one is the type of data used regularly, the other covers the needs of potential GTOS users.

4.1 *Data and information needs*

In order to supply decision-makers with relevant data and information, research must be undertaken to analyse and categorise the mass of data available. Decision-making is best supported by interpreted, aggregated information with a clearly identified quality assessment or an identification of trends supported by monitoring. This requires centralised databases, integrated analysis and a well defined interpretation and application methodology. Greater cooperation between sectors would facilitate exchange of information.

Lack of access to data and information on the environment is a major problem in Hungary. The lack of metadata sytems hinders access to existing data. Data on all scales (monthly and annual, local, regional or national) are required. Analysed, interdisciplinary data are also required. At present these are to be found only in reports or publications and are often not available or not easily comprehensible (e.g. correlation between different environmental variables, like land use and invasion of species).The high cost of detailed information is also a limiting factor for users.

4.2 *Requirements raised by potential users of GTOS*

All institutions and programmes contacted recognised the potential benefit of participating in GTOS to facilitate fund raising and international collaboration. Data providers like FOMI believe that GTOS has an important potential for further use of their data. Data collection must be supported by the development of a methodology on how to apply data. This methodology should then be disseminated through handbooks on how to prepare an output, how to interpret data, and how to use the information for different practical purposes.

The main objective of a terrestrial observing system like GTOS, based on remote sensing and ground confirmation at the same time, is to assist nature conservationists on how to cope with and interpret global changes. It is especially difficult to assess the effects of climate change as it is interlinked with other types of environmental changes, such land use and natural succession. Since climate change seems to result in more frequent unpredictable changes of the weather conditions, the early warning capability of the GTOS programme could be of great assistance in decision-making. Situated within the Carpathian Basin with only 11,4% of the catchment area of the Danube, the main river, a regional outlook of environmental measurements has a great importance for Hungary. During the interpretation of observation data on terrestrial systems the difficulty of dividing human induced changes from natural succession has to be taken into account.

5. Development of Standard Methodologies for Data Handling

The network of environmental quality measurements is already well developed in Hungary for physical variables while a new sophisticated monitoring system for biota is in the early phases of implementation. The main drawback to the effective use of monitoring information is the lack of centralised databases on projects and the lack of proper data policy. Sufficient data and information is gathered but the arrangement of information, its handling and access must be further developed.

5.1 Need for standard methodologies in integration

New methodologies have to be developed for the establishment of information centres. Management of data-bases must be improved particularly in ministries and assistance should be attained from international sources. Very little attention is paid to the elaboration of application methodologies and interpretation requirements. The joint interpretation of different variables sampled by different sectors is especially weak and help in modelling is required.

Since the integration of environmental data in Hungary is still in its first stages, it would be useful to reflect international agreements on information management, dissemination and exchange in the internal re-Organization. GTOS could play an important role as a facilitator of data integration. It is important to develop a system of public data access. The public is usually not aware of the diversity of existing information and their possible links so that judgement is mostly based on data provided by the media. A user-friendly public database could also raise awareness of environmental problems and eventually of personal responsibility.

5.2 Institutional framework

The institutional network is well developed in Hungary and expertise is sufficient to satisfy the needs of environmental monitoring. The weak link is the lack of funds, which often results in the loss of skilled personnel to more developed countries (mainly the USA and Western Europe). This drawback is most evident in the case of information officers: companies are ready to pay an information expert several times more than what he is paid by the government in Hungary. International cooperation could help in solving these problems by providing tested frames for databases and by giving consultancy support to information centres.

5.3 Need for a national meta-database

The Ministry of the Environment has already initiated the establishment of a meta-database for environmental information. This programme is of the highest priority in order to continue with on-going programmes and to ensure synthesis of available information. The monitoring institutions have to select the type of information that can be stored in a meta-database. Information on homepages and their links could facilitate this activity. Institutions should be encouraged to provide Internet access to relevant information.

5.4 Training needs

The level of higher education is sufficient in Hungary to produce the experts needed for specialised environmental studies. Lack of finance, however, limits the number of personnel for advanced data and information management In most cases specialist in other topics develop their skills in informatics to fulfil the requirements of data management. In this case, training is required.

Concerning biodiversity assessments, there is a need for taxonomist specialists (mostly zoologists), since, in many cases, the selection of monitoring objects is guided by the availability of specialist to identify the samples. Hungary is not particularly at a disadvantage in this respect since this type of expertise is difficult to find worldwide. Nature conservationists are encouraging universities to promote specialisation in these fields.

5.5 Missing international linkages

The institutions themselves have a good overview of international programmes relating to their speciality. Problems mostly rise in the lack of information on programmes in linking topics and in more general type of international activities. The use of internet information is not a routine exercise. The reason for this is the work load and the working habits of experts. The meta-database could help in this respect by providing quick and successful searches.

5.6 Identification of main potential users of a future GTOS information supply

- Regional Environmental Centre (REC) for Central and Eastern Europe
- Ministries which have a regional outlook (Basin level)
- Decision-makers at country and municipal level
- Research institutes
- Joint projects
- Media
- NGOs
- Universities and schools

Expectations and needs of national information network from the international initiative is detailed in user needs (4.2).

References

Báldi A., Csorba G., Korsós Z. 1995. Nature conservation evaluation of the vertebrate fauna of Hungary. (in Hung.) Natural History Museum, Budapest.

Borhidi A. 1995. Social behaviour types, the naturalness and relative ecological indicator values of the higher plants in the Hungarian flora. *Acta Botanica Hungarica* 39:97-181.

Di Castri, F., Hansen, A.J. & Debussche, M. 1990. Biological invasion in Europe and the Mediterranean basin. Kluwer, Dordrecht. pp. 463.

Drake, A.J., Mooney, H.A., Di Castri, F., Groves, R.H., Kruger, F.J., Rejmánek, M. & Williamson, M. 1989. Biological invasion. A global perspective. John Wiley, Chichester.

Farkas E., L kös L. & Verseghy K. 1985. Lichens as indicators of air pollution in the Budapest agglomeration I. Air pollution map based on floristic data and heavy metal concentration measurements. *Acta Botanica Hungarica* 31:45-68.

Gallé L., Margóczy K., Kovács É., Gy rffy Gy., Körmöczy L. & Németh L. 1995. River valleys: are they ecological corridors? *Tiscia* 29:53-58.

G bölös A. 1995. Forestry policy. (in Hung.) *Biotechnológia és Környezetvédelem* 8:6.

GRID 1998. State of the Environment in Hungary. (http://www.gridbp.meh.hu/ GRID3VER/AINDEX.HTM)

Hungarian Central Statistical Office (HCSO)1997. Hungarian Statistical Year Book.

Hungarian Central Statistical Office (HCSO)1999. Environmental Statistical Data of Hungary, 1997.

Király G., Kun A. & Szmorad F. 1999. The vegetation of the Vas-hegy and its floristic peculiarities. (in Hung.) *Kitaibelia* IV:119-142.

Leskó K. & Szabóky Cs. 1997. The greater moth fauna of the Great Plain based on the data of the forestry light traps (1962-1996). (in Hung. with Engl. Summary). *Erdészeti Kutatások* 86-87:171-200.

Magyary T. 1998. Nature conservation in the agricultural areas. (in Hung.) in: Kiszel V. (ed.) Nature conservation for land managers. Göncöl Alapítvány, Vác. 147-262.

Mika J. 1988. Regional characteristics of global warming in the Carpathian Basin. (in Hung.) *Id járás* 92:542-559.

Mika J. 1993. Climatic change of the Great Plain in relation to global climate change. (in Hung.) *Alföldi Tanulmányok* XV:11-29, Békéscsaba.

Maastricht-The Hague, 1995. Habitat fragmentation and infrastructure. Proceedings of the international conference "Habitat fragmentation, infrastructure and the role of ecological engineering". 17-21 September 1995. The Netherlands.

Ministry for Environment 1998. Homepage (http://www.ktm.hu/).

Szabó G. 1999. Country report on the present environmental situation in agriculture - Hungay. p. 16-35. in: Present Environmental Situation in Agriculture, Central and Eastern European Sustainable Agriculture Network. FAO SEUR, Humbolt University of Berlin, Gödöll University of Agriculture.

Török K. & Halassy M. 1999. Fighting invasive species: a case study of open sand grasslands in Hungary. Proc. Of the VIth International Rangeland Congress. 610-612.

WMO. World Meteorological Organization, 1998. Homepage (http://www.wmo.ch/).

List of Institutions and Contact Persons Visited in Hungary.

Institution	Name, Email	Function
FAO SEUR Budapest, Benczúr u. 34. 1068	Mr. J. Suchman. Jaroslav Suchman@fao.org	Representative
Hungarian Central Statistical Office Budapest, Keleti K. u. 5/7. 1024	Mr. Ferenc Németh ferenc.nemeth@ksh.x400gw.itb.hu	Head of the Environmental Statistics Dept.
Authority for Nature Protection Budapest, Költö u. 21. 1121	Dr. A. Demeter Demeter.Andras@ktmdom2.ktm.hu	Director of the Division of Nature Conservation
Ministry for Environment Budapest F u. 44-50. 1011	Mr. P. Bozó Pal.Bozo@ktmdom2.ktm.hu	Chief Information Officer, Dept. for Environmental Information System and Head of GRID – Budapest
Institute of Geodesy, Cartography and Remote Sensing (FÖMI), Budapest, Bosnyák t. 5. 1149	Mr. G. Büttner buttner@harsp.rsc.fomi.hu	Head, Environmental Applications, Remote Sensing Centre
	Mr. P. Winkler	Head of the Remote Sensing Centre

Danube Basin Ecological Convention Temporary Secretariat, Budapest, Költö u. 21. 1121	Dr. Ödön Rádai Radai.Odon@ktmdom2.ktm.hu	Head of Department
Regional Environmental Centre	Mr. Alexander Juras ajuras@rec.org	Dept. executive director
Szentendre, Ady E. u. 9-11. 2000	Mr. Jerome Simpson	Information Service Officer
	Ms. Mira Mileva	Biodiversity expert
	Ms. Eva Izsák	Hungarian Local REC officer

Country Assessment on the Environment
Poland

Dr. Marek Baranowski
Environmental Information Centre UNEP/GRID-Warsaw

1. Country profile

Population	38,660,000 (31 December 1997 est.)
National product:	GDP-purchasing power parity: $246.3 billion (1996 est.)
National product per capita	purchasing power parity - $6,400 (1996 est.)
Agriculture	GDP in agriculture: 6% potatoes, milk, fruits, vegetables, wheat; poultry and eggs; pork, beef
Climate	Temperate with cold, cloudy, moderately severe winters with frequent precipitation; mild summers with frequent showers and thunderstorms
Terrain	Mostly lowlands, with mountains along the southern border and low mountains in the southern central part. The average elevation is marginal 574 feet (175 meters) above sea level. Southern Poland houses the High Tatra Mountains which reach as high as 1.5 miles (2,499 meters) and is a popular destination for winter sports. Wooded lakelands decorate the northern central region, which also contains beach fronts on the Baltic coast as well as interesting desert dunes (in Slowinski Park - pictured). Lowest point: Raczki Elblaskie - 1,8 m below sea level Highest point: Rysy (Carpathian Mountains) 2,499 m. Territory: 322577 km^2 (land area including inland waters – 311904 km^2). Main rivers: Wisla: 1047 km, Odra, 854 km (of which 742 km in Poland)
Natural resources	Coal, sulphur, copper, natural gas, silver, lead, salt
Land use	Arable land: 47% Permanent crops : 1% Permanent pastures: 13% Forests and woodland: 29% Other: 10% (1993 est.) Irrigated land: 1,000 km^2 (1993 est.)
International agreements	Party to: Air Pollution, Antarctic-Environmental Protocol, Antarctic Treaty, Biodiversity, Climate Change, Endangered Species, Environmental Modification, Hazardous Wastes, Marine Dumping, Nuclear Test Ban, Ozone Layer Protection, Ship Pollution, Wetlands, Whaling (signed, but not ratified), Air Pollution-Nitrogen Oxides, Air Pollution-Sulphur 94, Law of the Sea
Environment	Current issues: situation has improved since 1989 due to decline in heavy industry and increased environmental concern by post-communist governments; air pollution remains serious because of sulphur dioxide emissions from coal-fired power plants, and the resulting acid rain has caused forest damage; water pollution from industrial and municipal sources is also a problem, as is disposal of hazardous wastes. Poland has many regions of unspoiled natural beauty, such as the Bialowieza forest - the last virgin forest of the European mainland - which is home to the largest surviving herd of European bison. However, forests

	suffer damage due to air pollution and resulting acid rain. Hazardous and industrial waste, water and air pollution also pose some environmental problems. Natural hazards: NA

2. Major Environmental Threats

2.1 Air pollution

The main air pollutants in Poland include sulphur dioxide, nitrogen oxides and dust. Most of these atmosphere-contaminating emissions originate from fuel combustion processes. The largest share of sulphur dioxide is emitted by power generating utilities, nitrogen dioxide – by mobile sources, and dust – by power utilities and industrial processes. The reduction by almost 50% of sulphur dioxide emission over the last decade demonstrates the effectiveness of the legal and economic instruments implemented in the early nineties and of the technologies applied. A possibility to further reduce SO_2 emissions is increased use of gas and change in household heating systems which should play an important role in the already improved air quality in cities.

A reduction in emission of nitrogen oxides is also recorded. The installation of low emission burners in many plants has further reduced the NO_x emissions from stationary sources. However air pollution by nitrogen oxides is principally due increasing numbers of mobile emissions. The currently binding national regulations, as well as introduction of the EC rulings on pollutant emission from motor vehicles, and the introduction of the requirement of international compliance certificates, should bring about some concrete reductions not only of nitrogen oxides, but also of carbon monoxide, hydrocarbons and lead.

Dust produced at fuel combustion and some industrial processes typically includes some compounds of heavy metals such as cadmium, lead, mercury and chromium. The air quality in Poland is also affected by contamination originating in the neighbouring countries. The main air pollutant concentrations (SO_2, NO_2, dust) in the vast majority of Poland’s territory are relatively low. Excesses of SO_2 and dust over allowable concentrations are most often recorded in the industrialized areas of southern Poland ,and particularly in the cities, where individual heating systems prevail. An excess of concentration of nitrogen dioxide is rarely reported. Ozone concentration is growing frequently above allowable levels.

Poland is striving to further reduce hazardous pollutant emissions and, as party to many conventions and international agreements, has assumed numerous obligations in this respect.

2.2 Water pollution

Most of Poland’s territory lies within catchment of Poland’s two largest rivers: Vistula (54%) and Oder (33,9%). Poland’s hydrological network includes also some maritime region rivers flowing directly to the Baltic Sea.

Poland’s water resources are scarce. Surface water resources are crucial for water supplies to the Polish national economy. Ground water resources provide good quality drinking water to the public.

The annual water consumption amounts to ca. 12000 million m^3, which includes 71,4% for industrial use; 19, 8% municipal use and 8,8% agricultural and forestry applications.

85% of water intake returns to surface waters as sewage. The yearly volume of sewage amounts to about 10 100 million m^3, out of which 17% are municipal wastes, and 82% industrial wastes. The yearly volume of sewage for treatment amounts to ca. 2 900 million m^3 which is mainly municipal originated sewage. A significant share of industrial sewage holds cooling water, which, as “conventionally clean”, does not require biological treatment.
The volume of municipal and industry originated sewage has continued to fall over the last six years, resulting from the rationalization of water consumption for both manufacturing and household applications enforced by the legal and economic instruments. At the same time, large-scale investment projects over the recent years have resulted in an increase in the number and efficiency of sewage treatment plants. There are currently ca. 5000 sewage treatment plants operating in Poland, including 1759 industrial, 1471 municipal and about 1770 other small treatment plants, including farm plants.

Most municipal treatment plants are small and designed to solve local water protection problems. However the discharge of untreated sewage still remains a very serious problem in large cities. Only 43% of sewage originating from 42 major cities in Poland is biologically treated.

Limitation of point and surface contaminator discharge (rationalization of chemical fertilization) has resulted in gradual improvement in the state of rivers in Poland. The number of river segments in which the water is of lower quality than allowable by binding Polish standards, has decreased. At the same the amount of river water meeting drinking water quality criteria has increased. A continued fall in biogenic substances, organic compounds, heavy metals, and phenols and other toxic compounds content has been recorded, although neither the river waters’ salinity, nor their suspension has improved.
The most important problem of the Polish rivers is still their poor sanitary condition. Despite a slight improvement, still ca. 80% of river segments carry waters contaminated with bacteria in excess of the standard limits. This is the result of discharges of untreated municipal sewage into the rivers and area run-offs from rural sites with unregulated water and sewage management.

The most commonly employed classification method takes into account the following mandatory indicators: dissolved oxygen, BOD_5, COD_{Cr}, phenols, chlorides, sulphates, dissolved substances and suspensions.

Poland participates in international programmes for the Baltic Sea survey and protection within the framework of the Helsinki Convention. A survey shows a gradual improvement in the Baltic Sea marine waters with a fall in pollutant loads denoted by the BOD7 indicator over the last few years. Nitrate and phosphate concentrations in marine waters, which are responsible for algal blooms, are also decreasing. Oxygen deficits in the Borholm, Gotland and Gdask deeps are still observed, worsened by lack of oceanic in-flows into the Baltic Sea. Apparent improvement in the sanitary condition of water in the coastal zones has been noted.

2.3 Biodiversity

Poland has many species of both flora and fauna found only in that country. Considerable biodiversity and ecosystems unique in terms of natural resources and landscape characterize the Polish nature. There are 33 066 different species of wildlife, including some31 000 invertebrates and about 600 vertebrates, of which 434 species reproduce in Poland. Most of the vertebrates are subject to legal protection. The successful protection of endangered species in Poland includes restitution of European bison, beaver and elk, as well as the maintenance of Europe’s largest wolf population.

To maintain this biodiversity, a system of protected areas has been developed, particularly since late eighties. The protected areas cover over 29% of the country, more than six times the area of fifteen years ago. In the same period the number of landscape parks have grown sevenfold, while the number of national parks and reserves over 1,5 times (in 1996 alone two new national parks were inaugurated).

Poland actively participates in numerous international initiatives and programmes of environmental protection and cooperates actively in this respect with neighbouring countries. It also participates in the development of the European network of protected areas (Natura 2000, ECONET).

The MaB (Man and Biosphere) program, under UNESCO's auspices, is developing a global biosphere reserves network. Poland has contributed one nature reserve (uknajno Lake) and six national parks, three of which are included in trans-border protected areas, to this program.

2.4. Land quality

Two forms of land use dominate in Poland: farmland and forests. Together they occupy over 88% of the total territory of the country. The location of Poland in the belt of the great European plains has significantly influenced the way land is utilized. The plains and large hilly country areas are suitable for cultivation despite the poor quality of the soil. As a result 59.77% of land in Poland is farmland. Arable land totals 14,269,000 hectares and permanent pastures occupy about 4,100,000 hectares.

However, the area of land being farmed is systematically decreasing. In 1994 the total area of farmland was 18,690,000 ha and this was 879,000 ha less than in 1979 and 411,000 ha less than in 1980. In comparing current acreage of farmland with that in 1970, it is apparent that the decrease in acreage was accompanied by an increase in acreage of forestry (270,000 ha), settlements (260,000 ha), idle land (135,000 ha), terrain used for transportation (about 100,000 ha), surface water (over 30,000 ha) and mineral extraction (14,000 ha). Compared to 1946 the share of farmland fell from 65.6% to 59.8% in 1994. With the increase in population of Poland there has therefore been a decrease of per capita acreage of farmland. In 1980 this figure was 0.54 ha per person, in 1994 it was only 0.48 ha.

Permanent grassland, both permanent meadows and pastures, occupy only 4,100,000 ha, which is 13.1% of total land area. Poland has one of the lowest areas of permanent grassland in Europe. In 1991 the acreage of permanent grassland in Poland was 3,891,000 ha. Permanent pastures occupied 1,512,200 ha or 38.9% of permanent grassland, while permanent meadows occupied 2,375,800 ha or 61.1% of the total.

Meadows in Poland are to a large extent artificial. They were formed as a result of riverside forest clear-cutting or by turning former tillable fields into meadows and pastures. Natural concentrations of meadows exist only in small areas, mainly in the mountains.

The second largest form of land use in Poland is forests. In 1994 forests occupied 8,720,000 ha, which amounted to 27.89% of total land area. Their distribution is very uneven. The greatest number of forests exist in the western and northwestern part of the country where the densest forests in the country. In the north the largest compact forest area is Bory Tucholskie, (120,000 ha). Forest complexes near the border of Lithuania and Byelorussia are a relict of

former great forest areas. They are the Puszcza Augustowska (107,000 ha), Puszcza Piska (about 100,000 ha), Puszcza Knyszynska (58,000 ha), Puszcza Bialowieska, (58,000 ha).
Almost 78% of forests, that is 6,801,600 ha, is covered by coniferous forest (Bory). This predominance of coniferous forests is especially visible on the lowlands, although it also occurs in the highlands and higher parts of the mountains. Coniferous forests occur particularly in land unsuitable for cultivation.

Deciduous forests occupy over 1,924,000 ha (over 22% of forests). They exist in larger complexes near Szczecin (Puszcza Bukowa), in Puszcza Knyszynska and Bialowieska and in the Eastern Carpathian mountains.

In 1990, the total acreage of forests increased by 2,224,000 ha, a growth of 34.37%. Coniferous forests increased by only 20% while the acreage of deciduous forests grew 228.8% to 1,924,000 ha (in 1994). These figures show a significant change in the species composition of forest stands. To a large extent this is caused by the necessity of introducing species which are more resistant to poorer environmental conditions, especially air pollution. Many forests in Poland are under 40 years old (I and II age classes).

The national afforestation program has project an increase of 30% in the area of forests by the year 2020 and up to 33% by 2050. State owned forests cover about 83% of the forested area, while the rest is private property. In 1997 legal protection was extended over 37,8% of the total forested area (against only 20,2% in 1980).

The habitat forest structure is predominated by coniferous forests covering 66% ca. of the forested area, the remainder is made up of leafy forests. The species structure features coniferous species over 77,5% of the total forested area. Over the last 50 years the share of leafy species has increased from 13% in 1945 up to 22,5% in 1996.

The environmental health of forests is assessed over fixed test areas on the basis of defoliation (i.e. decline in tree-top assimilation apparatus) and tree bark decolorization. Since 1995 a noticeable improvement in the condition of forest stands has been observed. The most prominent improvement in the coniferous species is in pine and fir, while improvement in spruce is only marginal. The condition of beech and birch has improved the most among leafy species, but oak only marginally. This improvement has resulted from continued reduction of air pollution and increase in precipitation over vegetation period.

Adoption and implementation of forest management based on the principle of sustainable development and nature conservation and upgrading of the national environmental regulations, have laid a foundation for effective forest protection.

2.5. Climate change

Human activities influence the climate of Poland mainly through the changes in the land utilization and air pollution. Both factors cause changes in the energy balance of the atmosphere and earth's surface, and thus of the circulation of heat and water in this system.

With regard to land use, deforestation and urbanization are the major problems. Deforestation causes an increase in thermal contrasts in the lowest layer of the atmosphere and a decrease in the amount of water vapour in the atmosphere. By changing the ground roughness the process of deforestation leads to an increase of the wind speeds, which lowers the humidity of air and increases evaporation of water. In the last 15 years (from 1975) the total surface of

forests increased slightly (by 1.7%). However parts of southern and western Poland the area of the forests decreased.
Urbanization increases air temperature (so called urban heat islands), lowering the amplitude of temperatures, weakening the inflow of solar radiation and changing the precipitation system.

Air pollution disturbs the balance of solar radiation by increasing atmospheric obscurity, changing the chemical composition of the atmosphere and of the drops of water that are in the atmosphere (acid rains), increasing the ozone concentration in the troposphere, decreasing it in the stratosphere, and delivering additional amounts of thermal energy to the atmosphere which changes its thermal structure.

A systematic increase of ozone concentration in the troposphere in the highly industrialized regions has been observed. Ozone is a result of photo-oxidation of carbon monoxide, methane and other volatile organic compounds in the presence of sulphur dioxide or nitrogen oxides. Because of the short lifespan of ozone in the lowest layers of the atmosphere, it does not have a large influence on climatic conditions, but it is a deterrent to living organizms.

According to international scientific institutions, the changes in the global climate result from the emission of gases into the atmosphere which cause the greenhouse effect. These emissions are the result human activities. The most important greenhouse gases are: carbon dioxide, methane, nitrous oxide and chlorofluorocarbons (freon gases). Freon gases have a great heat capacity and are used, among others, for cooling. A growing concentration of greenhouse gases in the atmosphere causes a rise in temperatures in the lowest layers of the atmosphere.

The increase of temperature and reduced precipitation in Poland is also related to the rising trend in the global temperatures. The average annual air temperature in Poland has risen by about 0.5^{o}C from the late 1960's to the 1990's, and average annual precipitation has fallen by about 70 mm.

One of the problems of a global concern is the destruction of the ozone layer in the stratosphere due to the emission of freon gases (chlorofluorocarbons, or CFCs). Ozone has a very important and beneficial function in the stratosphere – it absorbs ultraviolet radiation that is harmful to living organizms. Freon gases which, in the lowest layers of the atmosphere, act as greenhouse gases, decompose in the stratosphere freeing atoms of chlorine and bromine, which cause the break up of ozone particles.

Precipitation over the whole country follows a different trend. From 1931 to 1980 in urbanized and industrialized areas there was an increase of the total amount of precipitation, while in the rural areas there was a downward trend in precipitation. In the 1980s a downward trend of the total amount of precipitation occurred throughout the country. Studies of Cracow's climate indicate that from the middle of the 1970s the following changes in the climate occurred: decrease in the amount of clouds (as observed in much of Europe) and a fall in the amount of insolation due to increasing atmospheric obscurity and a worsening of city ventilation conditions.

Over the years city temperatures grew faster than temperatures observed globally. This is undoubtedly a result of an overlapping of both factors, urbanization and industrialization of urban areas together with global warming.

If urbanization and deforestation take place at a similar rate in the future, this tendency will continue causing unfavourable changes in the climate. An expected further increase of concentration of greenhouse gases in the atmosphere will lead to an increase of air temperature. The size of this increase depends on economic strategy, especially on how the power-generating industry develops world-wide. It is estimated however, that an increase of the average annual temperature to the end of the next century may range from 2 to 4 degrees. In a scenario of predicted climate changes in Poland to year the 2000, average annual air temperature are supposed to grow, mostly as a result of the increase of temperature during winter. At the same time, a slight increase of precipitation in the winter should be expected with a decrease in precipitation during other seasons. This means that a decreasing trend of annual precipitation should continue to the end of this century.

Another problem that will occur in the future is the further decrease of ozone in the stratosphere. In light of the long lifespan of freon particles in the atmosphere (up to 150 years) it cannot be expected that concentrations of freon gases in the atmosphere will fall. This is why in 1985 on the initiative of the United Nations Environment Program, the Vienna Convention for the Protection of the Ozone Layer was signed. In 1987 the Montreal Protocol was enacted. This document defines the strategy of gradual reduction of gases that destroy stratospheric ozone. Poland ratified this convention in 1990.

3. Status of National Environmental Observing Systems

3.1 Institutional framework

In Poland two central administration institutions are responsible for collecting of environmental data: the **Inspection for Environmental Protection** and **Central Statistical Office**. The first one is developing the state environmental monitoring system and environmental information system for central administration. The Inspection is in charge of reporting on the state of environment as well as for checking the proper use of environment. The similar functions are performed by the regional inspectorates in voivodships. The Inspection plays coordination role in regard to inspectorates, which are directly subordinated to voivodship administration (before 1999 they were subordinated to the Inspection).

The **Central Statistical Office** collects a lot of data on environment within the framework of state statistical activities. All administration and economic institutions are obliged to report to the Office on various matters including environmental indicators. The Office publishes a year-book dedicated to environment called “Environmental Protection” where one can find a vast amount of data.

The **Ministry of Environmental Protection, Natural Resources and Forestry** is supervising the environmental activities in country. The particular departments initiate and coordinate some data collection on environment. Especially data on nature, geology and forestry are collected with the involvement of the Ministry. The Secretariat of the Minister is responsible for maintaining the information system for the Ministry, and is in-charge of providing internal and external databases.

The **Institute of Environmental Protection** is research institute specialized in environmental studies and development works. The Institute is involved in air pollution monitoring, noise monitoring, lakes monitoring and biological monitoring of Baltic Sea as well as studies on biodiversity. The Institute has a number of regional units including several monitoring stations where they perform specialised observations. They also maintain the protected areas database for Poland as well as database on institutions dealing with biodiversity in Poland.

The **Forest Research Institute** main goal is to conduct the studies on the stability of forest resources threatened by the abiotic, biotic and anthropogenetic factors and also on the formation on the multiple-use forest to ensure the protection of soil and water, richness of flora and fauna which affect the climate and create opportunites for recreation activities. The Institute consists of 15 scientific departments and 4 separated scientific and research laboratories. The Institute carries out scientific and development research in the field of forestry science. The main research directions are:

- forest communities biology and ecology,
- natural factors regulating forest health condition,
- forest resources condition and development, comprehensive forest functions and division into regions for various forestry management purposes,
- hydrology and forest drainage,
- impact of industrial emissions and other man-caused factors upon forests, and restitution of withdrawing stands,
- silviculture, afforestation of non-forest lands,
- forest protection and methods to enhance the biological resistance of forest stands,
- forest protection against abiotical factors and fire,
- main and ancillary forest utilization,
- game management,
- forest planning and management, and forest productivity,
- economics of forest management and its linkage with other branches of the national economy, principles and methods of management and organization, forest policy, and forestry history,
- improvement in technological processes and technical means in forest management.

The **Institute of Botany of Polish Academy of Sciences** in Cracow is dealing with paleobotany, taxonomy and ecology. Recently they were involved in a 3 year tropospheric ozone monitoring (active and passive) programme in the Carpathians - with Slovakia, Romania, Ukraine, Poland, Hungary, Czech Republic and US (started 1997, till end of 1999).

The **UNEP/GRID-Warsaw** Centre is one of 14 nodes of the Global Resource Information Database network. Its main interest is related to the geo-referenced environmental information. The Centre developed several GIS-based databases for Poland and Europe (among others Base Map 1 : 100 000 database of Poland for environmental studies and management). They are also specialized in environmental mapping, especially for environmental reporting (among others maps for two publications of the European Environment Agency). One of scientific focus deals with biodiversity studies in general and its investigations on the basis of remote sensing. The Centre is also involved in implementation of NATURA 2000 programme for Poland and was in charge of constructing nature monitoring database for the country. The UNEP/GRID-Warsaw elaborated meta-database on environmental information four times since 1991.

The **Institute of Nature Protection of Polish Academy of Sciences** in Cracow is specialising in research on methods of nature protection and Organizational forms of designated areas arrangements. The Institute was in charge of CORINE Biotopes database development and maintain it updated till nowadays.

The **Institute of Geodesy and Cartography** is leading institution in applying remote sensing in many fields. The Institute was in charge of the CORINE Land Cover project for Poland resulting in medium scale (1 : 100 000) database of the country, elaborated on the basis of satellite images of the period 1992-1993. Many applications of that database have been developed by the Institute especially for the local and regional authorities. The Institute is also involved in mapping of the protected areas using air photographs as a source.

The **Institute of Geography and Spatial Organization of Polish Academy of Sciences** was in charge of elaboration of National Atlas of Poland. The environmental studies are concentrated in the Department of Biogeography where a lot of vegetation mapping has taken place. That activity is focused on the changes of biodiversity and consequences of climate change. They took part in the nature monitoring in Poland.

The **National Foundation for Environmental Protection** is specialising in biodiversity studies, both national and international, as well as in nature monitoring and environmental impact assessment. They also assist Ministry of Environmental Protection, Natural Resources and Forestry in elaboration of national reports to many international Organizations like Agenda 21 realisation.

The **Institute of Geography of A. Mickiewicz University** in Poznan is responsible for coordination of the integrated monitoring consisting of 7 stations in representative locations for different landscape. The works are conducted since 1992.

3.2 Analysis of existing observation sites

The integrated monitoring network was established in Poland in 1992 to help predict and explain environmental changes. Its focus is on fluxes of energy and matter and bioindication methods. The measurements include: precipitation, soil water, air and ground quality, nutrients, changes in quality and quantity of plant cover, invertebrates, lichens. Each station has its own special programme with a Core set of common variables measured according to standard protocols.

This is a national network of integrated monitoring consisting of 7 sites established in different major Polish ecosystems (glacial moraines, central plains, mountains). The following site selection criteria has been used:

- far from major pollution sources,
- typical ecosystem for the region,
- include a small catchment,
- ownership of land,
- existing expertise on site,
- available data on land use history.

3.3 National networking

Each sector monitoring has its own network. The most suitable for GTOS seems to be integrated monitoring, and just initiated nature monitoring. The last one consists of several networks of observations focused on specific groups of species or methods of data gathering. The same sites are expected to be revisited in 5 year intervals.

There are also other networks maintained by institution which are not involved in the state monitoring system supervised by the Inspection for Environmental Protection. The Institute of Cultivation and Soil Fertilization perform each year observations of heavy metals in soil at 7 500 sites. The network is densified in the five consecutive years reaching number of 45 000 sites which will be revisited after 6 years.

The Sanitary and Epidemiology Inspection also maintains its own network of air monitoring.

3.4 International networking

There are several international programmes of terrestrial observations with participation of various Polish institutions. Three of them are compatible with the European Union initiative called CORINE. Poland participated in the CORINAIR, CORINE Biotopes and CORINE Land Cover projects resulting in three databases covering all country. The first one – CORINAIR deals with data on air emission recorded in industrial plants. The second consists of a specific register of all valuable biological sites. The third one – CORINE Land Cover describes the forms of land use / land cover of all country with the unified nomenclature for Europe.

Seven national parks are included in the UNESCO MaB Biosphere network. They are involved in internet information exchange.

The national reporting to the various conventions' secretariats (UNEP, EU, EEA, etc.) are prepared on the basis of existing data, mainly collected in the framework of national environmental monitoring programme.

The European Environment Agency created environmental information network called EIONET as an infrastructure for environmental data and information exchange in Europe. Poland and other European countries participate in this initiative delivering data to two pan-European state of environment reporting. The data gathered within the framework of data collecting process have been structured and stored in the EEA data warehouse. It is now under development and updating procedure.

Poland has just started process of Natura 2000 network establishment. The Natura 2000 Programme is principally based on two EC Directives, i.e. Birds Directive and Habitat Directive. In 2000 the primary designated area network will be proposed and documented.
The European network of ecologically valuable areas called ECONET has been also implemented in Poland. It consists of core areas and corridors important for species to be able to migrate.

3.5 Analysis of legal framework for data handling

At the moment no legal regulations for the data handling and distribution have been introduced. Every data provider applies its own rules in that matter. Some of them are general for all users but in many cases the data are provided on the individual basis. Generally, source data (like monitoring observations) are not subject of distribution. They are interpreted and usually aggregated and in such a form are offered to users.

Some of data are published in the yearbooks and are also provided in the digital form. For instance, the Central Statistical Office delivers a lot of data related to the smallest administrative units electronically. Unfortunately, that kind of service is still very expensive.

On the other hand, there are some datasets more widely available to the public. Usually they are results of the programmes, financed by international institutions. Phare Programme supported development of several databases on the environment. The CORINE Land Cover, CORINE Biotopes and CORINAIR databases are good examples of projects resulting with data covering whole country. They can be available for non-commercial use by applications delivered to the EC office.
Another examples of free of charge data are regional databases. For instance, Black Triangle region laying in the border areas of Poland, Czech Republic and Germany has been covered by a number of GIS databases widely available to all local authorities and scientific institutions.

There is strong demand for clearing house mechanism development by the major data providers. This mechanism should be developed on the basis of the mature data policy prepared by some higher level legal regulation.

3.6 Use of environmental information

There are many users of the environmental information, naming decision-makers, scientists, media, international Organizations, universities, schools and general public. Each of these groups requires specific form of that kind of information. Usually the source data are significantly processed and provided as graphs, maps and tables. The environmental data are subject of interest merely for scientists, international Organizations and some decision-makers.

There is growing group of users demanding digital form of data. They require them in specific format useful for further processing. There is also strong demand for data distributed by Internet means.

The international cooperation especially through the European Environment Agency seems to be a major catalyser for developing national environmental data infrastructure.

4. User Needs Assessment

The information on user needs assessment should be developed on the basis of answers to the questionnaire. Unfortunately, only two institutions answered the questionnaire elaborated by GTOS Secretariat, so the content of this chapter is based mainly on the knowledge of the author.

4.1 Data and information needs

Decision-makers should base their decisions on the reliable and up-to-date information. Usually the existing information systems do not fulfil requirements of this group of users. Then they rather avoid referring to the information since it consumes too much effort. This means that most of decisions are taken without considering information.

The second group consisting of scientists is much more interested in reliable information which can be accessed not necessarily instantly. They usually collect data and information for some time, so existence of the efficient information system is not the most crucial. What would be more desired is a metadata system enabling access to data and information characteristics.

The environmental data are more frequently required by institutions involved in the international cooperation. Many international Organizations need data and information for the monitoring of realisation of various conventions and agreements. These Organizations usually stimulate development of information systems in the member countries.

The general public, schools and media are interested in environmental information which is processed to the form easily understandable, but usually also easily accessible. So the Internet information services are of their great interest.

The analysis of the particular thematic scope of data and information needs shows that the most frequently required information deals with land use. This phenomenon describes the geographic space in such a way that can be useful for locating other objects and phenomena. The fragmentation of the terrain provided by land use background is taken into account in many more sophisticated analyses.

The second theme deals with biodiversity which is very much related to the previous one. The location of particular species and habitats as well as their state and detail characteristic seems to be an object of growing interest.

The pollution data gathered in the framework of environmental monitoring networks are required for decision-making, scientific research and by average citizen. Unfortunately, most of these data need specialised interpretation and can not be used straightforwardly.

There is also clearly demanded a standardised background information for various spatial analyses and presentations. The lack of digital topographic map of Poland available to many users is treated as a stopping factor for development of computer science use in terrestrial analyses.

4.2 Requirements raised by potential users of GTOS

The potential users of GTOS expects the following roles to be played by the Programme:

1. Facilitating data and information access by putting together and standardising existing data from many sources;
2. Stimulating data policy development within the network and in particular countries;
3. Development of scientific methodology for interpreting, modelling and general processing of terrestrial data;
4. Elaboration of manuals and guidelines for terrestrial data processing, especially useful for decision-makers;
5. Processing source data using sound scientific methodology developed within the Programme framework;
6. Creating terrestrial data and information network facilitating exchange of data, information and ideas.

5. Lack of Observation and Methodologies for Data Handling, Need for Development

The observation methodology and data handling are fairly well developed in many areas of investigations. What needs development is information and data infrastructure which would facilitate access to information, its complex processing and efficient distribution.

5.1 Need for standard methodologies in integration

The international scientific Organizations introduce a lot of standard methodologies for observing systems, data interpretation, data processing, scientific modelling and data delivery formats. It is not a role of GTOS to repeat all these efforts. Much more required is harmonization of those standards in relations between various disciplines, groups of interest and data collection programmes.

5.2 Institutional framework

The following institutions should be taken into account when establishing the network of cooperating partners within the GTOS Programme:

- Inspection for Environmental Protection
- Central Statistical Office
- Ministry of Environment
- Institute of Environmental Protection
- Forest Research Institute
- Institute of Meteorology and Water Management
- Institute of Nature Protection of Polish Academy of Sciences
- Institute of Botany of Polish Academy of Sciences
- UNEP/GRID-Warsaw
- Institute of Geodesy and Cartography
- Institute of Geography and Spatial Organization of Polish Academy of Sciences
- National Foundation for Environmental Protection
- Institute of Geography of A. Mickiewicz

Most of them established already cooperation platform in many fields, so the development of mutual connections in new area seems to be feasible.

5.3 Need for a national meta-database

The environmental information meta-database was subject of the UNEP/GRID-Warsaw activity from the very beginning of its operation in 1991. The first such a database was created in early 1992. After that tree updating attempts have taken place. Unfortunately, the last update has been accomplished in the end of 1997 and since then no external data (other than UNEP/GRID-Warsaw owned) were introduced to that meta-database. The UNEP/GRID-Warsaw's data sets are systematically described in that database, immediately after their creation.

The external financing is needed in order to continue these efforts. The Ministry of Environment and the Inspection for Environmental Protection should be main interested parties.

The new version of the meta-database should be available in Internet and use it as a main tool for data distribution. So all available links to Websites providing data in Internet would be established, facilitating data access.

5.4 Training needs

The partners of the network enumerated under the section 5.2 have well educated personnel capable to solve most of scientific and managerial problems. The use of Internet browsers and data access interfaces as well as use of geographical information systems are the only areas where the training is required. It is true especially for the governmental and local administration.

5.5 Missing international linkages

The international cooperation of most potential partners in the GTOS Programme from Poland is fairly advanced, so there is lack of particular gaps in international relations.

5.6 Identification of main potential users of a future GTOS information supply

The general list of potential users of a future GTOS information supply can be structured as follows:

- Decision-makers on all levels (ministries, regional administration, local authorities)
- Scientists from universities and research institutes (including Polish Academy of Sciences)
- Media
- Schools
- NGOs
- International Organizations
- National and international programmes and projects

Country Assessment on the Environment

The Slovak Republic

Pavol Bielek
GTOS National Focal Point for Slovakia
and
Soil Science and Conservation Research Institute, Bratislava

1. Country Profile

Population	5 300 000 approx.
National product	Growth rate - 5-6% /1996-97)
National product per capita	n.a.
Agriculture	2 4446 000 ha.
Climate	Mild
Terrain	▪ Total area 49 035 km^2 ▪ 40% of land lies at 300m asl, 45% at 300-800m.asl and 1% at over 1 500m asl. ▪ Two main geomorphological formations: Carpathian mountains and adjacent lowlands. Highest mountain: Gerlach - 2 655 m. ▪ Three main rivers with catchment areas cross Slovak Republic: Danube, Tisa and Dunajec. Large number of natural lakes particularly in High Tatras region. Longest river: Vah (378 km.).
Natural resources	n.a.
Land use	Arable land: 1 483 000 ha. Forests: 1 991 ha. Urban areas and other: 373 000 ha.
International agreements	Party to agreements on: wetlands, natural heritage, trans-border environmental influences, climate change, ozone layer. Party to Washington Convention, Bonn Convention, Bern Convention, Danube Convention, Baziley Convention, Geneva Convention.
Environment	Current issues: soil erosion due to floods, industrial pollution of land and water - from metal, lime, cement and magnesium industries. Decrease of animal density due to pollution and use of pesticides. There are 724 protected areas covering 9 200 km^2.

2. Major Environmental Threats

The Slovak Republic is an industrialised country focussing on the production of steel and machinery. It also has well-developed chemical and food industries. Agriculture plays a relatively important role in the country's economy. All these activities have affected the environment to a certain extent but in recent years awareness of pollution problems has increased and steps are being taken to control air, land and water contamination.

2.1 Pollution and toxicity

The main industries in the Slovak Republic are responsible for heavy metals pollution (mainly Dc, Cr, and Mn). Ten particularly affected areas were identified in 1998. It is estimated that 30 000 ha of agricultural soils are polluted by heavy metals. Although emissions of $S0_2$ and No_x are still cause for concern, there has been a general decrease of these substances from 569 000 tons in 1989 to 199 000 tons in 1997. In the same period emissions of No_x decreased from 226 000 tons to 123 000 tons. Soil acidification as a result of air pollution by these substances affects at least 425 000 ha.

Levels of CO_2 have fallen from 60 million tons in 1990 to 46 million tons in 1996. These levels are however still cause for concern. Likewise methane emissions have fallen from 400 000 tons in 1990 to 320 000 tons and N_2O from 13 000 tons to 8 000 tons.

In the last decade the use of nitrogen fertilizers has decreased (from 90 kg per ha in 1989 to 37 kg per ha in 1997). A decline of almost 50% in animal density per ha, reduction of pesticide use and improvement in substitute pesticides have also led to a notable improvement in water pollution. Likewise improved manure technology has led to improved water quality. Drinking water is strictly controlled and from 97% to 99.9% of drinking water contains safe levels of nitrates, Mn, Fe, ammonium nitrites, pH, and microbiology.

2.2 Loss of biodiversity

Industrial and agricultural emissions have had negative impacts on air, soil, forest biota, and water sources resulting in changes in biodiversity. Damage to forests in Slovakia from pollution is high and it was estimated in 1997 that only about 18% of trees were not damaged. Large scale agriculture also decreases the habitat of wild living organizms. Drainage of soils destroys populations of wetland plants and animals.

2.3 Land quality

Soil erosion caused by high rainfall and floods is a major problem. More than 50% of agricultural soil and more than 90% of forest soils are suffering from soil erosion. As a result, vast sedimentation is taking place in many lakes to the detriment of the ecosystems of the land.

2.4 Availability of freshwater resources

The quality of surface water has stabilised in the past few years due to new water cleaning stations and a decrease in industrial activity. The purest irrigation water is found in the Danube River Basin. Water suitable for irrigation now accounts for 31.6%, conditionally acceptable water for irrigation for 43.1% and water unsuitable for irrigation for 25.3%. A gradual decrease of water surpluses has been observed.

2.5 Climate change

Global changes in the climate have affected the Slovak Republic over the past decade. Extreme rainfall and flooding have increased, together with a gradual rise in air temperature. This trend is expected to continue

3. Status of National Environmental Observing Systems

3.1 Institutional framework

The two main bodies concerned with the environment in Slovakia are the Ministry for Environmental Protection and the Ministry of Land Management. The Agency for Environmental Protection, under the auspices of the Ministry for Environmental Protection, is the body responsible for the implementation of national environmental policy. Problems related to air, water, biota, protected areas, biodiversity and meteorology are all referred to the Environment Ministry.

The Ministry of Land Management, on the other hand, is responsible for the protection of soil, water resources and forests. Data on soil, forests and water are collected by three institutes (the Institutes of Soil Science and Conservation Research, of Forest Management, and of Water Management) under the direction of the Ministry of Land Management. Other Ministries, such as those for the Economy, Transport and Construction, each have departments which deal with problems of the environment related to their field. The Ministry of Internal Affairs also has a Regional Office for Environmental Protection that works in cooperation with other government offices.

Some universities (in particular the Commenius University of Bratislava and the Agriculturla University of Nitra) collect data on natural resources.

The Statistical Office of Geography and Cartography provides detailed maps and edits those of other institutions on soil, geology, ecology etc. Official data is compiled annually by the Statistical Office of the Slovak Republic and published in its Statistical Yearbook.

Remote sensing methods have been developed by specialised institutions, in particular the Slovak Hydrometeorological Institute. Use is made of satellite information for weather forecasting and other applications. Other institutes using remote sensing methods such as aerial photography and satellite images include the Institute of Forest Management (Zvolen), the Institute of Geography (Bratislava) and the Soil Science and Conservation Research Institute (Bratislava). Under the EU Project MARS/MERA (1994-97), data was collected on soil use structure, soil degradation processes, forest management and a model of yield prediction was formulated. Despite the above, there is a need for improving remote sensing techniques in Slovakia.

3.2. Analysis of existing observation sites

The Ministry of Environmental Protection coordinates the work of institutions monitoring factors concerning the environment. In 1993 a Partial Monitoring System was set up to cover various headings. This system covers:

Soil - Soil Science and Conservation Research Institute, Bratislava
Water - Slovak Hydrometeorological Institute, Bratislava
Air - Slovak Hydrometeorological Institute, Bratislava
Biota - Slovak Agency of Environment, B. Bystrica

Waste - Slovak Agency of Environment, B. Bystrica
Settlement - Slovak Agency of Environment, B. Bystrica
Utilization of region - Slovak Agency of Environment, B. Bystrica
Geological factors - Geological Servis, Bratislava
Forests - Research Institute of Forestry, Zvolen
Foods - Research Institute for Food, Bratislava
Population - National Institute for Health Service, Bratislava
Radiation - National Institute for Health Service, Bratislava
Meteorology, **Climatology** - Slovak Hydrometeorological Institute, Bratislava

Each institute works according to an approved programme coordinated by the Partial Monitoring System. The system is financed by the Ministries for the Environment and for Land Management.

3.3. National networking

There are numerous networks which collect data on soil, water, air and forests.

- *Soil* : A network of 313 basic sites with a 5-year monitoring cycle and 21 key sites that monitor agricultural soils continuously. For forest soils there are 338 basic sites with a 5-year monitoring cycle. In both cases data is collected for agricultural and forest soils including information on: pH, nutrients (P, K, Mg, Ca), $N_{min,}$ Cu, Mn, Zn, Fe, CO_x, CEC, pollutants (Pb, Cd Cr, Ni, Se, Co, As, Hg), bulk density, porosity, structure, compaction, erosion (C^{137} - 8 fields). In the case of polluted soils plant pollution is also determined.

- *Water*: Observation sites collect information for 449 surface water sites and 1326 groundwater sites. Water quality data is collected from 225 surface sources and 313 ground water sources as well as from 424 springs.

- *Forest* : A network of 111 sites (grid 16 x 16 km) and 8 national key sites monitor information on a 6 year-frequency basis, including leaf analysis, growth and meteorological facors. A data base has been established to store this data.

Data reliability is based on the accreditation of institutions carrying out analyses and twice yearly controls by the Partial Monitoring System Centers.

3.4. International networking

Efforts in international coordination of environmental monitoring have, so far, not been successful. Cooperation, particularly in monitoring of soils, was proposed by the Liaison Centre in Hungary but has not to date led to any follow-up. It is hoped that further cooperation may be set up under the European Environmental Agency.

3.5. Analysis of legal framework for data handling

All information regarding the environment is by law accessible to the public free-of-charge, except for operational costs (computer time, labour cost). Incentives are given for environmental data with relation to market enterprise activities. To avoid incorrect interpretation of data by non-specialized bodies, primary data is normally not released but assessed by competent bodies.

International exchange of data has no strict legal background in Slovakia and is carried out with traditionally trustworthy national or international users.

3.6. Use of environmental information

A Central Office for the coordination of environmental data collected by the various institutions is required in Slovakia and this information should be more widely available to the public to increase general environmental awareness. This information should also be part of the educational curriculum. Data collected by small firms or institutes must be carefully evaluated by specialised authorities to avoid distribution of incorrect information.

4. User Needs Assessment

4.1. Information needs for decision-making

Decision-makers must have the support of expert and authorised systems related to their activities. At present there is a lack of experts in the GIS field. This is a field in which improvements are urgently needed. Cost of creating specialized software is very high and this curtails the ability of institutions to improve their systems.

4.2. Information needs for resource managers and researchers

Geographically referenced data is also essential to environment and natural resource management. The resolution should be a minimum of 1:50 000, but on a scale of 1:10 000.

Permanent updating and upgrading must be carried out, at least every 5 years to ensure quality of data on natural resources. Links from data collectors through data managers to users must be improved. The compatibility of software is also a problem which requires rapid solution.

4.3. Priority needs for international reporting

Data exchange is organized mainly on a bilateral (or personal) level. GTOS could play a decisive role in improving the exchange of data on a bilateral or unilateral basis, with the cooperation of SOTER and SOUVER. For example, soil classification in border areas must be compatible with that of other systems. Cooperation is needed in this field. Some transboundary projects require greater input from internationally collected data.

4.4. Data integration in environmental decision-making

A meta-database on information systems was only recently developed under the Ministry of Environment. Since integration of international data is required universally, it is recommended that projects should be coordinated by international bodies such as the FAO and EC or other international institutions. The creation of an international information journal or web-site for integration of information is recommended.

4.5. Financing of environmental information management

Environmental information services should, at the national level, be financed by the state budget. International systems are financed by international institutions or by contributions from national governments.

Data should be free-of-charge although operational time should be paid by users. All new data, including that obtained by research institutes, could be collected with support of national governmental budget.

5. Observation and Methodologies for Data Handling

In Europe there appear to be blocks of information; that of western Europe and that of central and eastern Europe with marked differences between the two. A primary task is to improve the compatibility of data both within and between the blocks.

5.1. Need for standard methodologies in integration

International handling of data depends on high level decisions. In each country, competent institutions must be nominated for international handling of data. Only data of those institutions should be accepted at the international level. This information should be coordinated by international institutions (FAO, OECD). Each level of coordination requires rules on methods of data producing, data processing, principles of data transports, and data handling. ISO norms, where are acceptable, should be adopted.

5.2. Institutional framework

The network currently existing in Europe is satisfactory although there is still scope for improvement. Lack of funds in central and eastern European countries is a handicap in the setting up of improved networks. Greater cooperation and exchange of information between institutes, both nationally and internationally will greatly benefit all concerned. In this field, GTOS can provide an important point of contact and assistance.

5.3. Need for national meta-database

The creation of a national meta-database would produce benefits in many fields such as environmental protection, agriculture, land use, and socio-economic development. At present, data on soil properties in Slovakia are used daily. GIS data is for farmers, state agricultural policy and economy tools, but also for soil sealing control and soil market, soil damage evaluation, natural disasters assessment, etc.

5.4. Training needs

Training on new methods of data processing would be useful. Such training would only be required on a limited basis and would not require large financial input.

Training is currently given every two years to map users, mainly on decoding of soil properties codes, on new maps products, and on new possibilities for data use etc. Mainly specialists from regional agricultural offices participate in these training programmes.

International training of specialists on data processing, such as that undertaken on remote sensing data interpretations in Paris, Warsaw and Prague organized by international coordination centres for remote sensing are of prime importance. Other databases (water, forest, meteorology) are permanently upgraded (technically and personally) and responsible institutions organize training courses for data users.

5.5. Missing international linkages

Greater cooperation should be established with the European Environmental Agency environmental databases, international centres of remote sensing services and international projects (e.g. MARS Project)

5.6. Identification of main potential users of future GTOS information supply

The potential users of GTOS in Slovakia are research institutes and universities, the Agency of Environmental Protection, Ministries for the Environment, Agriculture and the Economy) and its regional offices, and governmental offices (for economy and development, and regional development). Information from GTOS would be helpful in updating, upgrading and improving the current information situation in the country. It would offer the possibility for international comparison and improvement for national institutions and assist in motivating the setting up of new data collection and processing systems.

References

Bielek,P. - Šurina,B.: Agricultural Soils. Facts about Slovak Republic. VUPU Bratislava, 1995, 32 pp.

Bielek,P.: Code of Good Agricultural Practice in Slovak Republic. Soil Protection. Ministry of Agriculture of the Slovak Republic, 1996, 54 pp.

Demo,M. - Bielek,P. - Hronec,O.: Trvalo udr ate¾ný rozvoj (Sustainable development). SPU Nitra - VUPOP Bratislava, 1999, 400 pp.

Green Report of the Slovak Republic. Ministry of Agriculture. Bratislava, 165 pp.

Klinda,J. - Lieskovská,Z.: Správa o stave ivotného prostredia v SR v roku 1997 (Environmental situation in the Slovak Republic). M P - SA P Bratislava, 1998, 156 pp.

Monitoring of the Environment. Annual Report. Ministry of Environmental Protection, Bratislava, 1998

National Environmental Policy. Ministry of the Environment of the Slovak Republic, 1995, 130 pp.

Šimeg,I. - Smolinská,I.: Slovakia for the world. PEAS Publishing, Bratislava, 1996

Statistica Yearbook of the Slovak Republic. Statistical Office of the Slovak Republic. VEDA - Publishing House of the Slovak Academy of Sciences 1998, 726 pp.

Annex II:

Analysis of User Requirements for Developing Terrestrial Observation in Central and Eastern Europe

Alexandre Borde
Environment and Natural Resources Service, FAO

Introduction

The Central and Eastern Europe (CEE) programme is the first regional initiative of the Global Terrestrial Observing System (GTOS). Initiated in early 1999, it aims to reinforce information exchange on terrestrial ecosystems between researchers and decision-makers at the global and regional level. This programme aims at assessing the specific requirements of users in the CEE.

GTOS attempts to improve exchange of data on environmental issues. It facilitates access to available data and assists countries in focussing on local and regional environmental problems. To achieve this, both local observations and global aggregated data are required. It is essential to ensure that such data are efficiently collected by local institutions to serve as input to national policy makers and scientists.

This survey involved sending questionnaires to selected recipients in Central and Eastern Europe to ascertain their involvement in terrestrial information. The information obtained was used to set out a programme for user requirements in the CEE.

2. Objectives and Methodology

Among the principal objectives of the CEE programme are:

i) The prioritisation of the five GTOS global environmental issues in the Central and Eastern European context;
ii) The identification of gaps in the field of terrestrial information collection, harmonization, management and exchange;
iii) The review of terrestrial ecosystem monitoring sites.

An analysis of this information assists in the formulation of the regional implementation plan and helps to develop awareness of emerging environmental issues. It is important that GTOS take into account the specific variables, data and information tools that each of the users requires and that its activities be targeted towards products of interest to users.

A questionnaire (see Section 6) was designed to provide both qualitative and quantitative data. For example, to prioritise the five GTOS environmental issues, recipients were asked to rank these from 1 (most important) to 5 (least important). More general questions aimed at gaining an insight into existing activities regarding collaboration in terrestrial observations or missing data types were included. Information on contacts was also requested. The questionnaire was sent to approximately 250 recipients from Central and Eastern European countries. These were selected on the basis of their involvement in environmentally related activities, both in the scientific community and from governmental bodies. The questionnaire was distributed in the English language.

3. Potential Users of GTOS

The main users of GTOS in Central and Eastern Europe fall into three categories: research scientists (mainly environmental scientists), technicians and managers (mainly from international agencies and organizations associated with the operation and management of technical development and application programmes) and policy makers and planners (mainly from national governments).

The scientific community frequently has the greatest capacity to collect environmental information and is the group most interested in accessing and participating in regional and global networks. It requires global coverage of certain key variables at a resolution consistent with the scale at which the processes operate, and sufficient to make global and continental-scale inferences. It also needs some very detailed and high-resolution data sets for limited areas and periods in order to develop new hypotheses and rigorously test the broader-scale approaches. While scientists and researchers in Central and Eastern Europe have the capability to undertake advanced environmental research programmes, they usually lack access to long-term monitoring data that are consistent across space and time.

Technicians and managers in international organizations have responsibilities regarding the monitoring and assessment of terrestrial ecosystems, particularly if they are parties to Conventions such as the Framework Convention on Climate Change (FCCC), the Convention on Biological Diversity (CBD) or the Danube Basin Convention.

Governmental bodies of the region face new environmental issues. These may be related to new regulations of Conventions to which their country subscribes or when new environmental threats arise at the local or national level. Countries often lack data on terrestrial ecosystems and on trend analysis to cope with these emerging issues. Furthermore, some of the CEE countries have to apply to new European standards and, at the same time, negotiate and implement environmental Conventions and protocols.

GTOS aims not only to develop the use of terrestrial observations, but also to facilitate information exchange. It is expected that the three types of users identified above can also provide inputs to GTOS. Researchers may provide considerable input into GTOS, particularly in the early stages of any activity, by providing advice on the variables to be observed, the techniques to be used, and on appropriate methods of data analysis and data management. Technicians and managers can also advise GTOS on their new and continuing data and information needs. Policy makers often require the generation of secondary and tertiary data such as social, economic and environmental indicators for national planning. They also need to work closely with scientists to ensure that data relevant to their requirements are collected or generated

4. Analysis of Questionnaire Responses

A total number of 34 responses were received by GTOS. The rate of responses was approximately 14%.This low figure may be the result both of the difficult situation in the Balkan countries at the time of the survey and of the fact that the questionnaire was available only in English. The table below shows the number of responses by country.

Table 3.1. Distribution of respondents by profile

Country	Responses from research institutes, universities or National Parks	Responses from governmental or international bodies	Total number of responses
Armenia		1	1
Bulgaria	1		1
Czech republic	5	2	7
Estonia	2	2	4
Georgia		1	1
Hungary	6	2	8
Latvia		1	1
Lithuania		1	1
Poland	1	1	2
Romania	4		4
Slovakia	2		2
Slovenia		1	1
Ukraine		1	1
Total	**21 (62%)**	**13 (38%)**	**34**

In order to assess the main GTOS environmental issues (changes in land quality, impacts of climate change, availability of freshwater, loss of biodiversity, pollution and toxicity), the respondents were asked to rank the issues in order of importance to them.

Table 3.2. Ranking of the five GTOS environmental issues

GTOS environmental issues	Ranking average
Changes in land quality	2.56
Impacts of climate changes	4.34
Availability of freshwater	2.78
Loss of biodiversity	2.35
Pollution and toxicity	2.73

Loss of biodiversity is considered the major issue by respondents from Central and Eastern Europe, with an average rank of 2.35, although this figure may reflect some bias due to the fact that a significant number of respondents work in ecological research institutes or national parks. Changes in land quality is also an important issue. With the end of the communist era, the privatization of land has brought about fragmentation and new practices in land management. This has generally affected the quality of land due to soil depletion. Availability of freshwater and pollution and toxicity are very closely ranked. Although these issues are important with respect to human health, due to the decrease in the industrial production in the region, levels of pollution and toxicity no longer appear to pose a major threat. Although availability of freshwater is not a major issue in this temperate region, the quality of the water can be more problematic. Climate change, with an average of 4.34, ranks significantly lower than the other issues. This could be explained by the fact that the CEE region is not confronted with threats such as desertification, rises in sea level or the shrinking of glaciers. On the other hand, it could also be that there is a lack of awareness of the subject within the region.

The survey also served to identigy potential sites not yet included in the Terrestrial Ecosystem Monitoring Sites (TEMS) meta-database.

Table 3.3. Potential TEMS sites

Country	Name of the sites	Address of responsible institutions
Armenia	▪ Lake Sevan (freshwater reservoir)	▪ Several institutions among which the Ministry of Nature Protection
Bulgaria	▪ Moussala, NP Rila	▪ BAS, Institute for Nuclear Research and Nuclear Energy, Sofia
Bulgaria	▪ Alinitza, NP Rila	▪ BAS, Institute for Nuclear Research and Nuclear Energy, Sofia
Czech republic	▪ Bílé Karpaty	▪ Sprava CHKO Bílé Karpaty, Veselí nad Moravou
Czech republic	▪ White Carpathians Moravia	▪ White Carpathian Protected Landscape Reserve Administration, Luhacovi e
Czech republic	▪ Krkonoše Mts. Bohemia	▪ Krkonoše NP Admin., Vrchlabí
Czech republic	▪ Reservoir Vltava River watershed	▪ Hydrobiological Institute, AS CR, Ceské Budejovice
Estonia	▪ Saarejárve EE02	▪ Tartu University, Institute of Geography, Tartu
Hungary	▪ Szigetköz	▪ Fertô-Hanság NP and the Office of Nature Conservation
Hungary	▪ Kis-Balaton	▪ Balatonfelvidek NP
Hungary	▪ Duna-Ipoly	▪ Duna-Ipoly NP Admin.
Hungary	▪ Lake Velence and Dinnyés	▪ Duna-Ipoly NP Admin.
Hungary	▪ Bükk	▪ Bükk NP, Eger
Hungary	▪ Szarvas	▪ Körös-Maros NP, Szarvas Anna-Liget
Hungary	▪ Duna-Dràva	▪ Duna-Dràva NP, Pécs
Poland	▪ Kampinoski Park Harodowy	▪ Kampinos NP
Romania	▪ Baia Mare	▪ Vasile Coldis Western University, Arad
Romania	▪ Zlatna, Western Carpathian Mountains	▪ Institute of Biological Research, Clui Napoca
Slovakia	▪ Small Fatra (Terchova)	▪ Institute of Landscape Ecology, Bratislava
Slovakia	▪ Moravsko-Sliezske Beskydy (Turzovka)	▪ Institute of Landscape Ecology, Bratislava
Slovakia	▪ Danube inundation (Gabcikovo)	▪ Institute of Landscape Ecology, Bratislava
Slovakia	▪ Little Carpathian (cadaester Castá)	▪ Institute of Landscape Ecology, Bratislava
Ukraine	▪ Danube Delta biosphere reserve	▪ Danube Delta Biosphere Reserve Admin., Odessa Oblast
Ukraine	▪ Lower Danube Lakes	▪ Odessa State University, Centre for Environmental Monitoring, Odessa

In addition, respondents could be asked to provide further information on current networking or terrestrial observation collaboration activities such as those summarized in Table 3.4.

Table 3.4. Networking activities

Country	Type of efforts	Name of the project	Main institutions
Bulgaria	Collate terrestrial observations	NA	▪ Institute for Nuclear Research and Nuclear Energy, Sofia ▪ Institute of Zoology, Sofia ▪ Institute of Botany, Sofia
Czech Republic	Network of sites	LTER	▪ Hydrobiological Institute, Ceské Budejovice
Czech Republic	Network of sites	Biosphere reserves integrated monitoring	▪ MAB National Committee, Prague
Czech Republic	Coordination of terrestrial observations	Biomonitoring of the State Nature Conservancy in CR	▪ Agency for Nature Conservation and Landscape Protection, Brno
Estonia	Network of sites	The Conservation Area Net	▪ Estonian Agricultural University, Tartu
Estonia	Network of sites	The Estonian National Biodiversity Monitoring Master Plan	▪ Estonian Environmental Information Centre, Ministry of Environment, Tallinn
Georgia	Collate terrestrial observations	The Environmental Standards Database	▪ EBRD and PHARE
Georgia	Collate terrestrial observations	Observation of forests and protected areas	▪ Dept. of Biodiversity and Protected Areas, Ministry of Environment, Tbilisi
Georgia	Collate terrestrial observations	Environmental Pollution Monitoring	▪ National Centre of Environmental Monitoring, Tbilisi
Georgia	Collate terrestrial observations	Country Biodiversity Studies	▪ NACRES
Hungary	Collate terrestrial observations	Monitoring of forest health	▪ Forest Research Institute
Hungary	Network of sites	Network of agricultural and forestry pest and diseases sample spots and light traps	▪ Plant Protection RI, Forest Research Institute
Hungary	Collate terrestrial observations	Biodiversity Monitoring System	▪ Dept. of Nature Conservation, Ministry of Environment, Budapest
Hungary	Collate terrestrial observations	Soil Conservation Information and Monitoring System	▪ Ministry of Agriculture and Regional Development
Hungary	Collate	Environmental	▪ Ministry of Environment

	terrestrial observations	Monitoring System	
Latvia	Collate terrestrial observations	State Environmental Monitoring Programme	▪ Environmental Consulting and Monitoring Centre, Riga
Lithuania	Collate terrestrial observations	National Environmental Monitoring Program	▪ Joint Research Centre, Ministry of Environment, Vilnius
Poland	Collate terrestrial observations	Land cover inventory CORINE	▪ Institute of Geodesy and Cartography, Warsaw
Poland	Collate terrestrial observations	Biotopes inventory CORINE	▪ Institute of Nature Protection, Krakow
Poland	Collate terrestrial observations	Nature Monitoring	▪ Inspectorate for Environmental Protection, Warsaw
Romania	Collate terrestrial observations	Nature Protection in Romania	▪ Romanian Academy, Committee for Nature and Natural Monuments Protection, Bucharest
Romania	Collate terrestrial observations	Research and Education	▪ Faculty of Biology, University of Bucharest
Slovakia	Collate terrestrial observations	Health State and Biodiversity	▪ Institute of Landscape Ecology, Bratislava
Slovakia	Collate terrestrial observations	Changes in relationship to ozone, SO_2, NOx pollution	▪ Forestry Research Institute, Zvolen

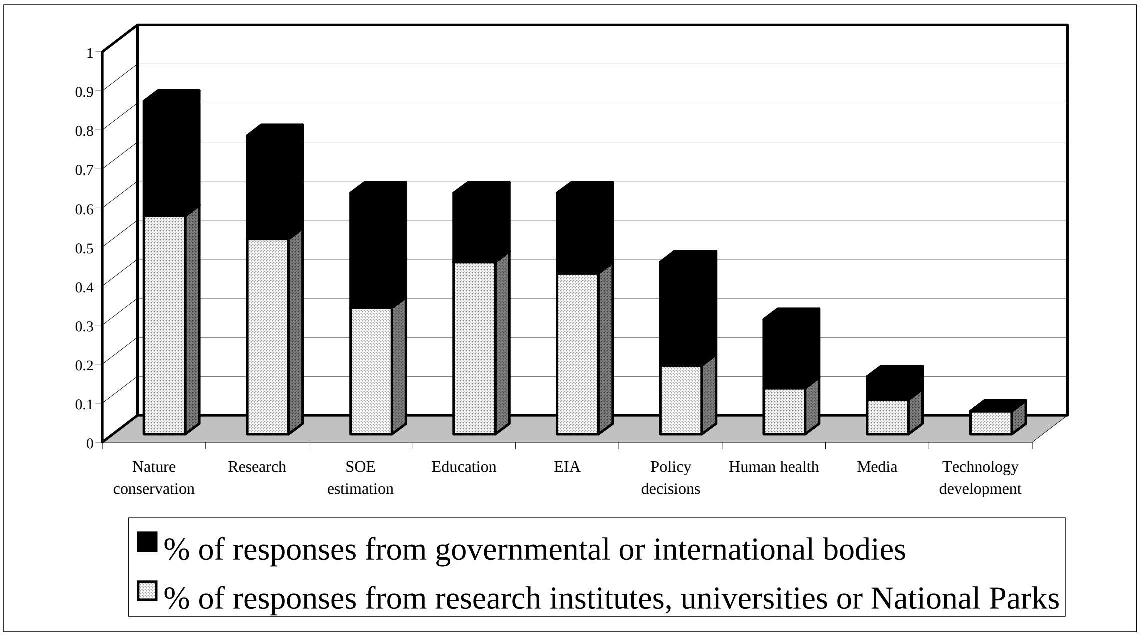
The reasons for use of existing data were assessed and described in Table 3.5.

Table 3.5. Main purpose of data currently used

Purpose	Responses from research institutes, universities or National Parks	Responses from governmental or international bodies	Total number of responses
Nature conservation	19	10	29
Research	17	9	26
SOE estimation	11	10	21
Education	15	6	21
EIA	14	7	21
Policy decisions	6	9	15
Human health	4	6	10
Media	3	2	5
Technology development	2	0	2

Nature conservation and research are the two major topics for which existing data are used. If responses from the scientific community only are taken into account, education is considered an important activity for which data are used (71% of the responses of researchers), while the decision-makers tend to use data for the State of the Environment and environmental impact assessments. The graph below shows the percentage of the responses by type of users.

Fig. 3.1. Percentage of responses by type of users



In order to obtain a better understanding of the use of data by respondents, details on data resolution and variables used on a regular basis, were requested The table below illustrates responses indicating the data type in rows and the data resolution in columns.

Table 3.6. Resolution of data types used regularly

Data type	**Resolution**						
	Time				**Space**		
	day	week	month	year	local	national	regional
Land use		1	1	14	4	12	6
Land cover		2	2	13	6	12	10
Biomass		1	2	9	7	2	7
Primary production	1	3	4	8	8	5	5
Litter		3	4	7	8	2	5
Decomposition rate			2	4	6		1
Vegetation structure	1	2	4	14	13	6	10
Leaf area index		4	6	5	6	4	4
Land degradation		3	4	9	7	6	9
Hydrology	1	1	4	6	6	3	5
Biodiversity	1	1	3	19	9	15	11
Air quality	3	3	6	7	8	11	4
Freshwater quality		1	9	8	9	8	4
Soil quality			3	11	7	8	5

Climate	4	3	6	11	6	10	7
Total	11	28	60	145	110	104	93

In terms of time resolution, the main scale of the data used is yearly, apart from leaf area index. Climate data are measured on a daily, monthly and yearly resolution.

The geographic scale varies from local to regional. Soil quality and vegetation structure are mostly local, while land use, land cover and biodiversity data are measured at the national scale.

After surveying the data used by respondents, users were asked to specify the type of missing data to which they would require access. Table 3.7 presents the qualitative types of missing information.

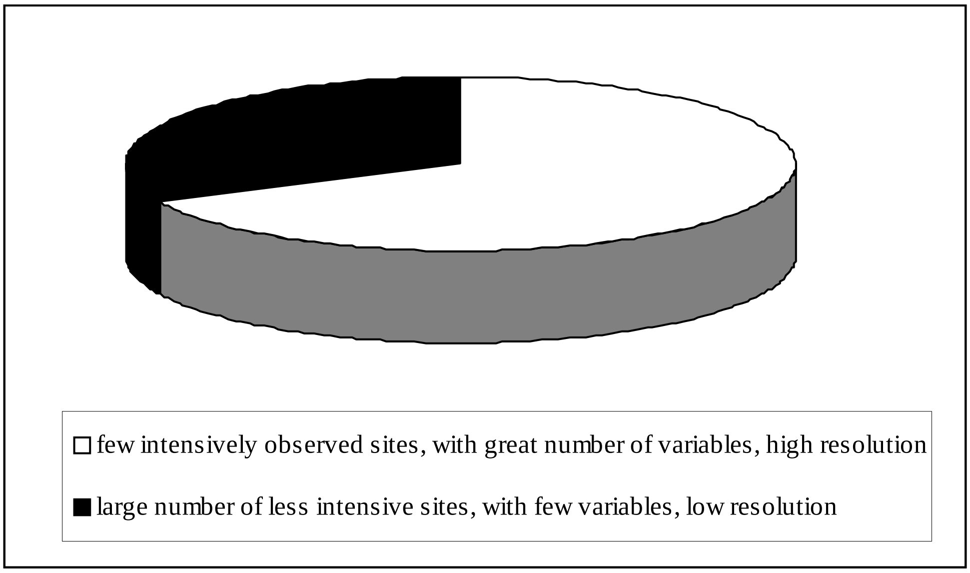
Table 3.7 List of type of missing data mentioned

Type of missing information	Time scale	Spatial scale
Soil quality		
Impact of management on grasslands	10-20 years	Europe
Development trends in specially protected parts of nature		
Extent of individual habitats and their dynamics		national
Aquatic biomass or production from reservoirs	month-year	national-regional
Biodiversity changes	year	national, Europe
Impact of pollution	year	Europe
Indicators of biodiversity changes	year	national
Soil conditions	year	national
Characteristics of water quality and water management	year	national
Meta-database		
Tree increment	year	local
Habitat coverage and changes	year	national
Species richness	year	national
Spatial distribution pollution data: air pollutants, toxicity, heavy metals, VOC, radiation	month	national
Changes of wetlands and oxbows	year	national
Changes in water quality in wetlands		
Satellite images		1:100000
Global area maps of plant and animal species		1:500000 1:1000000
Species monitoring	year	national
Climate	month	local
Air pollution	month	regional
Access to large compiled database	year	national
Free access to pollution, emission and other data		national-district
Detailed database (all from 6 except climate)	day-week	local to regional

4. Analysis of Questionnaire Responses

With respect to monitoring activities, respondents were asked to indicate how missing information could be provided. Two data collection activities were proposed: a limited number of intensive sites with a greater number of variables and a high resolution, and a large number of generic sites with few variables and low resolution. Several respondents ticked both boxes (these responses have been taken into consideration since the question was not exclusive).

Fif 3.2



68% of respondents preferred few intensively observed sites with a greater number of variables and high resolution to a large number of less intensive sites with few variables and low resolution. This is consistent with the type of missing information identified i.e. complex variables such as soil conditions, species richness, etc.

Finally, respondents were requested to identify potential users of a programme like GTOS. Respondents were classified in different categories.

Table 3.8 Main potential users of GTOS

Main potential users of GTOS	Responses from research institutes, universities or National Parks	Responses from governmental or international bodies	Total number of responses
Scientific community	16	8	26
Regional decision-makers	13	7	20
Governmental bodies	9	9	18
NGOs	11	5	16
General public	5	4	9
Media	5	2	7
Private sector	2	2	4

Governmental bodies, regional decision-makers, the scientific community and NGOs are seen as main users. It is interesting to note that NGOs are also seen as an important users of GTOS.

4. Main Results

GTOS aims to supply data and information to various categories of users. Some results of this survey are listed below and could serve as an input into the implementation plan of GTOS for Central and Eastern Europe.

- Priority should be given to biodiversity monitoring and analysis;
- The importance of climate change in the region needs to be investigated further;
- Institutions responsible of the terrestrial monitoring sites inventoried in the survey should be approached for completion of the TEMS form and their agreement should be asked to figure in the TEMS metadata base;
- GTOS should contact existing networks and programmes for terrestrial observation, and propose regional thematic partnerships;
- Some efforts should be made in terms of missing variables, either by proposing more research – for complex variables for which data are not collected on a routine base – or by assisting in the aggregation or the harmonization of the data when available but not compiled into datasets;
- In addition to the scientific community, governmental bodies and regional policy makers, GTOS should establish contacts with NGOs.

The assessment of user needs should be a continuing process of GTOS, since experience indicates that requirements change with time as a result of new users and new issues.

6. Questionnaire[1] to Help Initiate GTOS for Central and Eastern Europe

By responding to the questions below, you may contribute to the development of the Central and Eastern Europe component of GTOS concerning user requirements on terrestrial observation information.

Contact information

Family name: Title:	First name(s):
Institution:	Mailing address:
Country:	Tel: Fax:
Title of position:	Email:

1. The following issues are addressed by GTOS. Please prioritise the most important threats to your county or region (from 1 *most important*, to 5 *least important*). Identify others if you consider them more important than the ones listed.

changes in land quality ☐ freshwater resources ☐

loss of biodiversity ☐ climate change impacts ☐

impacts of pollution and toxicity

other ______

Refer to relevant data that supports this selection, or give the reasons for your answers. (Use additional pages if needed.).

2. A GTOS meta-database called the Terrestrial Ecosystem Monitoring Sites (TEMS) - is already available on the internet[2]. It allows access to information on terrestrial observation and monitoring stations. A selection of them for CEE countries is given in Annex 3. Evaluate the observations done at the sites (if any) in your country on the basis of GTOS issues. Match the relevant issue and the observations carried out at the site(s) in your country list.

changes in land quality	
freshwater resources	
loss of biodiversity	
climate change impacts	
impacts of pollution and toxicity	
other:	

3. List sites you may know that are not included in the TEMS database but that are relevant to GTOS.

Name of site, location	Address of responsible Institution

[2] http://www.fao.org/gtos/pages/tems.htm

4. Do you know of any efforts in your country to collate or coordinate terrestrial observations or to build a network of sites? Yes ☐ No ☐

If yes, please give the details below.

Type of effort	Responsible institution, address, name of coordinator

5. To your knowledge, for what purpose is the data currently used that is originating from the environmental observations? Select by a tick (√) or specify.

research ☐ policy decisions ☐ nature conservation ☐

education ☐ human health ☐ media ☐

environmental impact assessment ☐ state of environment estimation ☐

technology development ☐ other ☐

6. Please select (√) the type of data you regularly use in your work and specify the resolution of variables.

Data type * *please specify*	**Resolution**						
	Time				**Space**		
	day	week	month	year	local	national	regional
land use							
land cover							
biomass							
primary production							
litter							
decomposition rate							
vegetation structure							
leaf area index							
land degradation							
hydrology							
biodiversity*							
air quality*							
freshwater quality*							
soil quality*							
climate*							
other*							

7. Please specify your information needs that are not satisfied because of the lack of data collected or the lack of access to collected data. If the data are collected but are not available to you please tick this box. ☐

type of missing information	time scale	spatial scale

8. What type of data sources do you think could best provide you with the missing information?

few intensively observed sites with great number of variables, high resolution ☐

large number of less intensive sites with few variables, low resolution ☐

9. Identify the main potential users of a future GTOS information supply in your country.

governmental bodies ☐
regional decision-makers ☐
scientific community ☐
other ____________________

non-governmental organizations ☐
media ☐
general public ☐
private sector ☐

Annex III:

International Conventions Signed by SEUR Countries

	Al	Ar	Az	HB	Bu	Cr	Cz	Es	Ge	Hu	La	Li	Ma	Mo	Po	Ro	Sk	Sn	Yu
Convention on Long-Range Transboundary Air Pollution http://www.unece.org/unece/env/conv/lrtap_s.htm		X		X	X	X	X		X	X	X	X	X	X	X	X	X	X	X
Convention for the Protection of the Ozone Layer http://www.unep.org/ozone/ratif.htm			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
United Nations Framework Convention on Climate Change http://www.unfccc.org/resource/conv/ratlist.pdf	X	X	X			X	X	X	X	X	X	X	X		X	X	X	X	X
Convention on the Protection and Use of Transboundary Watercourses and International Lakes								X		X	X					X	P	?	
Convention on Cooperation for the Protection and Sustainable use of Danube River										X						X	X	X	
Convention on Wetlands of International Importance, especially as Waterfowl Habitat								X		X	X					X	X	X	
Convention concerning the Protection of the World Cultural and Natural Heritage, http://www.unesco.org/whc/nwhc/pages/doc/main.htm	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X
Convention on the Conservation of Migratory Species of Wild Animals										X	X						X		
Convention on the Conservation of European Wildlife and Natural Habitats, http://www.nature.coe.int/english/cadres/berne.htm	X				X		X	X		X	X	X	X	X	X	X	X		
Convention on Biological Diversity http://www.biodiv.org/conv/pdf/ratification-alpha.pdf	X	X	X		X		X	X	X	X	X	X	X		X	X	X	X	
Convention on International Trade in Endangered Species of Wild Fauna and Flora, http://www.wcmc.org.uk/CITES/english/parties1.htm			X		X		X	X	X	X	X				X	X	X		
Convention on Environment Impact Assessment in a Transboundary Context										X	X						X		

No independent check yet

Information sources: Starting point was an analysis by Edit Kovacs-Lang for the NoLIMITS Project

Al: Albania, Ar: Armenia, HB: Bosnia and Herzegovina, B: Bulgaria, Cr: Croatia, Cz: Czech Republic, Es: Estonia, Ge: Georgia, Hu: Hungary, La: Latvia, Li: Lithuania, Ma: Republic of Macedonia, Mo: Republic of Moldova, Po: Poland, Ro: Romania, Sk: Slovak Republic, Sn: Slovenia, Yu: Yugoslavia.

Annex IV:

Contact List

GABRIELYAN, Juliet
Ministry of Nature Protection
Armenia

SOUKISSIAN, Armen
Ministry of Nature Protection, Analytic Information Centre
Armenia

METCHEVA Roumiana
Institute of Zoology
Bulgaria

BABICKA, L.
Ministry of Agriculture
Czech Republic

BRANDL, Z.
University of South Bohemia
Czech Republic

CHARVAT, K.
Forest Management Institute
Czech Republic

CIHAL, Libor
Ministry of Agriculture
Czech Republic

HAVRáNEK, Vojtek
Ministry of Agriculture
Czech Republic

HLADNY, J.
Hydrometeorological Institute
Czech Republic

JELINKOVA, Eva
Academy of Sciences
MAB/UNESCO National Committee
Czech Republic

JONGEPIER, Jan Willem
Bilé Karpaty
Czech Republic

KOLAR, Jan
GISAT
Czech Republic

KOSATA, Ondrej
MZE CR
Czech Republic

KVET, Jan
Academy of Sciences, Institute of Botany
Czech Republic

LEONTOVYCOVá, Drahomila
Hydrometeorological Institute
Czech Republic

MATENA, J.
Hydrobiological Institute
Czech Republic

PLESNIK, Jan
Agency for Nature Conservation and Landscape Protection
Czech Republic

RIEDER (*with D. Leontovycova)*
Hydrometeorological Institute
Czech Republic

ROUDNá, Milena
Ministry of Environment
Czech Republic

STRASKRABOVA, Viera
Hydrobiological Institute
Czech Republic

VLASIN, Mojmir
Ecological Institute VERONICA
Czech Republic

VOTOCKOVA, Tereza
Environmental Institute
Czech Republic

FREY, Toomas
Estonian Agricultural University
Estonia

JOGISTE, Kalev
Estonian Agricultural University
Estonia

KLEIN, Lauri
Estonian Environment Information Centre
Estonia

TALKOP, Reet
Estonian Environment Information Centre
Estonia

JINTCHARADZE, Zurab
UNEP/GRID
Georgia

AMBRUS, András
Hortobágy National Park
Hungary

BöHM András
Ministry of Environment
Hungary

BORHIDI, Attila
Institute of Ecology and Botany,
Hungarian Academy of Sciences
Hungary

BOZó, Pál
Ministry of Environment
Hungary

BüTTNER, György
Institute of Geodesy
Hungary

DEMETER, A.
Authority for Nature Protection
Hungary

FARKAS, Tunde
Aggtelek Natonal Park
Hungary

IZSáK, Eva
Regional Environmental Centre Hungary

JURAS, Alexander
Regional Environmental Centre
Hungary

KADIKIS, Normus
Environmental Consulting and Monitoring Centre
Hungary

KISS, Krisztina
World Bank
Hungary

KOVACS, Eva
Kiskunság National Park
Hungary

KOVáCS-LáNG, Edit
Institute of Ecology and Botany,
Hungarian Academy of Sciences
Hungary

LéNáRT, Csaba
Debrecen Agricultural University
Hungary

MERZA, Agnes
Hungarian Meteorological Serivce
Hungary

MILEVA, Mira
Regional Environmental Centre
Hungary

NEMETH, Ferenc
Hungarian Central Statistical Office
Hungary

NéMETH Tamás
Research Institute for Soil Science and Chemistry
Hungary

PEPó, Pál
Ministry for Environment
Hungary

RáDAI, Odön
Danube Basin Ecological Convention
Temporary Secretariat
Hungary

RANDRIAMAMPIANINA, Roger
Hungarian Meteorological Service
Hungary

SIMPSON, Jerome
Regional Environmental Centre
Hungary

SUCHMAN, Jaroslav
FAO-SEUR
Hungary

SZöCS, Zoltán
Central European University
Hungary

TAKACS, András Attila
Duna-Ipoly National Park
Hungary

TARDY, Janos (*with A. Demeter)*
National Authority for Nature Conservation
Hungary

TöKéS, István
UNDP Regional Support Centre
Hungary

TöRöK, Katalin
FAO-SEUR
Hungary

TóTH, János Attila
University of L. Kossuth, Ecological Institute
Hungary

VARALLYAI, György
Research Institute for Soil Science and Agricultural Chemistry
Hungary

WINKLER, P.
Institute of Geodesy
Hungary

TSCHIRLEY, Jeffrey
GTOS
Italy

STOSKUS, Liutauras
Joint Research Centre, Ministry of Environment
Lithuania

BARANOWSKI, Marek
UNEP/GRID
Poland

CIOLKOWSKA, Lucyna Dygas
State Inspectorate for Environmental Protection
Poland

GRODZINSKA, K.
W. Szafer Institute of Botany
Poland

HILDEBRAND, R.
Forest Research Institute
Poland

JAWORSKI, R.
State Inspectorate for Environmental Protection
Poland

KOZLOWSKA, A.
Institute of Geography and Spatial Organization
Poland

KRYWULT, Marek
W. Szafer Institute of Botany
Poland

MATUSZKIEWICZ, J.
Institute of Geography and Spatial Organization
Poland

MIREK, Z.
W. Szafer Institute of Botany
Poland

SMYKALA, J.
Forest Research Institute
Poland

SOLON, J.
Institute of Geography and Spatial Organization
Poland

SZKILADZ, Janus
Kampinos National Park
Poland

WAWRZONIAK, J.
Forest Research Institute
Poland

WEINER, J.
Jagellonian University
Poland

COGALNICEANU, Dan
Bucharest University
Romania

COLDEA, Gheorghe
Institute of Biological Research
Romania

BENKO, V.
Slovak Environmental Agency
Slovakia

BIELEK, Pavol
Soil Sciences and Conservation Research Institute
Slovakia

BUCHA, T.
Forest Research Institute
Slovakia

CARNI, Doroteja
Ministry of the Environment and Plysical Planning
Slovenia

CURLIK, Jan (*with Bielek)*
Research Institute of Pedology and Soil Protection
Slovakia

DUPEJ, J.
Slovak Environmental Agency
Slovakia

DUPEJOVá, Jarmila
Slovak Environmental Agency
Slovakia

ELIáS, Pavol
Slovak Agricultural University in Nitra
Slovakia

FERANEC, J.
Institute of Geography, SAS
Slovakia

GAZO, Jan
Slovak Agricultural University
Slovakia

GECOVIC, Miroslav
Forest Research Institute
Slovakia

GUZIOVA, Zuzana
Ministry of Environment
Slovakia

ILAVSKY, Jan/ BUBENKA
Forest Research Institute
Slovakia

JANKOVIC, J.
Forest Research Institute
Slovakia

KARPIS, S.
Ministry of Environment
Slovakia

KASSA Martin (*with J. Dupejova)*
Environmental Agency, Centre for Nature and Landscape Protection
Slovakia

KULíK, D.
Slovak Agricultural University in Nitra
Slovakia

KULLMAN, E.
Hydrometeorological Institute
Slovakia

MARTINKA, K.
Hydrometeorological Institute
Slovakia

MINDAS, J.
Forest Research Institute
Slovakia

OSZLANYI, Julius
Institute of Landscape Ecology
Slovakia

OUDRAS, M.
Hydrometeorological Institute
Slovakia

PUKANCIKOVA Katarina *(with Zavodsky)*
Hydrometeorological Institute
Slovakia

RONCAK, P.
Hydrometeorological Institute
Slovakia

SKULEC, S.
Hydrometeorological Institute
Slovakia

SPANIK,
Slovak Agricultural University in Nitra
Slovakia

STANKOVIANSKY, M.
Institute of Geography, SAS
Slovakia

STRAKA, P.
Ministry of Environment
Slovakia

ZáVODSKY, D.
Hydrometeorological Institute
Slovakia

SIMPSON, Ian
UK Environmental Change Network, ITE
UK

GOSZ, James
International Long Term Ecological Research Network (ILTER)
USA

WASSER, Christopher
Colorado State University
USA