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Note by the Secretariat

In the light of its relevance to the consideration of agenda item 5.5.1 on "scientific and technical information to be included in national reports", the UNEP document "Guidelines for Country Studies on Biological Diversity" is made available to the participants.

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GUIDELINES FOR COUNTRY STUDIES ON BIOLOGICAL DIVERSITY

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THE BASIC PRINCIPLES

THESE GUIDELINES ARE INTENDED TO ASSIST COUNTRIES IN ASSESSING THE STATUS AND VALUE OF THEIR BIODIVERSITY AND BIOLOGICAL RESOURCES, AND TO SHOW HOW COUNTRIES CAN DEPLOY THIS INFORMATION AS AN INPUT TO THE NATIONAL BIODIVERSITY PLANNING PROCESS.

THE GUIDELINES SHOULD SERVE AS A SUPPORT SYSTEM OR PROMPT TO FACILITATE NATIONAL DISCUSSIONS ABOUT THE GATHERING AND PRESENTATION OF DATA, AND MUST NOT BE REGARDED AS AN INFLEXIBLE SET OF INSTRUCTIONS OR RULES.

THE FINAL AUTHORITY REGARDING THE USE, INTERPRETATION AND ADAPTATION OF THESE GUIDELINES LIES EXCLUSIVELY WITH THE COUNTRY UNDERTAKING THE ASSESSMENT. THE COUNTRY STUDY IS AN EXPANDING PROCESS THAT EVOLVES THROUGH THE ACQUISITION OF ADDITIONAL DATA. THE FIRST VERSION OF THE STUDY SHOULD INCLUDE ONLY THOSE DATA THAT CAN BE READILY COMPILED FROM EXISTING SOURCES. THERE IS NO EXPECTATION THAT A COUNTRY WILL BE ABLE TO PROVIDE THE FULL ARRAY OF DATA PROPOSED IN THESE GUIDELINES IN THE FIRST VERSION - COUNTRIES MUST INTERPRET THE GUIDELINES IN THE LIGHT OF THEIR OWN CIRCUMSTANCES AND CAPABILITIES. THE TECHNICAL ANNEXES ATTACHED TO THESE GUIDELINES ARE INTENDED TO PROVIDE A FRAMEWORK FOR THE GATHERING AND PRESENTATION OF THE DATA FOR USE AT THE DISCRETION OF THE COUNTRIES.

1 INTRODUCTION

1.1 Historical Background

1.1.1 The need for national assessments of biological diversity was recognised early in the negotiations for the Convention on Biological Diversity. In February 1990, the Ad Hoc Working Group of Legal and Technical Experts on Biological Diversity recommended the preparation of country-specific studies on "the costs, benefits and unmet needs for conservation and sustainable use of biological diversity". An Expert Advisory Team for Country Studies was established by UNEP, and the first tranche of country studies was completed in January 1992, including studies from 10 countries. A synthesis report on the results from those 10 studies (UNEP Country Studies/Inf. 1, Nairobi, 23 April 1992) was prepared by the UNEP Expert Advisory Team, and a summary was produced by the UNEP Executive Director (UNEP/Bio.Div/N7-INC.5/3, 23 April 1992).

1.1.2 At its final meeting, in February 1992, the Advisory Team recommended that the guidelines for country studies issued in May 1991 (UNEP/Bio.Div/Guidelines) should be revised to incorporate the experience gained from the first tranche of studies. In particular, the revised guidelines should focus more upon the compilation of biological and economic data to reinforce the biodiversity planning process within countries, and less upon quantifying the unmet financial needs of nations to implement the Convention on Biological Diversity, which had been the primary orientation of the first tranche of studies.

1.1.3 The Convention on Biological Diversity was signed at the United Nations Conference on Environment and Development in Rio de Janeiro in June 1992 by 156 States and the European Economic Community, and since then more States have signed. Article 6 of the Convention states that the Contracting Parties shall prepare national strategies, plans or programmes for the conservation and sustainable use of their biological resources. The Conference for the Adoption of the Agreed Text of the Convention on Biological Diversity, held in Nairobi in May 1992, adopted resolution 2 in which it recognized the importance of country studies in the preparation of national strategies and action plans. Paragraph 2 of this resolution outlines the components of the country studies:

- identification of components of biological diversity that are important for its conservation and sustainable use
- collection and evaluation of data needed for the effective monitoring of the components of biological diversity
- identification of processes and activities that threaten biological diversity
- evaluation of the potential economic implications of the conservation and sustainable use of biological resources
- determination of the economic values of biological and genetic resources
- assessment of priority actions for the conservation and sustainable use of biological diversity

The need for a more comprehensive process of biodiversity planning, encompassing all relevant sectors to initiate and implement actions at the national level, underlies resolution 2.

1.2 The Context of the Country Study Process

1.2.1 The objectives of the Convention on Biological Diversity are given in Article 1:

> "The objectives of this Convention, to be pursued in accordance with its relevant provisions, are the conservation of biological diversity, the sustainable use of its components, and the fair and equitable sharing of the benefits arising out of the utilisation of genetic resources, including by appropriate access to genetic resources and by appropriate transfer of relevant technologies, taking into account all rights over those resources and to technologies, and by appropriate funding."

1.2.2 These aims are reinforced by Agenda 21, chapter 15 of which stresses the value of biological resources as a capital asset with great potential for yielding sustainable benefits at the country level. The same chapter stresses the need to build capacities for the assessment, study, evaluation and monitoring of biodiversity at the national level, whilst ensuring the full participation and support of local communities. It also calls for the production of country studies, with particular reference to costs, benefits and socio-economic issues.

1.2.3 The contribution of the country study process to the implementation of the Convention is presented schematically in figure 1. Four main steps are recognized:

- Step 1 (Take Stock) is the process of gathering and analyzing data to identify gaps and potential conflicts as might be revealed by the data, and to review the array of possible conservation measures. It includes the collection of data on the status and distribution of biological resources, identifying threats, assessing current capacities, collecting socio-economic data useful in evaluating benefits of conserving and sustainably using biodiversity, and estimating the current expenditures on biodiversity related activities. Collectively these activities comprise the country study, and these guidelines are intended to assist nations to undertake this process of national assessment. The provisions in the Convention that relate to these activities are Articles 6 and 7.

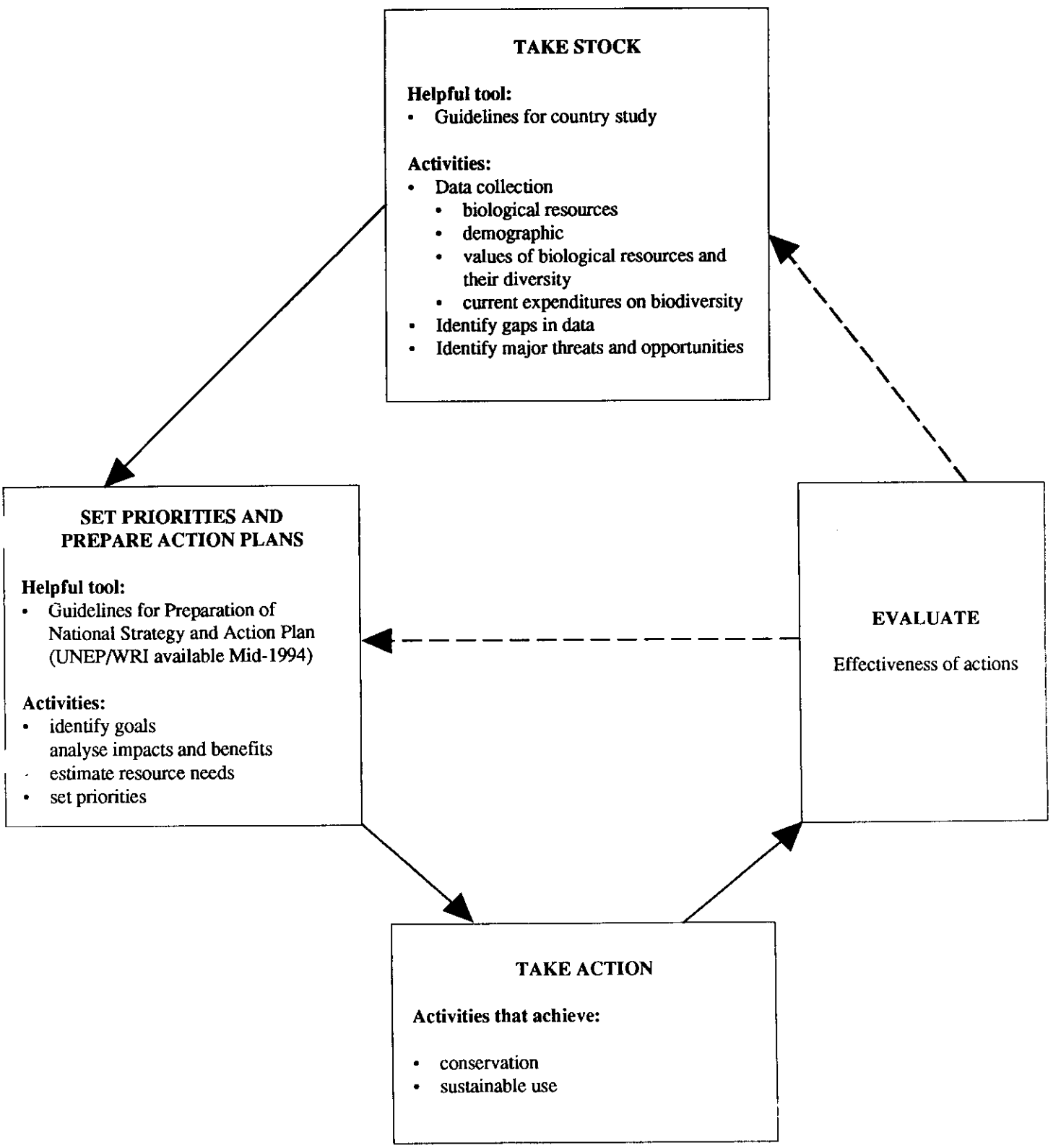
- Step 2 (Set Priorities and Prepare Action Plans) is the formulation of strategies and action plans, involving all sections of the community and Government, and including the assessment of objectives, priorities and resource requirements, and the evaluation of the costs and benefits of the proposed measures. Interacting with this evaluation is the need for analyses of the environmental and social impacts of the proposed measures. References to this step are contained in Articles 6, 10, 11, 12, 13, and 14 of the Convention.

- Step 3 (Take Action) is the implementation of actions for conservation and sustainable use of biological diversity. This includes all types of action such as the implementation of policies, improved management of conservation areas, incentives to promote adoption of new methods for sustainable use, development of economic instruments to integrate biodiversity into national accounting systems, enforcement of national legislation, research programmes, biodiversity monitoring and other activities. References to this step are found in Articles 6, 7, 8, 9, 10, 11, 12, 13 and 14 of the Convention.

- Step 4 (Evaluate) is the evaluation of the effectiveness of the actions, including the monitoring of the progress in implementing the proposed actions assessed against targets prescribed in the action plan.

Figure 1

CONTEXT WITHIN WHICH THE COUNTRY STUDY PROCESS CONTRIBUTES TO THE IMPLEMENTATION OF THE CONVENTION ON BIOLOGICAL DIVERSITY



A fifth step, which can occur at any time during the process, is the mandatory reporting by each Contracting Party on the measures it has taken to implement the provisions of the Convention. Reference to this step is given in Article 26 of the Convention.

1.2.4 These guidelines only relate to step 1 above. Additional guidelines are being developed for the other steps.

1.2.5 A statement of the objectives at the national level for the country study is presented in box 1.1.

Box 1.1 Objectives of the Country Study Process

The objectives of the country study process for individual countries include:

- to provide the information basis for countries to develop national strategies and action plans for the conservation and sustainable use of their biological diversity
- to gather baseline information on the components of biological diversity and their conservation status as a benchmark to monitor the effectiveness of national strategies and action plans
- to identify activities that are likely to have an adverse impact on the conservation and sustainable use of biological diversity
- to provide a basis for determining national priorities for the conservation and sustainable use of biological diversity
- to identify the economic benefits resulting from the conservation and sustainable use of biological diversity
- to identify appropriate measures, such as agricultural practices, training and institutional capacity building, to achieve effective conservation and sustainable use of biological diversity
- to quantify the costs of these measures
- to quantify the current level of national, bilateral and multilateral funding for the conservation and sustainable use of biological diversity and the unmet financial needs to implement national strategies and action plans
- to build the monitoring, assessment, planning and management capabilities of national institutions, particularly in the setting of priorities and the implementation of action plans
- to provide a feedback mechanism to evaluate the effectiveness of national biological diversity action plans

2 THE COUNTRY STUDY PROCESS

2.1 Overview

2.1.1 The purpose of the country study is to gather and analyse biological, economic and social data that collectively can provide the assessment framework for preparing the national strategy and action plan. The goal of the country study is therefore to initiate a process of improved biological diversity planning that will stimulate the action necessary at the national level to implement the Convention.

2.1.2 Clearly the country study process must address not just the need to inventory and monitor the biological resources of the nation but also the need to estimate the economic benefits accruing from the biodiversity-related activites. This in turn has

strategic implications, not least the need to develop practical mechanisms to quantify the economic costs and benefits of biological diversity.

2.2 General Considerations

The Need for Data

2.2.1 Up-to-date quantitative and qualitative data underpin all types of activities involved in the conservation of biological diversity. Box 2.1 identifies the range of measures prescribed in the articles of the Convention of Biological Diversity, for each of which data are necessary. It is therefore necessary to draw together a range of information on which priorities and actions can be based. However, it must be appreciated that biodiversity and economic data are dynamic: the status and distribution of species and habitats are continually changing, as are the costs of their conservation and the economic benefits of their sustainable use. Collating biodiversity data therefore necessitates the development of databases that allow for the regular systematic updating of the information as well as the gathering of new data as part of an open-ended incremental process.

Box 2.1 Types of Activities Involved in the Conservation of Biodiversity

The following range of activities prescribed in the articles of the Convention on Biological Diversity require up-to-date reliable data for their effective implementation:

- biological survey and inventory
- biodiversity research and evaluation
- data management and analysis
- monitoring and assessment
- education and training
- public awareness and participation
- *in situ* management
- restoration and rehabilitation
- *ex situ* conservation measures
- capacity building of institutions
- networking and information exchange
- environment impact assessment
- policy coordination and development
- assessing economic benefits
- equitable distribution of benefits
- estimating conservation costs
- institutional collaboration
- legal instruments
- technology transfer
- socio-economic studies and surveys

2.2.2 The great variability in the biological environment between and within nations must be recognized in implementing these guidelines, as must the wide differences in political and economic circumstances. The availability of data also varies considerably, as does the national capability in managing and interpreting such data. The guidelines are designed to be sufficiently general and flexible for application under a wide variety of national circumstances. Specific recommendations must be tailored by each country to meet its own individual needs in developing appropriate national programmes for conservation and sustainable use of biological diversity.

An Ongoing Process

2.2.3 The country study must be seen as an ongoing and evolving process and not just as a one-time product. The process of data gathering, priority assessment, strategic planning and conservation action will itself generate more data through research and monitoring. The results of inventories and the estimates of costs and benefits must feed back into the national assessment, leading to the revision of priorities and actions. In this way a process is established with an expanding monitoring and assessment capability at its centre, generating enhanced national planning, management and utilization of the country's biological wealth.

2.2.4 No country, irrespective of its scientific and technical capabilities, will have solutions to all the issues concerning the conservation and sustainable use of its biological diversity. The country study is the first step in an incremental expanding process. The initial assessment cannot be fully comprehensive. In the majority of countries, most species have yet to be identified and the assessment of genetic diversity, even in major agricultural crops, has barely begun. The first iteration of the country study calls for the collation of existing information about the biological diversity of the nation from in-country and out-of-country sources. The intention in the initial assessment is to identify gaps in the knowledge but not to fill them. Such gaps may be identified as priorities for action, in which case they will be filled in subsequent assessments as the research is completed. The first iteration of the country study therefore provides the baseline against which national efforts to implement the Convention can be measured.

Scope of "Biological Diversity"

2.2.5 A distinction is made by the Convention between "biological resources" and "biological biodiversity". Article 2 defines biological diversity as "the variability among living organisms from all sources including, *inter alia*, terrestrial, marine, and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems". The term biological resources is defined as including "genetic resources, organisms or parts thereof, populations or any other biotic component of ecosystems with actual or potential use or value for humanity".

2.2.6 Although resolution 2 of the Nairobi Final Act (see paragraph 1.1.3 above) is clear in its requirement to "ascribe values to biological and genetic resources", it can be interpreted as encompassing the need to evaluate biodiversity itself as a source of benefit to humankind. Biological resources produce tangible benefits such as food, medicines, shelter and employment that can be readily translated into monetary terms. Biological diversity, as well as being vital for the functioning of ecosystems, does itself also provide valuable economic services. However, it is important to realize that not all the services ascribed to biological diversity, such as control of soil erosion or the assimilation of pollutants, are a consequence of diversity *per se*, in that they can be provided with equal benefit by less diverse and even derived ecosystems. Clearly this service is very difficult to evaluate, since humans derive benefits from biological resources as commodities, as well as from the assemblages of resources. There is a need to assess the value of biological diversity as well as the value of individual biological resources.

The Economic Considerations

2.2.7 The dependence of humankind upon biological diversity and biological resources for its long-term well-being is not yet fully appreciated in decision making. When these resources are not properly measured and valued, biodiversity conservation may be viewed inaccurately as a cost to society rather than an investment in its development. The country study should contribute to demonstrating the value of biological diversity and biological resources. If it can be shown that these benefits exceed the costs of conserving the resources, then a powerful incentive for investing in biological diversity will be established.

2.2.8 The development of appropriate methods to evaluate the benefits of biological diversity and their eventual incorporation into systems of national accounting will provide a powerful incentive for conservation. Under enlightened management, the utilization of biological resources should ensure a sustained flow of goods and services of direct benefit to human development without reducing the productive capacity of the resource base. Taking stock of these resources is the essential first step, the process for which is set out in these guidelines.

Integrated Planning

2.2.9 Many countries have already prepared national conservation strategies, national environmental action plans and other similar planning documents. The country study is not intended to replace these initiatives but to build upon them, focusing upon the specific issues of biodiversity conservation and use. Planning is an incremental process, and previous exercises can provide an invaluable contribution. However, the provisions of the Convention on Biological Diversity do call for a range of specific activities, so it is likely that existing plans will need to go through a process of modification and expansion to focus on the particular needs of the country study as the basis for subsequent decision making for policies and investments.

2.2.10 It is also necessary to recognize the planning burden upon countries following the United Nations Conference on Environment and Development in Rio. Nations are now expected to produce national strategies for curbing the emission of greenhouse gases as prescribed by the United Nations Framework Convention on Climate Change, as well as national plans to promote the sustainable management of forests as called for by the Statement of Forest Principles. These climate change and forest plans must then be integrated with the biodiversity programmes in preparing national sustainable development strategies.

2.3 Using the Guidelines

2.3.1 The purpose of these guidelines is to assist nations to undertake step 1 of the country study process. The intention is not to enforce a rigid set of rules but to provide a support framework that recognizes the very different capabilities and circumstances of countries and hence the need for flexibility.

2.3.2 However, to promote some commonality of approach, a series of **20 guiding principles** are presented. These must be read in the context of the technical annex. If, for example, the proposals for gathering species data appear for some countries to be unrealistically onerous, the guiding principles (guidelines 5 and 20) stress that the first iteration of a country study should concentrate on the data that are readily available rather than striving to achieve a comprehensive coverage. Each country in the light of its own circumstances must reach a compromise that for provides the

need for adequate coverage without overloading the process so that it becomes unworkable.

2.3.3 Following these **guiding principles**, recommendations on information collection and management are contained in the technical annex, which is divided into five sections:

- **Section A: Socio-Economic Factors Affecting Biological Diversity**

  Because biodiversity planning must be carried out in the national socio-economic context, the data gathering initially focuses on **human systems**, particularly population demography, infrastructure, government policy, and rights of access to biological resources.

- **Section B: Biological Data Gathering**

  Land-use and aquatic resources data are divided into agricultural, forestry and fisheries sectors reflecting the likely institutional arrangements for compiling the data. The biodiversity data are divided into information on **habitats**, including the functional benefits and service values of the biodiversity component, and on **species**, separating ***in situ*** data from ***ex situ*** conservation measures, and **protected areas**. **Threats** to biological diversity are an important component of this process, but the data collection recognizes that threats may also be linked to short-term benefits and that threat alleviation may involve an economic trade-off. This section concludes with **monitoring**, including recommendations for a minimum coverage of biodiversity factors that a country should monitor to assess the effectiveness of its national conservation strategy.

- **Section C: Valuation and Current Expenditures**

  This section focuses on the gathering and processing of information on **benefits and expenditures** related to biological diversity. Socio-economic data are essential in influencing decision makers. The section also distinguishes the different **sources of expenditure** incurred in the conservation and sustainable use of biological diversity, and outlines a number of different cost-effective approaches to gathering such data. Attention is drawn to the need for disaggregated information according to type of resources.

- **Section D: Current Capacity**

  The national assessment must include an overview of the **current capacity** within the country for the conservation and sustainable use of biodiversity. Particular attention is given to the institutional capacities, human resources, legislative base and information systems available for carrying out the country study process.

- **Section E: Directory of Data Sources**

  This section provides a listing with addresses of selected major international sources of biodiversity information. It also lists those countries and agencies that have already undertaken country studies, or are in the process of doing so, and thus might be able to provide practical advice.

Data Presentation

2.3.4 Whenever possible, countries are urged to present the data as a series of integrated tables and maps. Maps are essential for planning, and whenever biogeographical data are presented (such as the distribution of a species or habitat, vegetation types, protected areas, land-use, etc.), maps should be produced. In some cases, it will be necessary to derive a series of tables each relating to distinct geographical regions or provinces within a nation. Parts of some of the proposed tables and maps overlap each other: rationalizing these may be worthwhile, but the increased clarity arising from some duplication reduces the need for cross-referencing. The design of the tables presented in the data sections should be adopted as far as possible, but these should not be regarded as mandatory. Some countries may need to modify the tables to meet the limitations of their data; others with comprehensive data sets may want to expand the tables or develop new ones to demonstrate the full coverage of their information.

2.3.5 Responsibility for gathering the country study data and for generating the national biodiversity strategy lies with the national biodiversity unit (NBU) or similar national institution or arrangement set up by the Government for the purpose. The NBU should be a multi-sectoral and multi-disciplinary body including representatives of all the major interested parties (relevant Government departments, parastatals, universities, non-governmental organizations and the private sector). It is envisaged that the NBU will establish a technical secretariat to coordinate the country study process, and will set up a number of inter-disciplinary working groups to focus on specific sectors. Responsibility for the actual data collection within these sectors may be delegated to relevant government agencies, university departments or NGOs, with the technical secretariat providing coordination and integration.

2.3.6 The process of data gathering could be significantly advanced if the main out-of-country sources were accessed at the commencement of the work. A list of the major international data sources is presented in section E of the technical annex. Similarly, the experience of those nations that have already completed Country Studies would be beneficial in assisting countries that are now commencing the process.

2.3.7 These guidelines have been prepared for use particularly in developing countries, where there is an awareness of the importance of the need for sustainable use of biological diversity as presented in the Convention. For those users less familiar with the values of biological diversity and the mechanisms for its conservation, attention is particularly drawn to the following publications:

- *Global Biodiversity Strategy*, produced by WRI, IUCN and UNEP, 1992
- *Global Biodiversity: Status of the Earth's Living Resources*, compiled by the World Conservation Monitoring Centre and published by Chapman & Hall, 1992
- *Caring for the Earth*, produced by IUCN, WWF and UNEP, 1992
- *Global Marine Biological Diversity Strategy*, produced by the Centre for Marine Conservation, 1993

3 TWENTY GUIDING PRINCIPLES

The following general principles are presented to assist countries in planning their country study, particularly in setting priorities for data-gathering and monitoring. The implementation of the study is a national process, but can be facilitated by international cooperation, particularly in the transfer of data and information management skills.

Guideline 1: The final decision and authority regarding the interpretation and selection of elements of these guidelines for implementing the country study lies with the country undertaking the study

3.1 It is essential that these guidelines are regarded as providing support and not prescriptions of actions that must be undertaken. The country itself is responsible for selecting appropriate avenues and priorities for data-gathering and analysis. During the process of collating and interpreting the data on biodiversity status and trends and on economic aspects, special note must be taken of the limitations in institutional, managerial, scientific and technological capacity to ensure that they receive consideration in the preparation of national strategies and action plans.

Guideline 2. The institutional procedures for data-gathering must be multi-disciplinary and multi-sectoral, with the national biodiversity unit or other identified institution providing coordination and integration

3.2 Many sectors will be involved in gathering biodiversity and economics data. This process will involve the national wildlife and protected areas authorities, together with other sectors, particularly agricultural, forestry and fisheries departments. The primary role of the NBUs will be to identify the types of data needed so that the NBU can coordinate the data-gathering by the different sectors, both governmental and non-governmental, and to synthesize the results as input into the national strategy and action plan. For this purpose, it will be vital for the coordinating institution to bring together a team of experts from the biological and physical sciences as well as from the social, economic and cultural disciplines.

Guideline 3. The primary objective of the country study is to gather and analyse the data required to drive forward the process of developing national strategies, plans or programmes for the conservation and sustainable use of biological diversity, and to integrate these activities with other relevant sectoral or cross-sectoral plans, programmes or policies

3.3 To be effective, national biodiversity strategies must incorporate the ethic of sustainable use with conservation planning and be based on an analysis of the most comprehensive information available. It is only through the assessment of up-to-date and relevant data that rational decisions can be made concerning priorities, policies and investment strategies. This is the primary purpose for undertaking a country study: the full range of objectives included is presented in box 1.1. Key considerations include: the compilation of baseline information for monitoring; data on economic values of biodiversity conservation; institutional capacity-building; quantifying current levels of funding; identifying threats and opportunities.

Guideline 4. The country study is an incremental process that evolves through the acquisition of additional data and expanding knowledge

3.4 The implementation of national action plans will generate further data which in turn will feed into the production of revised strategies. A process is thereby established with the regular production of up-dated strategies and plans based on an increasing knowledge base. At the heart of this process is an expanding database which the country will develop and use to provide the analyses and predictive capabilities for the improved planning and management of biological diversity. This enhanced information management and monitoring capability is a key component in building the capacities of developing countries in the biodiversity sector.

Guideline 5. The first iteration of the country study should aim to include only those data that can be readily compiled from existing in-country and external sources

3.5 The exercise of gathering data for the country study does not in itself comprise a final product but the first step of an open-ended process. A balance must be achieved between the commitment of time and effort to compiling data and the need to develop strategies as quickly as possible. As the country study is an incremental process, in the first instance its data coverage does not need to be comprehensive. In practice, the correct balance is likely to be achieved by allocating the resources necessary to gather such data as are available, including out-of-country sources, without attempting total coverage. The information must address the underlying causes of loss of biodiversity, resulting from the fundamental lack of adequate and accurate analysis of the benefits accruing from biological resources.

Guideline 6. Data-gathering is a tool for decision-making and not an end in itself - the agenda for data acquisition must be constituent-driven and issue-based

3.6 It must be appreciated that the gathering of data can be an endless process unless clear boundaries are specified and linked to unambiguous objectives. One of the most common errors in conservation planning is to allow researchers and data managers to set the parameters for data acquisition independent of the interests of the information users. In determining what data to collect, the question must always be asked, "How does this information contribute to the biodiversity planning process?" An information management strategy should be developed as part of the action planning process and, as part of this, the information needs of the users should be determined through a continuing dialogue that identifies or prioritizes the types of data to be gathered.

Guideline 7. It is essential to set priorities as not all data are of equal value to the planning process

3.7 With limited resources available, the setting of priorities for the types of data to collect is critical. These will vary according to the planning needs and requirements of the country. A generic list of possible priorities for data gathering is presented in box 3.1, although this will need refining in the context of the circumstances of each individual country.

Guideline 8. Flexibility will be necessary in interpreting and applying these guidelines to meet the different circumstances of different countries

3.8 No two countries will be the same in terms of their biodiversity planning requirements. Different levels of socio-economic development, political structures, land-use policies, land tenure systems, and biological resources will generate different national needs and priorities. These guidelines must therefore be seen as a prompt or support system rather than a set of

Box 3.1 General Priorities for Types of Data to be Compiled

Decisions relating to the types of data to be included in the country study must be made in the context of the planning needs of each country and the resources available, but in general the following kinds of data are likely to be priorities:

- data that will provide a practical baseline for monitoring the effectiveness of action
- data identified by biodiversity managers as being important for decision-making
- species of actual or potential economic value
- plant and animal genetic resources, including medicinal plants, land races and wild ancestors of domestic breeds and cultivars
- species that could serve as indicators of ecosystem health, particularly predators at the top of the food-chain or invasive colonizing species that may indicate ecosystem disturbance
- "flagship" species, the conservation of which will also protect a diversity of other species and habitats
- alien or exotic species, the spread of which could threaten indigenous biological diversity
- species threatened at the national and regional level
- species already protected within conservation areas
- data on threats to species and habitats
- time-interval data on rates of loss or endangerment of species and habitats
- geographical information, particularly data that can be mapped, on species and habitat distributions
- data on biodiversity function and benefits, particularly the service functions of ecosystems and protected areas
- data on species and sites of special significance for the conservation of biological diversity outside existing protected areas
- status and distribution of protected areas, including the species and habitats they contain
- data on the socio-economic values of protected areas
- policy, conservation programmes, legislative and institution-related information

fixed prescriptions that must be rigidly adhered to. The intention is to stimulate thinking rather than impose an inflexible set of instructions - they are guidelines not rules.

Guideline 9. A secondary goal of the country study is to relate national needs and priorities to those identified by other countries in the region

3.9 The biodiversity data should be compiled adopting whatever national systems for species taxonomy or habitat classification are already in use. Relating these national systems to international criteria for purposes of inter-country comparisons and syntheses is a secondary objective. Responsibility for developing international systems, such as a global or continental vegetation classification, and for integrating national systems lies with agencies such as the UNEP Harmonization of Environmental Measurements (HEM) Programme. Developing countries should apply their own, possibly unique, national systems to assess national priorities, giving only secondary consideration to international comparability. However, countries should adopt international standards if they do not already have their own; a major ancillary role of the country study is to provide information for regional assessment of ecosystems and other components of biodiversity which cross national borders.

Guideline 10. The compilation of data for the country study must include all species within national jurisdiction and a full attribution for each data accession, following as far as possible standard definitions and units of measure

3.10 When compiling data on the number of species within the country, all species that occur should be considered. It may be necessary to confine data-gathering to achieve a manageable level, but all types of species, such as marine mammals in off-shore waters and migratory birds, should be considered together with introduced species as well as native and endemic species. The full attribution of each data item should include source, date, and accuracy (see box 3.2).

Box 3.2 Information about the Data

Whenever possible, the following attributes should be provided for all data included in the country study:

- **source** - who collected the data or where did it come from?
- **method** - what method was used for its collection?
- **date** - when was it collected?
- **reliability** - what is the quality/reliability of the data?*
- **scale** - for mapped data, at what scale was the data collected?

* It is suggested that a simple four category reliability classification should be adopted, based mainly on the method of derivation:

- Category A - high reliability: data derived from systematic scientific survey or sampling
- Category B - medium reliability: data derived from extrapolation, approximation or other imprecise methods
- Category C - low reliability: anecdotal data or guestimates
- Category X - unknown reliability: derivation of the data unknown

Guideline 11. Data-gathering must focus on the interaction of social factors, economic sectors and biological systems

3.11 Biodiversity planning aims to influence the interface between human and biological systems. The country study should also demonstrate how the biological data relate to, and are affected by, such socio-economic factors as human population demography, land use and resource ownership. For instance, how does agricultural price intervention affect land use and thus biological diversity, or what effect will a change in the rights of access by local people to biological resources have upon patterns of consumption and thus the loss of biological diversity? These socio-economic parameters provide the framework within which to interpret the biological data. It is often the dynamic relationship between the different systems that generates the changes critical to an understanding of the factors that influence biological diversity.

Guideline 12. The biodiversity data must incorporate human uses of biological resources and the functional benefits of biological diversity

3.12 As well as focusing on the planning interface between human and biological systems, the data-gathering must concentrate on the utilization of biological resources, and the functional uses of biodiversity to human society. It must be recognised that these values will vary at different levels - internationally-traded commodities, resources for local communities, and the needs of individual farmers for sustainability. Resource utilization, whether at the national, local or individual level, must be the key criterion for selecting biodiversity data.

Guideline 13. Data on processes or activities that are likely to have an adverse impact on biological diversity must be compiled

3.13 The identification of threats must be a key consideration in national biological diversity strategies with recommendations for their reversal included in action plans. Threats may arise from natural hazards; from the indirect consequences of human processes, or externalities such as changes in agricultural commodity prices or the servicing of international debt; and from direct human activities such as shifting agriculture, logging, poaching or pollution. The initial focus should be on the direct human-induced threats that can be most readily monitored and reversed, for example by the enforcement of existing national legislation. It must be recognized that most threats are created by a potential beneficiary, normally the causal agent of the threat, and that actions for threat relief therefore involve an economic trade-off.

Guideline 14. The process of gathering and managing the data by the NBU or other identified institution must contribute to building capacity for national biodiversity planning

3.14 A national strategy or plan should not be a static document that prescribes a series of actions to be taken with no mechanism to monitor their effects. It must evolve as circumstances change, and information management must be organized to provide support for this process (see box 3.3).

Guideline 15. Priorities for filling gaps in the data coverage must be based on the needs of senior decision makers to improve their management of biological diversity

3.15 Analyses of the data holdings will assist the identification of data gaps. Priorities for filling these gaps must be set out in the national strategies, based on the principle of asking managers what additional information they need. The tendency of scientists and data managers to gather data for the sake of the completeness of the coverage must be resisted (see guideline 6) .

Guideline 16. Identify and document sources of information, both national and external, on the status and trends in biological diversity

3.16 The NBU will be able to identify the main in-country sources of data from such institutions as governmental departments, parastatal agencies, university research institutions, national data centres, non-governmental organizations, museums and botanic gardens. A list of some of the more important international data sources is presented in section E of the technical annex.

Box 3.3 Application of a Geographic Information System (GIS) for Data Management to Support the Country Study Process

The specification and design of the databases required to store and process the biodiversity data gathered by the country study must be considered on an individual country basis in the context of its needs, priorities and existing information management capabilities. However, such spatially-related data would be most effectively handled in a relational database linked to a geographic information system capable of producing the reports and maps proposed in these guidelines.

A GIS is a powerful tool that can reinforce the national biodiversity planning process for long-term integrated resource management. The establishment and support of a GIS capability is important for identifying the institution to host the NBU. The capability includes resident skills, in-programme training, technical and logistical support, sustainable funding, and political acceptability of the outputs. The NBUs established with the short-term goal of coordinating the country study process must build the long-term capability to monitor and plan the development of the nation's own resources.

Guideline 17. Data gathered on *ex situ* species conservation must relate to, and support, *in situ* actions, whilst recognizing the potential economic value of collections of genetic materials

3.17 *Ex situ* measures, involving the activities of zoological and botanical gardens, herbaria, museums and other genetic resource collections, are a key component in the repertoire of species conservation programmes, but the orientation of such data gathering must be to demonstrate how *ex situ* activities can reinforce field conservation efforts; for example, through the captive breeding and reintroduction of threatened species. The potential economic value of genetic resources provides a powerful incentive for nations to conserve their biological diversity, and the data presentation must facilitate the analysis of such economic benefits.

Guideline 18. The biodiversity data gathering must not be confined to national parks and protected areas but must cover the whole landscape: data on protected areas should seek to emphasize their relationship with other components of the landscape

3.18 To many politicians, biodiversity conservation is viewed in the narrow context of managing protected areas. The data gathering exercise must incorporate the entire landscape (see box 3.4), including the agricultural, forestry and fisheries sectors. As reservoirs of biological diversity, protected areas will obviously form a key component, but data relating to surrounding areas must also be compiled to ensure the fullest integration with the entire rural development process.

Guideline 19. The data gathering should include an assessment of the current capacity of the country to conserve, study and sustainably use its biological diversity

3.19 The national assessment process should provide summarized information that characterizes the country's existing capacity to manage its biotic wealth. Such information should cover national institutions, programmes, policies and legislation including both the government and private sectors. This assessment must incorporate the agricultural, forestry and fisheries sectors as well as the environmental and conservation agencies, and should include estimates of the human resources directly and indirectly associated with biological diversity.

Box 3.4 **Definition of Landscape**

Landscape includes the geological structure of the land, its soils, animals and vegetation, as well as the pattern of human activity such as fields, forests, settlements and local industries. It also includes aesthetic issues such as nature and architecture, and the entire ecology and history of an area. Landscape therefore recognizes the interface between nature and culture, and the purpose of considering the entire landscape as an entity is to seek to reinforce the positive aspects of this interface.

International Symposium on Protected Landscapes. Poore, D. and Poore, J.

Guideline 20. The undertaking of a country study should not become an over-onerous task because of the excessive demands for data-gathering

3.20 For the majority of countries, most species have yet to be identified, habitats are inadequately mapped, and genetic resources have been barely inventoried and understood except for those in current economic use. The purpose of the country study is to collate what little is known and to identify the gaps in the knowledge, but not to seek to fill those gaps, which is part of the national strategy and action plan process (see guideline 15). The need for comprehensive data coverage must be balanced against the resources and time needed to compile such data. Each country will need to identify this balance in the light of its own circumstances, and set its own priorities for data-gathering in the context of the resources available (see guideline 7).

A summary of these guiding principles is presented in box 3.5. It is emphasized that these are not mandatory rules but a support system to assist nations to undertake the country study process. Faced with different circumstances and realities, countries cannot be placed in a strait-jacket of fixed prescriptions, but must be allowed flexibility to implement the study as they deem best. However, the basic approach is for an incremental expanding process, the objective of which is to build the capacity for improved biodiversity planning and management.

Box 3.5 **Summary of Guiding Principles**

- The final **decision and authority regarding the interpretation** and selection of elements of these guidelines for country studies lies with the country undertaking the study
- The responsibilities for the data gathering must be **multi-disciplinary and multi-sectoral**, with the NBU or other identified institution providing coordination and integration.
- The primary use of the data is to reinforce the **biodiversity planning process** through the preparation of national strategies and action plans.
- Developing this planning capability is an **incremental process** that evolves through the acquisition of additional data and expanding knowledge.
- The initial selection of data should focus on **readily available information** that will provide a **baseline for monitoring** the effectiveness of action.
- The data gathered must be selected on the basis of their **applicability to the planning process** and their use in generating "on the ground" action.
- **Priorities** must be agreed at the outset concerning the types of data to be compiled: a general focus on species of economic value, indicator species, flagship species and genetic resources is recommended.
- The **standard definitions** and units of measure prescribed in these guidelines should be adopted whenever possible, but **inter-country comparability** is of secondary importance to identifying national needs and priorities.
- The data-gathering must focus on the interaction between **human and biological systems** and must be assessed in the context of **human use and functional benefits**.
- **Threats** to biological diversity must be identified and monitored, recognising that most threats are generated by a potential beneficiary and that threat reversal involves an economic trade-off.
- The **spatial** context of the information is a key consideration: **integrated tables and maps** will be essential for GIS assessment.
- **Biodiversity managers** should be asked what additional data they need as a means of determining priorities for filling information gaps.
- One of the first steps should be the development of a list of **information sources** and their data holdings, and a list of **human resources** and their expertise.
- The data on ***ex situ* measures** must recognise the potential economic value of genetic resources as an incentive for nations to conserve their biodiversity.
- The **protected areas data** must emphasize their integration into the rural development process.
- Data gathering, analysis and management must contribute to **building the national capacity** for improved biodiversity planning.
- The **current capacity** of the country to conserve, study and sustainably use its biodiversity must be assessed.
- The interpretation and application of these guidelines must be **flexible**, with the countries themselves deciding the balance between comprehensive coverage and overload.

GUIDELINES FOR COUNTRY STUDIES ON BIOLOGICAL DIVERSITY

TECHNICAL ANNEX

INTRODUCTION

1 PURPOSE OF THE ANNEX

The present technical annex provides details of the types of data that are recommended to be compiled and analysed for inclusion in the country study. It is intended for use by practitioners with experience in information handling and analysis relating to the various thematic areas covered. While it may be of interest to policy makers, it has not been written with such an audience in mind.

2 BACKGROUND MATERIAL

It is, however, strongly recommended that technical users acquaint themselves with the main text of the country study guidelines before embarking on collection or processing of information covered by the technical annex. In particular, chapter 3 (Twenty Guiding Principles) of the country study guidelines will provide essential background to the process of undertaking a country study and sets out a number of key considerations which should be helpful in implementing a national assessment of biological diversity. These principles will influence the approach and direction underpinning data collection, analysis and presentation of material.

3 DESCRIPTION OF STRUCTURE OF ANNEX

The annex provides details of the specific types of information that should form the basis of the country study. It is divided into five sections covering the major subject areas that will constitute the country study: socio-economic factors affecting biological diversity; biological data; assessing the monetary value of benefits and estimating the costs of biodiversity conservation and use; determining the current capacity in-country; and providing potentially useful external sources of data and expertise.

Section A The first section provides a focus on **human systems**, since these inevitably control the context within which all planning and management activities are addressed. Particular attention is given to population demography, infrastructure and rights of access to biological resources.

Section B **Biological data** forms a substantial component of the annex and deals with land use, habitats, species and protected areas. Threats to biological diversity, and monitoring of the effectiveness of national conservation strategies, are key factors for consideration and these aspects are elaborated at the end of the section.

Section C This section covers the **economic assessment** of biodiversity. It includes procedures for estimating the economic value of the **benefits** resulting from the sustainable use of biological diversity, methods for quantifying the **costs** of conservation action, and the resulting **net monetary values.** The development of techniques to produce monetary estimates of the benefits accruing from the sustainable use of biological diversity is a crucial consideration, for if reliable information can be presented, it will be possible to influence policy by incorporating biodiversity benefits in national income accounting procedures. Such recognition of biodiversity values will assist in financing conservation initiatives if appropriate economic instruments can be developed.

Section D Assessment of the **current capacity** to conserve, study and sustainably use biological diversity is essential. This section will consider the national programmes and policies, institutional capabilities, human resources and the legislative base.

Section E A list of the main **international sources** of appropriate biodiversity data, including addresses, is presented together with contact addresses for those countries that may be able to share relevant experience having themselves already undertaken a national assessment.

SECTION A: SOCIO-ECONOMIC FACTORS AFFECTING BIOLOGICAL DIVERSITY

1 SOCIAL, POLITICAL AND ECONOMIC ISSUES

1.1 General Considerations

1.1.1 Biodiversity planning necessitates the evaluation of biological data in the context of human social, economic and cultural development. It is therefore central that the country study process commence with an assessment of human population demography and related socio-economic factors (see guideline 11), and then proceed to a consideration of the human uses of biological diversity and its functional benefits (see guideline 12). These socio-economic factors, often difficult for the traditional nature conservation sector to influence, are paramount in establishing the balance between the productive capacity of biological resources and the demands placed upon these resources to support human development.

1.1.2 Where possible, the following demographic and socio-economic parameters should be considered both at the national and state or district levels. To improve integration with map-based biological and physical data, the information should if possible be mapped for GIS use at a comparable scale - for example, national population census data should be analysed to provide the information suggested below, which could be mapped at the province or district level. The level of resolution should give the best coverage for data integration but without overloading the data-gathering and analysis capability (see guideline 20).

1.1.3 The sources of these data will be governmental but scattered amongst the responsible ministries. Cooperation and participation by these departments will be necessary if these essential data are to be included.

1.1.4 Although for the reasons outlined above socio-economic factors are considered first, this section does not necessarily have to be completed first. Collection of the data proposed below will be a long-term process that should be undertaken concurrently with the gathering of the biological data (section B). Moreover, the undertaking of section A should not be regarded as a major obstacle, since only those data that are readily available without further research should be included in the first version of the country study.

1.2 Human Population Demography

1.2.1 The effects of human settlement and activities are perhaps the most important factors in biodiversity planning. Tables and maps that can be easily integrated with the biological, economic and physical data are essential. The most important demographic factors will differ depending on the circumstances of individual countries, but the following list is likely to include most of the key parameters:

- population density and distribution (if possible, mapped at the district level)
- projections of population density and distribution in ten years' time (to identify districts of greatest predicted change)
- existing and projected growth rates
- age distribution
- gender distribution
- educational level (possibly adult literacy rate, or proportion of 16-year-old children still attending secondary school)

- health (possibly number of medical dispensaries or qualified medical practitioners per thousand population at the district level)
- relative proportion of urban/rural population
- size and pattern of human settlements
- population migrations, including seasonal movements, both historical and current

1.2.2 Particular attention should be given to gathering data on indigenous peoples and minority ethnic groupings who are closely associated with biological resources, such as forest dwelling peoples. Such data should include:

- population density and distribution, including, where relevant, maps of ethnic areas
- seasonal movements and migrations
- level of dependence upon wild biological resources possibly percentage of subsistence requirements that are gathered from the wild)
- identification of key resource use areas or cultural sites

1.3 Infrastructure Development

1.3.1 Development of the infrastructure of a country can profoundly affect biological diversity. The initial construction of the transport network, for example, can open up new areas for human settlement and uncontrolled resource use. The effects of damming streams for water supply or rivers for hydro-electric power can be widespread and long-lasting, causing not least the displacement of resident peoples. All infrastructure development should be subject to a comprehensive environmental impact assessment, in accordance with Article 14 of the Convention on Biological Diversity, and such assessments must include the indirect knock-on effect on biodiversity which may be experienced a considerable distance from the location of the development itself (see subsection 6.2.1 on external threats to biological diversity).

1.3.2 Data presentation should focus on existing and proposed infrastructure elements, and whenever possible should be mapped at an appropriate scale for integration with other types of biological and economic data:

- existing transport network, including density and pattern by type, particularly road and rail
- projected extension of the transport network over the next 10 years, including possible new roads into forest logging or mining concession areas
- descriptive text on current and projected impacts

1.4 Land Tenure and Property Rights

1.4.1 Land tenure and the rights of access to natural resources vary greatly according to national legislation. The issue of resource ownership is, however, fundamental to sustainable use - it is unrealistic to expect an individual or community with no long-term tenure or legally-backed rights of access to manage the resources they use on a sustainable basis. Sustainable use necessitates sustainable rights to use or there is no incentive for enlightened management.

1.4.2 For many natural resources and ecological services it is impossible to define individual property rights: for example, the global climate has open access to all humanity. Where property rights can be identified, these should be recorded as private, communal or State-owned. The relative proportions of these categories of ownership will vary between countries according to specific social, economic and

political circumstances. The important consideration in analysing property rights is to assess the extent to which the current pattern precludes sustainable resource use or jeopardizes the maintenance of essential ecological services.

1.4.3 The parameters for data collection must be adjusted depending upon national policies and legislation, but a basic data set should include:

- map of land ownership and resource use rights at an appropriate scale - this should differentiate State land, district authority ownership, tribal lands, commercial corporate ownership, local community use, private land holdings, and land used by indigenous peoples
- table of attributes describing the rights applying to each tract identified on the map - it is recognized that there may be multiple ownership for some tracts
- ownership of marine and freshwater aquatic resources
- map and attribute-table of land illegally occupied or resource rights illegally exploited
- map and attribute-table of mining rights, logging concessions in natural forests, or marine fishing rights

1.5 Economic Factors

1.5.1 This subsection is concerned primarily with economic factors at the community or individual level, particularly in rural situations. The intention is to identify a range of factors that may indicate dependence, and thus impact, upon biological diversity or the extent to which the individual is cushioned by income generated from employment or agricultural production. Some economic factors can be mapped at the province or district level: a spatial representation of these factors can be useful in conservation and development planning.

- per capita annual income (translated into United States dollars)
- employment statistics
- value of annual agricultural production, excluding domestic consumption (United States dollars)
- yield per effort of harvesting wild stocks (hunting, honey, fisheries, etc.)
- income derived from tourism and other non-agricultural activities.

1.6 Cultural Factors

1.6.1 Cultural factors can play a significant role in use of biological diversity and the conversion of land to agriculture, having a major effect upon the appearance of the landscape. Such factors may include the preservation of sacred groves of trees, constraints on the killing of wild animals, or social practices that may impact the carrying capacity of grazing land, such as cattle ownership and social status, and the use of cattle as a dowry.

1.6.2 Such cultural information must usually be presented as descriptive text, but with accompanying analytical figures and graphs. However, maps showing the geographical extent of such practices would assist planning.

1.7 Government Policy

1.7.1 National policies and international agreements can have formulative impacts upon biological diversity. Governments have the potential to exert a major positive influence, but usually through a lack of appreciation of the knock-on effects of their policies, their impact is more often negative. Such failures generally arise from

policy interventions designed to address a short-term need but which in the long term work against the conservation of biological diversity.

1.7.2 Policies and programmes initiated by different ministries can have an exacerbating effect when taken together, often generating unforeseen knock-on effects. For example, an international trade agreement, such as the General Agreement on Tariffs and Trade (GATT), may restrict government subsidies for the production of an agricultural crop, leading to a change in the commodity price, resulting in turn in a change in land-use with direct impact upon biological diversity. The practice of direct intervention in agricultural prices, including production subsidies and guaranteed markets, creates a situation in which intensified production is rewarded, often causing considerable environmental damage. Such policies preclude biodiversity conservation by promoting monoculture systems with a loss of genetic and species diversity. Government subsidies that encourage the excessive use of fertilizers and pesticides, the drainage of wetlands, or the afforestation of uplands with monoculture conifers all further deplete the diversity of landscapes.

1.7.3 A variety of economic and social policies initiated by Governments can affect biological diversity, and a number of macro-economic factors, such as national fiscal policy, trade agreements and subsidies for resource use, that lie outside the mandate of those sectors of government traditionally responsible for the management of natural resources are recognized as the ultimate factors driving biodiversity loss (see paragraph 6.2.1 of section B below). The potential impacts of such policies must be analysed and remedial actions proposed as part of the process of preparing national biodiversity strategies and action plans. Inevitably such information will be presented in text form.

1.8 International Conventions and Agreements

1.8.1 Most countries are parties to a number of international legal agreements which may have a formulative influence upon national policies and legislation. Such agreements usually cover economic or social issues at the regional or global level and are designed to foster improved international cooperation. Although not explicitly environmentally oriented, such instruments can have a profound indirect impact on biological diversity. For example, agreements relating to international trade, import tariffs, or commodity prices can have a direct effect upon agricultural practices and thus upon biological diversity.

1.8.2 An increasing number of agreements also have an explicit environmental component. Conventions for the regional management of oceans, the joint management of shared water-bodies, and the allocation of marine fisheries quotas all have direct biodiversity implications, as do the recently negotiated accords for ozone depletion and climate change. Paragraphs 3.5.2, 5.9.1 and 5.10.1 refer to agreements that require contracting parties to designate specific sites for biodiversity conservation.

1.8.3 All conventions and agreements to which the country is party should be assessed to identify possible impacts on biological diversity, even when the subject of the agreements seems far removed from conservation. For each listed instrument, the following information should be provided:

- date of signing and ratification
- date of last report
- responsible government department

- financial contribution, if any
- summary of implementation actions taken (such as a national action plan)
- summary of implementation actions planned
- possible consequences of these actions on biological diversity

Lists of this sort can provide the first step towards improved inter-departmental communication and the recognition of ministerial responsibilities in developing unified policies.

SECTION B: BIOLOGICAL DATA GATHERING

2 LAND-USE AND AQUATIC RESOURCES

2.1 Resource use policies have a very significant impact on a country's ability to conserve its natural resources, and to develop programmes for the sustainable utilization of these resources. Nowhere is this more apparent than within the **agriculture**, **forestry**, and **fisheries** sectors. This section addresses the issues of land-use in the wider countryside, and where relevant, resource use within coastal waters and large lakes.

2.2 The first part of this subsection deals with the preparation of national land-/sea-use maps. The rest of the section is divided into three components covering agriculture, forestry and fisheries, reflecting the different government departments that are likely to be responsible for gathering the data. As proposed in guideline 2, it is envisaged that the institutional arrangements for compiling the land-use data must be sectoral, with the NBU providing coordination and integration.

2.3 Land-use Mapping

2.3.1 Using the land-use classification system adopted in-country, a map can be prepared showing the current distribution of the main land-use types. If possible, these data should be digitised for further GIS analysis. For some countries, maps of land capability have also been developed, which can help in the assessment of the likely future expansion of different categories of land-use.

2.3.2 If possible the national land-use classification should be cross-related to an international classification to facilitate analysis at the regional level. In fact national Governments already provide land-use information to the Food and Agriculture Organization of the United Nations (FAO) on an annual basis using the classification outlined in box 2.1.

2.3.3 In addition to the categories identified in box 2.1, areas of particular social or cultural significance, such as sacred groves or ancestral sites, should also be identified when the social influence has a formulative effect upon the land cover. In addition, areas of agriculture and forestry that are regarded by the country as being managed under sustainable practices (that is, the productivity of the resource-base is not being eroded over the long-term) should also be delineated.

Box 2.1 **FAO Land-use Analysis**

FAO compiles statistics on land-use adopting the following categories, which are defined in the *FAO Production Yearbook*:

- arable land
- land under permanent crops
- permanent meadows and pastures
- forests and woodland
- other land

2.3.4 Using information from land-use maps, a table can be prepared showing the area of each land-use type and the percentage coverage of the country's land area. An example table showing a possible format for presenting land-use data is outlined below.

2.3.5 In this table, column (b) shows the land-use categories recognized in-country. If possible, these should then be allocated in column (a) to the major use categories adopted by FAO. Column (e) is a subjective measure of the likely quality or condition of biological diversity in the land-use category. This measure will be a qualitative assessment of the level of disturbance or loss of wild biological diversity within the land-use type and will be recorded as:

- high (biological diversity relatively intact)
- medium (moderate disturbance)
- low (extensive loss).

Example Table: Land-Use

(a) Major Use Category (after FAO)	(b) In-country Land-use Classification	(c) Land Area (km^2)	(d) % of Total Land Area	(e) Biodiversity Quality of Land-use Category	(f) % Rate of Change	
					Last 10 years	Projected next 10 years
Arable land						
Land under permanent crops						
Permanent meadows and pastures						

2.3.6 Column (f) shows the rate of change of the land use over the previous decade, and predicted rates of change over the coming ten years. If possible, a map should be prepared of the likely land use in 10 years' time, which from comparison with the current land-use map will show areas where change is most probable. The implications for biological diversity in these areas must be assessed as part of the strategic planning process. It is appreciated that most countries will have little scientific basis on which to make such predictions, which therefore will often be no more than educated guesses: the purpose is, however, to identify those areas where a threat to biological diversity arising from a change in land use is more likely.

2.4 Mapping of Marine and Freshwater Resource Uses

2.4.1 Mapping of aquatic resource use is more complex, as a given area can have a greater variety of uses than is possible at one time on land. Using available resources, a map should be drawn up which identifies the areas used for different

activities taking place in the marine sector, or in large lakes, including fisheries, aquaculture, transport, recreation, dumping, and so on. Maps could also be compiled to identify how these patterns have changed over the previous 10 years, and how they are likely to change over the next 10 years. These maps would then be used in conjunction with information on natural habitats (see subsection 3 below). Separate maps should be prepared for marine and freshwater resource use, and each large water-body should be mapped independently.

2.4.2 It is appreciated that for many countries information on aquatic resource use of sufficient detail for mapping may not be available. In accordance with guidelines 5 and 20, countries should furnish whatever data they have readily available, and must not feel obligated to commission new data collection unless this is regarded as a priority action in the national biodiversity strategy. The advantage of presenting the data, if available, in map form is that it enables statistical information to be derived on the area of each use or multiple use in preparation for ascribing economic values (see section C below).

2.5 Agriculture/Livestock

2.5.1 The land-use maps developed under subsection 2.3 will include a significant amount of information compiled by the relevant government departments about the areas of the country dedicated to agricultural and livestock production. The present subsection describes in a little more detail how some of this information might be compiled. Livestock is defined as all domesticated live animals and birds.

2.5.2 Analysis of the impact of agriculture upon biological diversity requires information on the following:

- crop type
- method of production
- intensity of production
- likely changes in patterns of production over the next 10 years
- extent of use of fertilizers
- extent of use of herbicides and pesticides
- practices for the eradication of weeds and invasive species
- agricultural practices sited in localities that are ecologically unsuitable

2.5.3 Analysis of the biodiversity impact of livestock production requires information on:

- stocking densities
- degree of control of stock movement
- disease control measures
- degree of "improvement" of pasture
- likely changes over the next 10 years

2.5.4 Information on the direct agricultural use of biodiversity is also required on the following:

- extensive ranching and harvesting of wild game species (game-ranching operations)
- intensive domestication of wild game species (such as deer farming operations)
- development of new types of agricultural crops using species from the wild
- breeding of new varieties of livestock or agricultural crops using genetic materials from wild species

2.5.5 To provide information for the preparation of national biodiversity strategies and action plans, it is necessary:

- to assess the level of research on the impact of agricultural and livestock production
- to identify whether methods could be modified to reduce the biodiversity impact
- to identify the costs of improving research and changing methods

2.6 Forestry

2.6.1 The land-use maps described in subsection 2.3 above will include a significant amount of information about the areas of the country under forest, but will not necessarily indicate either the origin of that forest or management objectives. Forestry departments may have the information available to compile maps which for each forest block will furnish the information required in the example table below. Such detailed analysis may be regarded as low priority.

Example Table: Forest Analysis

(a) Forest Block Identification	(b) Forest Type	(c) Area of Block (km^2)	(d) Ownership	(e) Forest Use	(f) Date of Last Logging (if relevant)	(g) Date of Next Logging (if relevant)

2.6.2 In this table, column (b) shows the type of forest following the in-country national forest classification system, but including plantation as a category. Column (d) shows the broad category of forest ownership, and can be recorded as private individual, communal or State ownership. Column (e) indicates the likely use the forest, which may be for production, protection or conservation functions as defined in box 2.2. With date of logging (f/g), it is also important to include the extent of logging (complete, partial, selective). Completion of columns (f) and (g) is of lower priority, and should be attempted only if the data are readily available.

Box 2.2 FAO Definitions of Forest Function

These definitions have been used in the FAO Forest Resources Assessment 1990, and by the World Conservation Monitoring Centre in their review of the value of reserves in the forestry sector for nature conservation.

Production forests	Areas which support sustained production of wood
Protection forests	Areas, other than conservation forests, which in practice cannot support sustained wood production because the terrain is unsuitable (e.g. too steep or rugged, subject to flooding), but where maintaining forest cover is desirable for protection reasons (e.g. erosion control, watershed management)
Conservation forests	Areas designated for nature conservation

2.6.3 Analysis of the impact of forestry on biological diversity (as required in the first example table in Section 2.3.4) requires information on the forest function, and where relevant the logging regime. Other silvicultural treatments that might impact biodiversity, such as the planting of exotic species and scrub clearance, should also be noted.

2.6.4 To provide information for the preparation of national biodiversity strategies and action plans, it is necessary:

- to assess the level of research on forestry and forestry techniques, and their impact on biological diversity
- to identify whether methods could be modified to reduce environmental impact
- to identify the costs of improving research and changing methods

2.6.5 Where appropriate, countries should also provide information on national programmes undertaken relating to the Tropical Forestry Action Plan, the International Tropical Timber Organization, the UNCED Statement of Forest Principles and other international forest agreements. Such information should comprise actions planned or implemented, including national action plans, and their likely effect on biological diversity. The information should also indicate whether the actions have included a biodiversity impact assessment.

2.7 Fisheries

2.7.1 The present subsection covers activities and products derived from fish, crustaceans, molluscs and other aquatic animals, residues (e.g. guano), and plants utilized for industrial, commercial or subsistence purposes from freshwater and marine areas and intermediary zones. This definition corresponds to that used by FAO in its *Yearbook of Fisheries Statistics* and the *International Standard Statistical Classification of Fisheries Commodities* (ISSCFC). National statistics are already compiled under these auspices and comprise two basic types of data:

(a) Catch and landing data:

- list of species or genera of marine fish caught per annum (metric tons)
- list of species or genera of freshwater fish caught per annum (metric tons)
- list of crustacea and molluscs taken per annum (metric tons)
- numbers and species of marine mammals caught per annum (both deliberate and accidental)
- sponges and corals taken per annum (kilogrammes)

Catch data refer to "nominal catch" (live weight) which in many cases is the same as landed weight, but, if fish are gutted at sea, the weights should be converted to live weight equivalents using conversion factors.

(b) Fisheries commodities:

Data on the volumes of products derived from fisheries activities should be provided, particularly where it can be used to assess the value of these resources in trade. Much of this information is already compiled by FAO, and the gathering of additional information should be confined only to data of potential value for economic analyses.

2.7.2 The information furnished by these statistics is insufficient for biodiversity planning and monitoring purposes as it does not provide a direct measure of the status of the fisheries resource itself. Additional information more relevant to the concerns of

biodiversity conservation and sustainable use is identified in the following paragraphs.

2.7.3 Using the current in-country system of defining fisheries, both marine and freshwater, by region, a map should be prepared showing the distribution of the main fisheries. Attached to this, a table can be compiled showing the size, location and total area of each fishery. Information on threats to fisheries areas should also be included, together with information about other potentially conflicting uses. Internationally shared fisheries should also be included in this analysis with the allocation of quotas between countries. An example table is outlined below.

Example Table: Fisheries Areas

(a) Name of Fishery	(b) Location	(c) Area (km^2)	(d) Total Catch per annum (in tons)	(e) Proportion Subsistence, Commercial, or Sport (%)	(f) Threats	(g) Comments and Conflicting Uses

2.7.4 For each fishery area, a breakdown is needed of the species (or genera) taken. If available, the catch data should be presented over a wide time interval to assess the trend in take. Data should also be provided on the use of each species in subsistence, commercial or sport fishing, together with information on the method of take. An example table is outlined below.

Example Table: Breakdown of each Fishery Area

(a) Name of Fishery	(b) Species Taken	(c) Annual Catch (m ton)		(d) Trend in Take	(e) Method of Take	(f) Subsistence, Commercial, or Sport Use (%)	(g) Comments
		This Year	Previous				

2.7.5 Analysis of the impact of fisheries on biological diversity requires information on the following factors:

- target species - what are they, and are other non-target species affected?
- fishing method - how specific is it to the target species: does it impinge on other species or cause habitat damage?

- fish stocks - have estimates been made of the size and productivity of the stocks of each target species: does the target species migrate outside territorial jurisdiction?
- intensity of harvesting - has the maximum sustainable yield been set for each target species: is the species harvested by other nations, in which case is there a quota system in place?
- indicators of over-fishing - is the size class of fish caught diminishing: is the turnover in target species accelerating: is the total catch declining?
- restocking activities - are programmes in place or under consideration to restock freshwater fisheries: is the fishery being restocked with indigenous or exotic species: if exotic, has an environmental impact assessment been undertaken?

2.7.6 Habitat changes can also profoundly affect fisheries yields, and these need to be documented. Siltation from deforestation or chemical pollution from land-based industries can impact spawning grounds; clearance of mangroves can devastate in-shore fish yields; discharge of herbicides and agricultural fertilizers can impact enclosed water bodies; domestic sewage may carry pathogens that can contaminate shellfish industries. An assessment of the threats, including over-exploitation and competing uses, must be undertaken of each fishery area.

2.7.7 Where appropriate, countries should also provide information on national programmes or activities undertaken relating to international and regional agreements for regulating the exploitation of marine resources. Such agreements might include the International Convention for the Regulation of Whaling, the UNEP regional seas conventions, or other regional fish quota systems. Information should be provided concerning the quotas agreed, the actual catch, and measures taken to implement the agreement.

2.7.8 Two further important factors must be considered in assessing the impact of fisheries upon biological diversity:

(a) Aquaculture:
Over the next 10 years, the proportion of the world fisheries catch from aquaculture production is expected to increase from 15% to 33%. The freshwater culture of carp and other cyprinid fish is the main component, but production of salmon, shrimps, prawns and oysters is escalating. The commercial incentives for certain mariculture activities can pose significant threats to coastal ecosystems - for example, the replacement of mangrove forests with holding ponds for shrimp production. The proportion of the total fisheries production derived from aquaculture/mariculture must be assessed, and the effects on biological diversity monitored.

(b) Oceanic fisheries
More than 400 species of commercial fishing interest are considered to be high seas or oceanic, and outside the jurisdiction of national Governments. These resources are increasingly under pressure from long-range fleets, particularly through pelagic drift-netting using monofilament gill-nets. Statistics should be presented for the landings of oceanic catches, including the method of harvesting, which must, where possible, be differentiated from catch data from territorial waters.

3 HABITATS AND BIODIVERSITY SERVICES

3.1 General Considerations

3.1.1 Habitat loss and modification are the principal factors in the decline of global biodiversity. Of all the animal species recognized as being threatened with extinction at the regional level, some 76% are threatened by habitat loss or modification. The primary causes of habitat loss are (in diminishing order of importance) cultivation and settlement, pastoral development, logging and plantations, fire, and pollution. Monitoring habitats is fundamental to understanding the dynamics of biodiversity loss.

3.1.2 However, habitat monitoring is not just a simple matter of recording the rate of loss or gain of area: a number of parameters are needed to acquire an adequate insight into the problem:

- change in the geographical area of the habitat
- change in the condition or state of the habitat
- habitat fragmentation

3.1.3 The problem of habitat monitoring is exacerbated by the absence of an internationally accepted habitat or ecosystem classification at a scale appropriate for national biodiversity management. Most attempts at generating a classification system use a combination of general definitions of habitat type with a climatic descriptor (e.g. "tropical moist forest" or "temperate grassland") which may have little relevance at the country level. In addition, ecosystem mapping must take into account human impact on the landscape. For biodiversity monitoring, a realistic contemporary map of land-cover types is required rather than a potential vegetation map derived from an analysis of climate, soil type and other environmental variables, which is independent of human activities on the landscape.

3.1.4 For biodiversity planning purposes, habitat can be represented by the actual land-cover vegetation type. The present subsection therefore focuses upon natural vegetation cover. However, although this may be adequate for extensive habitat types such as forest or grassland, it cannot incorporate the physical and biotic characteristics of the coastal and marine habitat, nor of wetlands which are often not shown on vegetation maps. These two habitat types therefore receive separate consideration.

3.1.5 Vegetation and habitat maps should be used in conjunction with other environmental and natural resource maps covering such parameters as geology, soil, geomorphology, climate and land use to identify areas of potential biodiversity interest for ground survey. The criteria for defining ecologically sensitive areas presented in box 3.1 should be incorporated in such assessments.

3.1.6 A useful approach that lends itself to economic analysis is to classify and map the land surface on the basis of its ecosystem service value or benefit, recognizing such categories as watershed catchment areas, production forests, wildlife management/ hunting areas, erosion control, nursery grounds for commercial fish species, and so on. The criteria for ecologically sensitive habitats can be included in this functional classification system. This approach is expanded in subsection 3.6 below.

3.1.7 The capability of countries to prepare vegetation and land-use maps will be enhanced through the greater availability of satellite imaging at affordable prices. For countries that currently do not have the facilities to interpret remote-sensing

data for monitoring and planning purposes, consideration should be given to the transfer of such technologies and skills as part of the process of capacity-building under the Convention on Biological Diversity.

Box 3.1 **Ecologically Sensitive Areas**

Habitats can be considered ecologically sensitive areas if they:

- provide protection of steep slopes, especially in watershed areas, against erosion
- support important natural vegetation on soils of inherently low productivity that would yield little of value to human communities if transformed
- regulate and purify water flow (as valley forests and wetlands often do)
- provide conditions essential for the perpetuation of species of medicinal and genetic conservation value
- maintain conditions vital for the perpetuation of species that enhance the attractiveness of the landscape or the viability of protected areas
- provide critical habitat that threatened species use for breeding, feeding, or staging

Conserving the World's Biodiversity. IUCN, WRI, CI, WWF-US, and the World Bank 1990.

3.1.8 For each of the subsections below, maps should be produced to accompany the tables. If possible, these maps should be digitized to allow for more detailed GIS analysis, and to facilitate the overlay of information derived from remote sensing. Definitions of the criteria used in the classification and mapping must also be provided to facilitate the development of regional syntheses.

3.2 Physical Correlates of Habitat

3.2.1 Using existing surveys and other sources of information, comparable maps of the following parameters should be provided:

- surface geology
- soil type or structure
- meteorology (temperature and rainfall profiles by month)
- topography (contour maps or digital elevation models)
- hydrology (particularly surface water features, whether permanent, temporary or ephemeral)

3.2.2 In the absence of national vegetation or habitat maps, these parameters can be used, in conjunction with the land-use maps described in subsection 2.3 above, to predict vegetation type and distribution. Such inferred vegetation maps can then be analysed in the same way as actual vegetation maps referred to in subsection 3.3 below. These same parameters, used as GIS "layers", can also contribute to the analysis of species distributions.

3.3 Natural Vegetation

3.3.1 The effort to define and map vegetation is a struggle of the mind against the chaos of nature. Vegetation does not consist of the neat units seen on a map but, instead, of gradients and mosaics at whatever scale you look.

3.3.2 Most countries have undertaken vegetation surveys and have produced maps, although the classification system adopted is likely to be unique to that country. This incompatibility of national classification methods makes the synthesis of inter-country regional overviews extremely difficult. Country-specific assessments are clearly appropriate for national conservation planning, but increasingly such country analyses need evaluating at the regional level to develop a coordinated strategy for identifying priorities and investment decisions between countries. As stressed in guideline 9, the primary goal of the country study is to identify national needs and priorities, so developing international compatibility is a secondary requirement to be undertaken only if the resources permit.

3.3.3 The responsibility for developing such regional classification systems lies with the international agencies, working in close collaboration with the countries concerned. Several regional or global vegetation schemes have been produced, but for a variety of reasons no one scheme has been universally adopted that can be used at both the international and in-country scales. The urgency of preparing such a system is stressed if the country studies are to promote data exchange, networking, and the synthesis of regional assessments.

3.3.4 Using the classification system adopted in-country, maps should be prepared of the current geographical distribution of the main vegetation types. From this, a table can be derived showing the area of each vegetation type (km^2), percentage coverage of total area of country, and percentage of each vegetation type that is protected by national parks or other conservation areas. An example table showing a possible format for presenting natural vegetation data is outlined below.

Example Table - Natural Vegetation Cover

(a) Major Habitat Category	(b) In-country Vegetation Classification	(c) Area (km^2)	(d) % of Total Country Area	(e) % within Protected Areas	(f) Biodiversity Quality of Remaining Vegetation	(g) % Change of Area	
						Recorded History	Last 10 Years
Forest	Low Rainforest						
	Dry Deciduous						
Wood							

3.3.5 In this table, column (b) shows the vegetation classification used in-country. Column (a) cannot be completed until a standard global vegetation scheme has been developed and adopted. Some countries may, however, be able to merge their national classification units into broader categories (such as forest, wood, grass etc.). In such cases, the criteria used for defining the categories must be presented. Column (f) is a subjective measure of the quality of the remaining vegetation compared to its original pristine condition and should be recorded as high/medium/low, reflecting vegetation that is still relatively natural/disturbed/degraded. Column (g) shows the percentage loss of area of the vegetation type during recorded history and over the previous 10 years.

3.3.6 The map of current natural vegetation should also identify the location of ecologically sensitive areas. The broad stages involved in the identification process are set out in box 3.2.

Box 3.2 Identifying Ecologically Sensitive Areas

Each country will need to design its own approach to identify its ecologically sensitive areas (ESAs). The following general steps may provide a useful foundation.

Step 1. Evaluate patterns of habitats and vegetation, soils, mineral resources, topography, rivers and other hydrological features, climate, current land use, ethnic groups, and population density.

Step 2. Establish criteria for identifying ESAs and for providing objective guidelines on appropriate management regimes.

Step 3. Based on the criteria established, identify especially vulnerable locations, areas of high biological diversity, and areas of high economic value in the natural state.

Step 4. Prepare a national strategy for conserving ESAs, including establishing national objectives, identifying economic relationships, designing any necessary legislation, and assigning institutional responsibility for the ESAs.

Conserving the World's Biodiversity. IUCN, WRI, CI, WWF-US, and the World Bank 1990.

3.3.7 A fundamental consideration in monitoring habitat change is the issue of fragmentation. From the vegetation map, data can be derived showing the number of habitat patches and the percentage of the total habitat area in the four patch sizes of less than 10km^2, 10-100km^2, 100-1000km^2, and greater than 1000km^2.

3.3.8 The above example table calls for historical data on the rate of change of the habitat area over the last decade. Of equal importance is the predicted rate of change under current circumstances over the next 10 years. Clearly such prediction must be speculative, but it can be based on an extrapolation of recent change tempered by an intelligent insight into the socio-economic and demographic factors that underlie such change. A map showing the likely areas of habitat loss, gain and fragmentation, although obviously subjective, would contribute to the national strategy and action plan by focusing attention upon specific localities.

3.3.9 Certain azonal habitats, such as cliffs and cave systems, do not lend themselves to mapping as vegetation types, although they do provide important ecosystem

diversity. Such areas should be listed separately but cross-referenced to the map by use of symbols.

3.3.10 As part of the planning process, countries will need to identify the cause of loss of each habitat type which must be addressed in their national biodiversity strategy. To facilitate this process, a section on threats and their mitigation has been prepared as part of this technical annex (subsection 6 below).

3.4 Coastal and Marine Habitats

3.4.1 To monitor coastal ecosystems effectively, it is necessary to include both physical and biotic characteristics. A range of classifications are available, and a simplified version of one of these is provided in box 3.3

Box 3.3 Classification of Coastal/Marine Habitats

Coastal environments
- sedimentary features
- rocky/cliffed features
- bay
- riverine outlets
- brackish lagoon
- intertidal mud/sand flats
- coastal dunes
- coastal plain
- ice features

Living reefs
- coral reefs
- other living reefs

Offshore environments
- island
- continental shelf (soft bottom)
- continental shelf (hard bottom)
- oceanic ridges and rises
- deep ocean floor
- ice features

Coast-associated habitats
- algal and sea grass beds
- salt marsh and salina
- mangroves or swamp forests
- coastal grass/scrubland
- coastal forest/woodland

3.4.2 Using existing surveys and other sources of biogeographical information, maps of the known distribution of coastal features should be compiled. They can then be overlaid with information on water movement features such as eddies, currents and upwellings, and on critical habitats for species.

3.4.3 These maps should then be enhanced with information on land and resource use, including protected areas, settlements, transportation corridors, etc., in order to assess:
- naturalness of remaining features
- degree of protection
- potential threats to biological diversity

3.4.4 A derivative table of these coastal habitats should then be constructed from the maps providing baseline data on:
- area of each habitat (km^2)
- proportion of total coastal/inshore marine area (%)
- proportion of each habitat type protected by national parks or other conservation areas (%)
- biodiversity quality of habitat (see subsection 3.3.5)
- threats to habitat type (see subsection 6)
- rates of change of habitat over last decade (%)

3.4.5 In addition, some assessment must be made in the rates of change in the patterns of resource use, and of the actions that need to be undertaken to ensure efficient use of the available resources, while maintaining the ecosystem services (see subsection 3.6).

3.5 Wetlands

3.5.1 Wetlands serve a variety of functions, including flood control, water purification, shoreline stabilization, and providing support for vast numbers of fish and other wildlife on which many local communities or export markets depend. Information on wetlands is therefore fundamentally significant for the improved management and sustainable use of biological diversity.

3.5.2 Some 70 countries are contracting parties to the *Convention on Wetlands of International Importance especially as Waterfowl Habitat*, also known as the Convention on Wetlands, or the Ramsar Convention. Governments which become party to the Convention undertake to:

- designate at least one wetland for inclusion in the List of Wetlands of International Importance
- promote the wise use of wetlands
- consult with each other about implementing obligations arising from the Convention, especially in the case of a shared wetland or water system
- create wetland reserves
- include wetland conservation considerations in land-use planning

3.5.3 Although some countries may have reservations about ratifying the Ramsar Convention, it is urged that they should give serious consideration to implementing the above minimum requirements. Many countries have carried out wetlands surveys, often in consultation with the Ramsar Convention Bureau and with organizations working closely with the Bureau, such as the World Conservation Union (IUCN) and the International Waterfowl and Wetlands Research Bureau. One of the most useful products of such a survey is a map of wetlands distribution within the country, with wetlands classified according to some standard system, such as that adopted by the parties to the Ramsar Convention (box 3.4).

3.5.4 If information on the distribution of wetlands is combined with further information on the species found within the wetlands, human use, threat of ecological change, and management, this will provide the basis for planning at the site level. Compilations of this information at the national level will provide the basis for the formulation of a wetlands policy, and the means to review implementation of that policy.

3.6 Biodiversity Services

3.6.1 A functional land surface classification system that identifies the ecosystem "service" functions provided by natural and semi-natural areas should be developed. Box 3.5 lists a range of categories of "biodiversity services" which countries may wish to extend in the light of their own interpretations of the values of their ecosystems.

3.6.2 A biodiversity services map, using the same scale and projection as the vegetation and land-use maps, should be prepared showing the geographical distribution of areas where each of these functional categories are applicable. The list in box 3.5

Box 3.4 Classification System for "Wetland Type"

Marine and coastal wetlands
- shallow marine waters
- subtidal aquatic beds
- coral reefs
- rocky marine shores
- sand/shingle beaches
- estuarine waters
- intertidal mudflats
- salt marshes
- mangrove/tidal forest
- brackish/saline lagoons
- freshwater lagoons/marshes

Inland waters
- permanent rivers/streams
- seasonal/irregular rivers/streams
- inland deltas
- riverine floodplains
- permanent freshwater lakes
- seasonal freshwater lakes
- saline lakes/marshes
- freshwater ponds/marshes

Seasonal freshwater ponds/marshes
- shrub swamps
- freshwater swamp forest
- peatlands
- forested peatlands
- alpine/tundra wetlands
- freshwater springs
- geothermal wetlands

Artificial wetlands
- water storage areas
- farm ponds, small tanks
- aquaculture ponds
- salt pans, salinas
- excavations
- wastewater treatment
- irrigated land, rice fields
- seasonally flooded arable land

Box 3.5 Categories of Biodiversity Services

Functional categories of land management that depend on biodiversity to provide economic values, and which could be mapped include:
- watershed management area
- game management area
- extractive forest reserve
- soil erosion control area
- fresh-water fisheries area
- coastal protection zone
- fish spawning area
- riparian protection zone
- tourism/recreation
- nature conservation area
- agroforestry
- flood control
- salinity, sediment and/or toxicant removal
- migratory bird habitat
- species protection area
- genetic material repository
- scientific research area
- education area
- other services as identified in-country

is not intended to be exhaustive, and countries may need to identify specific biodiversity services that are provided by maintaining an area under the natural or semi-natural vegetative cover. In addition the same area is likely to have several functions: as far as possible the dominant service should be mapped with composite categories only in cases of equal importance, although subsidiary uses should be listed in the derivative table.

3.6.3 From this map, a table could be prepared showing the total area of each category, its percentage of the total land of the country, and the percentage covered by protected areas. As part of the assessment of economic benefits, it may be possible

to ascribe a monetary value (dollars/km^2) to these functional categories, based on the replacement cost of the service provided (see section C). The first step, to be completed in this part of the country study, is to identify and map the functional service values of the nation's natural habitats.

4 SPECIES, POPULATIONS AND GENETIC DIVERSITY

4.1 General Considerations

4.1.1 The present subsection considers the data requirements for planning and managing the conservation and sustainable use of individual species, populations and genetic resources. Realistic estimates suggest that there may be somewhere between three and ten million, and possibly as many as thirty million, species on Earth, of which some 1.7 million have been described by science. Compiling comprehensive information on all species would be a massive task and must be focused and assigned appropriate priorities if the country studies are to be productive.

4.1.2 It is essential that these priorities are clearly identified before the task of compiling species data is begun. This requirement, stressed in guidelines 7 and 20, applies generically throughout the data-gathering process for all sections of the country study, but is particularly critical for the species data. The list of general priorities presented in box 3.1 of the guidelines (p.11 above) should be used as the starting point for countries to determine their own species data requirements.

4.1.3 Comprehensive inventories covering every species in a country, especially a country with a diversity of tropical habitats, are time-consuming and probably unnecessary. However, countries should be prepared, over a relaxed timescale and as the necessary resources become available, to invest in the survey and research necessary to build a solid foundation of knowledge about their national species diversity. Clearly, this information is needed to quantify the biological assets of a country, to determine priorities for monitoring, to identify likely candidate species for genetic prospecting, and to assess the biological richness of the nation. However, as stressed in guideline 4, the country study is an incremental process, based upon a steadily expanding knowledge base, as additional data are acquired through the identification of priority gaps in the information.

4.1.4 The first iteration of the country study should assess the availability of information on all groups of species, including relevant information on status if this is readily accessible. If a focus is required within this in the first iteration or in subsequent priority setting, the following groups of species are suggested:

- species that are recognized as being threatened with extinction at the national and regional levels
- country-endemic species
- species that are of social or economic value for subsistence use at the community level or for commercial exploitation at the national and international levels
- flagship species that can serve to generate support for conservation action from which much broader components of biological diversity would benefit
- indicator or keystone species that can serve as a measure of ecosystem disturbance or condition
- landraces, varieties and wild ancestors of domesticated species for which action cannot be delayed if genetic diversity is to be conserved
- species already protected within conservation areas

- species held in *ex situ* collections within the country
- species that are the subject of national legislation and international conventions to which the country is a contracting party

4.1.5 Obviously the availability and quality of the data will vary considerably between different taxa and different countries. For most countries, data on the status and distribution of mammals and birds are reasonably complete, and for some species may include data on discrete populations (for example, in protected areas). National survey data on reptiles, amphibians, and particularly on fish, are likely to be incomplete, and an early decision must be taken on the priority to be assigned to a more intensive data search. Invertebrate data are likely to be confined to the more prominent species, such as butterflies and certain molluscs, whilst data on microorganisms will at best be confined to a few localities. A similar pattern will apply to plants, with the completeness of the data sets declining from higher to lower plant forms.

4.1.6 Countries should not be over-concerned about the patchiness of their species information for, as stressed in guideline 5, the first version of the country study should aim to include only those data that can be readily compiled, including those from out-of-country sources, without attempting a total coverage. The key issue is to use this initial data gathering exercise to determine the priorities for further research effort. These priorities should be incorporated in the national strategy and action plan.

4.1.7 The proposals for data gathering outlined below are separated into three sections:
- **national species information** to identify types of information on species that could be used to establish priorities for conserving biological diversity within the country. Information should be presented on freshwater and marine species as well as terrestrial
- **analyses** in the form of tables, reports and maps that focus on trends and rates of change, and which can serve to identify critical sites or areas
- ***ex situ* conservation measures** that need to be linked to field conservation initiatives

4.1.8 In each of the following subsections, the priority data parameters to be collected are shown **in bold italic typeface**. These then need to be cross-referenced with the priority species referred to in subsection 4.1.4 above to produce the minimum data requirement for species - for example, this minimum requirement will include data on the scientific and common names, conservation status, distribution, habitats used, trends in distribution, legislative cover, and economic significance of threatened species, country-specific endemics and other species types listed in subsection 4.1.4.

4.1.9 Data gathered on species should be incorporated into a database as part of the national biodiversity information management system to allow cross-referencing, easy updating and the storage of large numbers of data items, many of which will not be listed directly in the country study, but will contribute to the summary statistics that it contains.

4.2 National Species Information

4.2.1 What species occur?
- species ***name: scientific, common***, taxonomic authority, synonyms (where readily accessible)

- note to indicate taxonomy if this species is not included in a standard taxonomic publication

It is recommended that subspecies are only treated where there is some significant economic value or indigenous use. The rationale for this is that subspecific information can be added later, but would expand the scope of the work without corresponding benefits in the initial phases. For some groups of organisms, particularly plants, synonyms of species names are numerous and there is no published or centralised list: it is therefore recommended that only readily accessible synonyms are noted.

For some taxonomic groups, it will not be immediately obvious which species should be included. For instance, should marine mammals be included if they are present in coastal waters but do not breed there? The following definitions are provided for guidance; the underlying principle should be that where a list is produced, an appropriate qualification should be attached to make the contents of the list as explicit as possible. The first priority should be to include all species that breed within the country. For species that are not mobile, this is relatively straightforward, and will include all species occurring. It will be more complex for migratory or more mobile species such as birds and some mammals, which may spend part of the year within the national boundary and part elsewhere.

Highly mobile or migratory species should be identified separately. Information should be compiled on whether they breed or do not breed (i.e. over-winter within the country). If they are non-breeding, information should be included about the breeding grounds if this is known. For such species, two lists would therefore be compiled: first, a list of breeding species identified as full-time residents or migrants; and second, a list of non-breeding species that spend a significant part of the year within the country. Occasional vagrants, especially in the case of birds for which this is a common phenomenon, would be assigned low priority, since vagrants offer little opportunity for conservation action.

Information on microorganisms is also important, particularly soil organisms that contribute directly to sustainable agriculture and forestry. Priorities for data gathering must be clearly identified - there are an estimated 1.5 million species of fungi alone. Priorities should focus on microbes and soil organisms that are of direct benefit to human activities, and those that are held *ex situ* in microbial gene banks. Strains stored in culture collections should be documented, and information should be collected on the effectiveness with which natural habitats have been surveyed for microorganisms.

4.2.2 What is the conservation status of species in the country?

- ***conservation status (national and regional***; an international system of threat categories should be used such as the IUCN classification, or countries can use their own national system: whichever system is adopted, the method of assessing status must be identified)
- abundance/change in abundance
- exotic or native
- flagship, heritage or cultural significance

IUCN categories of threat have their principal application in assessing the global status of species. Their applicability nationally, and methods of linkage between

national and regional status may need separate attention. A comparable and related system may need to be developed for national purposes.

4.2.3 Where are they found?
- ***habitat types used by species*** linked to national classification system
- ***distribution***, focusing on country-endemic species, and incorporating localities from which they are recorded or a more generalized range map
- range of altitudes for priority species
- occurrence status (breeding, non-breeding etc.)
- ***trends in distribution***/recent changes

4.2.4 How are they protected?
- occurrence in *ex situ* institutions
- occurrence in protected areas
- ***level of protection under existing national species legislation*** (together with date of legislation) for priority species

4.2.5 How extensively are they used and for what purpose?
- ***economic significance***, including purpose/use (e.g. food, medicine, building, genetic resource value, forestry, agriculture, fisheries)
- volume/extent of use and trend
- cultural or heritage use
- levels of utilization (numbers of individuals per year or area exploited)
- levels of trade from customs statistics and permits issued under national legislation and international conventions (this would be summarized over a specified number of years)
- ***assessment of sustainability of use***

4.2.6 How are microorganisms furthering sustainable agricultural and forestry practices?
- areas where efficacious nitrogen-fixing strains of *Rhizobium* have been introduced to legume crops
- areas where natural nitrogen-fixation may have been enhanced by introduction of cyanobacterial inoculi e.g. improvement of cyanobacteria of *Azolla* for use in rice-fields
- use of bacteria and fungi as bio-control agents for insect pests, plant pathogens, disease vectors and invasive weeds
- existence of programmes for the inoculation of seedlings with mycorrhizal fungi

4.2.7 How well known are they?
- source and date of information acquired
- location/source of information if not directly accessible (e.g. indigenous knowledge of medicinal plants)
- bibliography
- directory of research
- key gaps in information

4.2.8 What would it cost to complete the gaps in information?
- priority to complete this information together with rationale for this priority
- costs of completing the information
- research and monitoring programmes

Example Table: National Species Diversity, Endemism and Status

Taxonomic Kingdoms	Major Taxonomic Groups	Total Number of Species		Number of Threatened Species		Endemic Species			National List	
		Known	Estimate	Nationally Threatened	Regionally Threatened	No.	% of Total	Number under Threat	Taxa List	Red List
ANIMALS Vertebrates	Mammals									
	Birds									
Invertebrates	Insects									
	Molluscs									
PLANTS	Flowering Plants									
	Ferns									

Data sources to table:

- taxonomic lists
- red lists
- others

References to taxonomy followed:

4.2.9 Some 118 countries are parties to the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). Although some countries may have reservations about ratifying the Convention, it is urged that they give serious consideration to monitoring the extent of their international trade in wildlife and its derivative products, particularly when species identified (e.g. by IUCN) as being globally threatened are involved. For the purposes of the Country Study, summary statistics should be provided as follows:

- volume of export trade by species or derivative product, summed for each year for the last five years
- financial value of this export trade, if known (expressed in United States dollars) for each species
- is the current level of trade in each species sustainable?
- have studies been undertaken to assess the sustainability of the trade in each species?

4.3 Analyses: Tables, Reports and Maps

4.3.1 Characterization of diversity and importance of species in the country

The number of species in each major taxonomic group should be compiled as a table. The taxonomic groups selected could be at class or family level, or could be tailored in some other way more appropriate to the country. For each major taxonomic group, the numbers threatened nationally and regionally would be included together with an indication of the extent of endemism for each group.

- total species (distinguish between known and projected numbers)
- existence of national list
- nature of total (count or estimate)
- date of total
- number of species regionally threatened
- number of species nationally threatened
- number endemic to country and proportion threatened (these must therefore be regionally threatened)
- reference to taxonomy followed

4.3.2 Threatened and declining species

A series of maps and tables should be prepared, one for each taxonomic group. Species included would be those regionally or nationally threatened, and those with declining populations not yet regarded as threatened, and priority focus should be on keystone species and endemics. In this context, a keystone species may be defined as a species the changing status of which provides an indicator of the condition or health of the ecosystem - because of their sensitivity to disturbances to the food chain, top predators may be examples of keystone species.

- level of threat (regional or national)
- conservation status (IUCN or other threat categories)
- nature of threat(s)
- comment to indicate whether entire species is of concern
- distribution
- national population figure/estimate
- reference for population data and date
- indication of existence of distribution map
- form of map (hard copy, GIS etc.)
- location of map
- degree/effectiveness of conservation action directed at, or of indirect benefit to, how each species would be scored
- research monitoring programmes (e.g. recovery plan)
- costs

4.3.3 Table/map of endemic species

A map and associated tables must be prepared containing information about biological endemics (species with highly restricted distributions) and single country endemics. The focus should be on local distribution of species and their abundance. The contents would parallel those outlined above for threatened species. This is important because species confined in range are particularly vulnerable and because, if confined to a single country, their conservation lies entirely within the auspice of a national plan.

Example Table: Threatened and Declining Species

Family	Species	Threat Status		Threats in Country	National Population		Distribution Map	Habitat Type	Recovery Plan etc.
		Regional	National		Estimate	Date/Ref.			

4.3.4 Invasive and introduced species

A map and associated table should be prepared focusing on species with increasing populations known to be of some concern because of their impact on key elements of biological diversity such as indicator species or endemics, or on economic processes such as crop production.

- name of species
- distribution
- population size and rate of change
- impact on national biodiversity - description and costs
- control measures proposed/in place
- costs of control
- research monitoring programmes
- costs

4.3.5 Species covered by national legislation

A table should be prepared identifying those wildlife acts and other regulations which record species for each national wildlife legislative instrument, the list of species covered and the nature of their protection. Protected area legislation is dealt with elsewhere.

4.3.6 Species covered by international conventions and agreements

A national table should be prepared listing those species covered by international conventions and bilateral agreements. Against each species, a column would indicate the convention on which the species is listed.

4.3.7 Economically significant species and key genetic resource materials

A table should be prepared consisting of species of economic value, both positive (exploitation or tourism value) and negative (such as damage to crops), and those species or infra-specific taxa adapted or used locally. Although some elements of this table would overlap with other tables (e.g. invasive/introduced species and *ex situ* measures), having a separate table would highlight economic values and significance. This table should identify the type of service or benefit, including negative impact, of each listed species, using the broad use categories proposed in table 8.2, showing economic values of direct uses of Biological Resources (section C).

Economic importance of species could be ranked. A system developed by the Taxonomic Database Working Group (TDWG) could be reviewed and extended as appropriate.

Example Table: Invasive and Introduced Species

Family	Species	Distribution	National Population		Impact on Biodiversity	Types of Control Measures	
			Size	Rate of Change		In Place	Proposed

4.3.8 Areas of high species endemism/diversity

A table should list areas of high endemism/diversity giving their extent (hectares or km²) and criteria for inclusion

Example Table: Areas of High Species Endemism/Diversity

Area Name	Area Size km²	Altitude	Habitat Type	Grid Ref.	Justification for Inclusion	Number of Key Species		Map Code
						Endemics	Threatened	

4.3.9 Areas of high endemism/diversity

A map should be prepared displaying information for the preceding table. It should include the extent of key areas for conservation, combined with protected area systems, habitats etc. Sites would be numbered to correspond to this table. The appropriate scale would be chosen for the area under consideration, but this would be at least 1:1 million, and in most cases would more usefully be at a scale of about 1:250,000.

4.3.10 Priority areas for action

A map combining key areas for species, protected area systems and other forms of land use/management, and habitats (perhaps also combined with human population density maps) is vital to indicate priority areas for action, or key sensitive zones within the nation. This format will have greatest impact on decision makers. Mechanisms for generating the synthesis could be needed, and should be appropriately developed in close collaboration with national planners and agencies.

4.4 Species covered by *ex situ* measures

A series of tables should be prepared covering species in zoological and botanical gardens, herbaria, museums and other genetic resource collections. The extent of these collections should be documented, together with location, management objectives and collaborative links with out-of-country programmes (e.g. management of meta-populations for captive breeding). For genetic resources, this would include assessments of laboratory collections/DNA banks and the extent of documentation of resources locally, nationally, in other countries or by international agencies. The following tables are examples of the kinds of information that should be gathered if available.

Example Table: *Ex Situ* Collections (one table for each institution)

Taxon	Type*	Number Native Species	Number Native Threatened Species**	Number Non-native Species	Number Non-native Threatened Species	Comments***

* A: "living"; B: in vitro; C: cryogenic

** threatened in the wild at the national level

*** for plants, this would include entire plants, seeds, gametes (e.g. pollen), vegetative propagules and DNA

Example Table: Captive Animals

Taxon	Institution	Active Conservation Research Programme	Number of Individuals	Percent Captive bred	Other Conservation Efforts***

* population managed in collaboration with other institution(s) - national and extra-national

Example Table: Genetic Collections (sperm and seed banks, microbiological collections, etc.)

Taxon	Institution(1)	Active Plan vs simply stored	Genetic Representation of *ex situ* Population*	Genetic Material Source Records	External Duplication of Genetic Material **	Percent Captive bred	When Last Propa-gated	Other Conser-vation Efforts ***

* How complete are the data held by the *ex situ* institution for these questions, not the actual data themselves
** To be used where duplicate collections, i.e. same genetic material, have been deposited with collaborating institutions
*** Population managed in collaboration with other institution(s) - national and extra-national

(1) It would be worthwhile to include an assessment of facilities - for instance, for storage at ambient or reduced temperature, field genebanks, slow growth and cryopreservation facilities.

Box 4.1 Definition of Genetic Resources

Genetic material of plants, animals or other organisms which is of value as a resource for present and future generations of people.

4.4.1 Exotic germplasm held within a country needs to be addressed; while this germplasm does not represent the native genetic resources of a country, it is still an important part of the overall biological resources of the country.

5 PROTECTED AREAS

5.1 General Considerations

5.1.1 One of the primary mechanisms for conserving biodiversity and maintaining ecological functions is the establishment and management of protected areas (see box 5.1). Such areas, which range from large wilderness reserves to small sites for particular species, and from strict nature reserves to areas for controlled exploitation, provide a wide range of goods and services of local, national and global benefit.

Box 5.1 Definition of a Protected Area

An area of land, fresh water, estuary or sea managed through legal or other effective means so as to protect and maintain biological diversity, and associated ecological functions.

5.1.2 Protected areas *de facto* come under the authority of agencies which are responsible for their management. To provide effective management, these agencies need to

maintain information on the sites and their management. The present subsection is therefore different from the others in that it addresses the question of what types of information on protected areas and protected area systems are likely to be required for their proper management. Application of this type of information in the country study, and in the development of a national biodiversity strategy, is just one potential use of this information amongst many.

5.1.3 It is therefore recommended that each agency responsible for protected areas management should be collecting and maintaining the following types of information for areas under their management (including proposed areas), and/or contributing to national efforts to maintain this information. This would include areas under the control of **forestry** and **fisheries** sectors, as well as wildlife. It would also include non-governmental organizations, and protected areas that they manage.

5.2 Systems Plans

5.2.1 A systems plan for the country (see box 5.2) is essential to coordinate protected areas planning. Information requirements should therefore include:

- whether a comprehensive systems plan exists
- stage of implementation of the plan
- resources required for its implementation and their availability
- strategies for achieving those resources
- period covered by the plan
- review and update cycle

5.2.2 If a systems plan does not exist, further information will be required on:

- whether there are plans to develop a comprehensive systems plan
- how far advanced these plans are
- what the costs of development are likely to be

Box 5.2 Protected Areas Systems Plan

A systems plan is a document which provides:

- a comprehensive national statement of the objectives, rationale, definitions, and future directions for the evolving network of protected areas in a country
- an assessment of the viability of the existing system and its completeness in terms of coverage of habitats, species, critical sites, etc.
- a systematic procedure that identifies additional areas most suitable for meeting national conservation objectives
- a clear statement of national priorities, and a plan of action for achieving the national conservation objectives

The types of information described below give an indication of the information required in systems planning and management.

5.3 Position of Protected Areas in the Surrounding Landscape

5.3.1 If protected areas are going to fulfil their roles, they must be planned and implemented as a part of the whole landscape. It is therefore important to compile

information on interrelationship between protected areas and the other components of the landscape. Questions to address include:

- whether landscape (or regional) planning takes full account of protected areas
- whether protected area management plans take full account of the position of protected areas in the wider landscape
- the use of buffer zones around protected areas, and the extent to which zones of influence are recognized
- the extent of private initiatives and stewardship programmes which protect land

5.3.2 These questions do not lend themselves easily to quantitative answers, so the information content is primarily to ascertain whether such activity is under way (or planned), and to ensure that the planning process takes account of these considerations.

5.4 Distribution/Characterization

5.4.1 The key issues to address are to identify what protected areas exist where, and their management objectives. Appropriate types of information would include summary tables illustrating numbers of sites in each management designation, lists of sites and maps. In particular the information required would include:

- area (hectares)
- location (map)
- current management objectives
- date and history of establishment
- purpose of original establishment

Example Table: Management Objectives for National Designations of Protected Areas

(a) Sites Organized by Designation	(b) Area (km^2)	(c) Year	(d-p) Management Objectives
Designation site			
site			
site			
site			
Designation site			
site			
site			

5.4.2 These data can be compiled in a table that quantifies the management objectives for every protected area within each national designation. The example table above includes sites organized by national designation (such as national park, wildlife sanctuary, etc.) in column (a), the total area of the site in column (b), and the year established in column (c). Columns (d) through (p) cover the range of management objectives listed in box 5.3, and would be scored high (1), medium (2), low (3) or not appropriate (-). These objectives are those used in the IUCN system of classifying protected areas by management criteria. The creation of a "Miller Matrix" in this way can help identify which is the most appropriate IUCN management category for a given site.

Box 5.3 **Objectives of Management**

- maintain sample ecosystems
- maintain ecological diversity
- conserve genetic resources
- provide for education, research and monitoring
- protect watershed
- control erosion
- provide for hunting and fishing
- provide for recreation and tourism
- produce timber, forage, etc
- protect historic and cultural sites
- protect scenic values
- control multiple use
- stimulate sustainable rural development

Source: IUCN 1978. *Categories, objectives and criteria for protected areas.*

5.4.3 The creation of this numerical matrix of management objectives can help identify the most appropriate IUCN management category for the given site. The IUCN classification system (box 5.4) provides an international standard for comparing sites between countries - for example, the national designation of "national park" may have very different management objectives in different countries. The IUCN system is used for categorizing sites in the official United Nations register of protected areas, *United Nations List of National Parks and Protected Areas*. Countries are encouraged to relate their national designations to the international standard.

5.4.4 A map showing the location of the protected areas should be associated with this table. This must be at an appropriate scale for planning purposes, but not less than 1:250,000. Boundaries should be marked, and appropriate location information included so that the map can be digitized, and overlaid with other types of map (vegetation, soils, topography, demography, etc.) for planning purposes.

5.4.5 Other supporting information should include copies of the legislation establishing sites, with details of activities allowed and prohibited within certain areas.

5.5 Biodiversity Information

5.5.1 This section covers what is known about individual sites, and the means to increase the knowledge base. For each site, information should be provided on the following categories of information. In all cases, such information should be readily available for compilation from the protected area managers.

- vegetation/habitat/soils (location, status and trends)
- land use
- ownership/rights of access
- water resources
- species inventories (by taxonomic group)
- status and trends in key species and genetic resources
- utilization
- library/bibliography (is published information accessible/available?)

5.5.2 Wherever relevant, such information should be supplied in mapped form, and at an appropriate scale. For example, for each protected area, maps should be prepared illustrating at least distribution of vegetation types, habitats, soils, land use, ownership and water resources.

Box 5.4 Categories and Management Objectives of Protected Areas

I **Scientific Reserve/Strict Nature Reserve**: to protect nature and maintain natural processes in an undisturbed state in order to have ecologically representative examples of the natural environment available for scientific study, environmental monitoring, education, and for the maintenance of genetic resources in a dynamic and evolutionary state.

II **National Park**: to protect natural and scenic areas of national or international significance for scientific, educational and recreational use.

III **Natural Monument/Natural Landmark**: to protect and preserve nationally significant natural features because of their special interest or unique characteristics.

IV **Managed Nature Reserve/Wildlife Sanctuary**: to assure the natural conditions necessary to protect nationally significant species, groups of species, biotic communities, or physical features of the environment where these require specific human manipulation for their perpetuation.

V **Protected Landscape or Seascape**: to maintain nationally significant natural landscapes which are characteristic of the harmonious interaction of man and land while providing opportunities for public enjoyment through recreation and tourism within the normal lifestyle and economic activity of these areas.

VI **Resource Reserve**: to protect the natural resources of the area for future use and prevent or contain development activities that could affect the resource pending the establishment of objectives which are based upon appropriate knowledge and planning.

VII **Natural Biotic Area/Anthropological Reserve**: to allow the way of life of societies living in harmony with the environment to continue undisturbed by modern technology.

VIII **Multiple-Use Management Area/Managed Resource Area**: to provide for the sustained production of water, timber, wildlife, pasture, and outdoor recreation, with the conservation of nature primarily oriented to the support of economic activities (although specific zones may also be designed within these areas to achieve specific conservation objectives).

IX **Biosphere Reserve**: to conserve for present and future use the diversity and integrity of representative biotic communities of plants and animals within natural ecosystems, and to safeguard the genetic diversity of species on which their continuing evolution depends.

X **World Heritage Site**: to protect the natural features for which the area was considered to be of World Heritage quality, and to provide information for world-wide public enlightenment.

Abridged from IUCN 1984.

5.5.3 At the national level, a summary table of this information may be more useful than individual site maps for incorporation within summary databases, and for comparison with national habitat maps to provide "ground truth". An example table for distribution of habitats follows.

5.5.4 Information on the status of species within protected areas is fundamental for effective management of biological diversity. An example table is presented below in which the availability of a species inventory for each group of plant or animal might be rated as follows:

- 1 = Preliminary - based on limited field observations

- 2 = Extensive - based on partial surveys
- 3 = Comprehensive - based on systematic survey

Example Table: Distribution and Status of Habitats within Protected Areas

Habitat Type	Area Protected (km^2)	% Total Protected Area	Number of Blocks	Status	Trend	Action

Example Table: Availability and Quality of Species Inventories and Checklists

	Plants			Animals					
	Trees	Vascular	Non-vascular	Mammal	Bird	Reptile	Amphib-ian	Fish	Inverte-brate
Designation site									
site									
site									
site									
Designation site									
site									
site									

5.5.5 Protected areas may also have **monitoring programmes** and **research programmes** which are designed to provide the improved information necessary for management. Details would be presented on action being taken to obtain this information, and the likely costs involved (this is necessary to future planning). Such details might be included in management plans, research programmes and/or monitoring programmes of protected areas agencies and collaborating institutions, and information on such plans and programmes should be provided in support of the planning process.

5.6 Status and Management

5.6.1 This section would cover the status and management of individual sites, focusing particularly on the actual implementation of the defined management objectives. This would include information on:

- adequacy of legislation
- clarity of boundaries
- whether there is a current management plan
- clarity of management objectives

- zonation to segregate uses
- adequacy of resources
- stage of implementation of the objectives/management plan

5.6.2 In most cases the information will be qualitative rather than quantitative, although it could be made semi-quantitative by using a scoring system (such as 1 - Good, 2 - Adequate, 3 - Inadequate) where applicable. The system used to categorize management effectiveness should be explicit, following either an international standard or a nationally adopted system. A sample set of requirements is included in box 5.5.

5.6.3 As well as monitoring the effectiveness of management, which will be done at both the site and the national level, there is also a need to:
- review threats to parks/systems
- review threats to the integrity of specific sites
- review potential future threats

Threats are dealt with further in subsection 6 below.

Box 5.5 Evaluation of Management Effectiveness

The criteria for the demarcation of boundaries as a measure of management effectiveness are that a protected area:

(a) Has physically and narratively demarcated boundaries which effectively define the area;
(b) Has demarcated boundaries in certain key areas and this is felt adequate;
(c) Has some boundaries demarcated, but these are felt insufficient;
(d) Lacks demarcation of boundaries;
(e) Lacks or partially lacks formal demarcation of boundaries but this is deemed appropriate for the current situation.

Source: MacKinnon, J., MacKinnon, K., Child, G. and Thorsell, J. 1986. *Managing Protected Areas in the Tropics.*

5.6.4 As part of the process of integrating protected areas into the wider landscape, information on the management of areas immediately adjacent to each site is also required, including:
- buffer zones and corridors
- human population
- land-use
- naturalness of habitats

5.7 Resources

5.7.1 Assessment of the role of designated sites in national biodiversity programmes must include information on the resources available for the implementation of protected area plans, which can be assessed in terms of budgets and manpower. It is appreciated that this sort of infrastructure assessment must be extended to include other resource sectors that influence biodiversity, particularly agriculture, forestry and fisheries, and this broader overview of current conservation capacity is presented in section D. However, because of the particular significance of protected sites in conserving biological diversity and their widespread adoption as a tool in

conservation planning by virtually all countries, consideration is given in this section to the specific resource needs of protected areas although the information must be interpreted in the context of the section D overview.

5.7.2 Information required about annual **budgets** should include the following items for each site:

- expenditure on staff costs
- other recurrent expenditure
- capital expenditure
- total budget
- source of funds

Example Table: Budgets

	Staff Costs		Recurrent Expenditure		Capital Expenditure		Total	
	Available	Required	Available	Required	Available	Required	Available	Required
Headquarters								
Regional Offices								
Designation site								
site								
site								
site								
Totals								

5.7.3 Information will also be required on the numbers of **staff**, both currently deployed and required to implement future plans for protected area management, which can be broken down into a number of categories:

- management and planning
- information and research
- law enforcement
- environmental management
- administration and maintenance
- community relations/extension
- training

This information on current staff levels must be summarized for inclusion in the human resource capacity table in section D.

5.7.4 Staffing information should be supported by data on the levels of training of the staff involved, training required, and by a **review of the training establishments** available, analysing the relevance of their curricula to the work of protected areas staff.

Example Table: Number of Staff

	Management/Planning		Information/Research		Law Enforcement	
	Available	Required	Available	Required	Available	Required
Headquarters						
Regional Offices						
Designation site						
site						
site						
site						
Totals						

5.7.5 With respect to budgets and manpower, it is important to be aware of two items often not included within protected areas budgets, but very relevant to implementation of protected areas:

- relevant expenditure covered under other agency or organization budgets (such as deployment of forest guards within areas managed by wildlife departments)
- staff action provided by other agencies (for example by the military)

These considerations are further addressed in section D.

5.8 Benefits

5.8.1 Like many areas that are not legally gazetted for protection, designated areas provide a wide variety of services to communities in addition to their direct conservation function, although these often go unrecognized because the financial value of the service has never been quantified. Section 3.6 above assesses these services with a provisional list of functional benefits accruing from biological diversity presented in box 3.5. A number of additional benefits that might be provided by protected areas include:

- stabilizing hydrological functions
- protecting soils and soil development
- conserving renewable harvestable resources
- protecting genetic resources
- protecting species reservoirs
- maintaining natural balance
- tourism and recreation
- employment
- facilities for research and monitoring
- use by traditional communities
- heritage/cultural values

5.8.2 Because the range of services provided by a specific protected area can be more readily identified than the biodiversity benefits in the wider landscape, it should be possible to compile a list of such services for each protected area. The relative importance of each service could then be estimated on a scale of 1-5, where 1 is of only marginal or nominal significance and 5 is of predominant importance. Such an

assessment could be facilitated by reference to the management goals of a protected area which should identify the main service objectives. The next step would be to determine the economic value of each service which should be weighted according to its perceived importance. The methods for assessing values are presented in section C.

5.8.3 Clearly such an assessment of the economic benefits must be extended to the services provided by biodiversity in the wider landscape, and these are considered in subsection 3.6. However, one financial benefit that is generated specifically by protected areas is the income from visitors. The sort of information that should be collected includes:

- number of visitors, both overseas tourists and national residents
- direct income generated from entry fees
- indirect income generated from hotel accommodation, vehicle hire, package tours, guides and other services
- the cost of maintaining visitor facilities such as a visitor centre, hotel accommodation, vehicle maintenance, car parks, road maintenance and the upkeep of such facilities
- the cost of tourist impacts such as restoring degraded areas, reseeding damaged sites, tourist patrols to enforce regulations, litter collection and similar impacts

Example Table: Benefits and Costs of Tourism

	Number of Visitors Annually	Proportion of Foreign Tourists	Proportion Residents of Country	Direct Income Generated	Indirect Income Generated	Cost of Maintaining Visitor Facilities	Cost of Tourist Impacts
Designation site							
site							
site							
site							
Total							

5.8.4 Given that analysis of costs and benefits is relatively new, it is important also to identify:

- studies of values/benefits that had been undertaken
- cost/benefit analyses that had been undertaken

5.9 International Conventions and Programmes Relating to Sites

5.9.1 Countries enter into a range of international agreements which place certain obligations on their activities. A number of these agreements relate directly to sites, and to their planning and management. It is therefore important to manage information on these agreements and sites relevant to them. In this subsection, consideration will be given to those international conventions and programmes that require contracting parties to designate sites for management in accordance with the articles of the agreement. Such agreements include the *Convention on Wetlands of International Importance especially as Waterfowl Habitat* (Ramsar Convention), the *World Heritage Convention*, and Biosphere Reserves designated under the UNESCO *Man and the Biosphere Programme*. A wider list of international agreements to

which the country is a contracting party and which relate even indirectly to biodiversity should be compiled in accordance with subsection 1.8 above.

5.9.2 In the case of agreement for which sites have been designated, the following information should be provided:
- list of international (global and regional) conventions and programmes to which the country is a contracting party
- further information on participation in each convention and programme, such as:
  - dates of adherence to conventions
  - identification of the responsible national authority
  - financial contribution for participation, and source of funds
  - whether there is a national programme for implementation, including actions taken or planned

5.9.3 For each convention or programme, the following information should also be provided:
- list of sites designated under relevant convention or programme
- further information on each site concerned, including:
  - area covered by each site with map
  - date designated
  - site description
- protected areas and other designated areas within the site (or within which the site lies)
- whether the site has a particular programme relating to its designation

5.10 Bilateral Agreements

5.10.1 Conservation of biological diversity can also be significantly enhanced by bilateral international action. This part would include identification of bilateral agreements and programmes in which the country participates, with dates and information on the relevant national administering authority, incorporating such activities as:
- twinning of protected areas
- research and monitoring programmes
- staff exchange/training
- support and advice

5.10.2 These data would need to include some information on the nature of the cooperation, and the sites which are relevant to the activity concerned. Further details would also be required on the actions necessary, programmes of activity, and funding implications.

5.11 Transfrontier Protected Areas

5.11.1 Protected areas that meet across international borders can play a valuable role in international relations and these need particular emphasis. Information about the following activities would be useful:
- regular meeting of wardens
- staff exchange
- joint management agreements
- joint research and monitoring
- harmonization of management planning
- joint facilities
- costs

6 THREATS TO BIOLOGICAL DIVERSITY

6.1 Definitions

6.1.1 A threat may be defined as any activity, process or event, whether natural or human-induced, that is causing, or is likely to cause, an adverse effect upon the status or sustainable use of any component of biological diversity. It is important to distinguish between the agent or factor causing the threat, which the present subsection is mainly concerned with, and the adverse effects or consequences generated by the threat becoming a reality. Box 6.1 presents a list of the main adverse effects that may be caused by any of the threats listed below.

Box 6.1 Major Adverse Effects Caused by Threats to Biodiversity

- loss of area available for biological diversity
- change in vegetation or habitat cover
- loss of plant and animal life
- loss of genetic diversity, especially in agricultural crops
- change in balance of species, including local extirpation and introduction of exotics
- change in water regime, including altered stream/river flow
- damage by pollution, including smoke and dust
- change in nutrient status
- damage to conservation facilities or infrastructure

6.1.2 Although a threat may adversely affect biological diversity, it is also likely to generate a potential beneficiary, who is often the causal agent if the threat is the consequence of a human activity. Agricultural settlement, road building, poaching or logging, as examples of human-induced threats, each have beneficiaries at the government, local community or individual level, whose interests must be taken into consideration if the causal agent is to be reversed. It must therefore be recognized that threat alleviation often involves an economic trade-off, which must be quantified in the process of preparing national biodiversity strategies and action plans.

6.1.3 The greatest potential threat to biolgocal diversity is **change**, irrespective of whether the causal factor is natural or the result of human activities. To quantify threats, it is necessary to assess both the type of threat and the severity of its impact. Three generic categories of threat can be distinguished:

- **External socio-economic factors**, where a human activity or process generates a situation in which a knock-on impact may threaten biodiversity. Generally, external factors have the most pernicious impact as they are usually difficult to predict, often not easily identified, and highly problematic to reverse. Typically, they are the result of Government policies or international agreements which have been developed to address a socio-economic or political need, and where the possible knock-on effects on biological diversity were not even considered.
- **Direct threats**, caused by a range of human activities, which may themselves be the immediate consequence of external factors. On the basis of the geographical area affected, direct threats may be divided into local impacts and regional/global impacts which extend beyond the boundaries of a country's national jurisdiction.
- **Natural hazards**, which lie outside human control, although human activities may indirectly affect their frequency or severity (e.g. flooding or drought)

6.2 Types of Threat

6.2.1 External Socio-Economic Factors

Any activity or process where the causal factor lies outside the control of those agencies traditionally responsible for the management of natural resources. These might include:

- human population increase or movement
- national debt or financial instability
- political instability or civil strife
- trade tariffs and agreements
- fiscal policy and tax incentives
- subsidization of resource use, including agricultural price subsidies
- rural settlement
- public health programmes
- energy policy
- industrialization
- transport policy
- agrarian reform and land ownership
- individual needs, including poverty, hunger and shelter

To assess the potential impact of such factors, information about each potential threat is required,covering such points as:

- have studies been undertaken to predict the potential environmental impacts?
- are impacts likely to vary between different geographical locations and, if so, how?
- what remedial activities are required to mitigate the impacts?
- what is the cost of such remedial activity?
- what opportunities are there to modify the external factor to reduce its effect, and what would be the costs of doing so?

6.2.2 Direct Threats: Local Impact

A wide range of human activities, which may be officially sanctioned, illegal or the result of ignorance, can be perceived as constituting a potential threat to biological diversity. These activities impact biological diversity at the local in-country level, and can be addressed directly by national policies and legislation. As shown in box 6.2, these can be divided into seven broad categories:

- development
- encroachment
- exploitation
- management of natural resources
- management of human resources
- political issues
- disasters

6.2.3 Direct Threats: Regional/Global Impact

Many human-induced threats impact biodiversity at the international level and their sources may lie outside the country's national jurisdiction. Such regional or global threats include:

- impact of climate change
- wet and dry deposition of pollutants, such as acid rain
- ultra-violet radiation from ozone depletion
- large-scale emission of nuclear radiation

Box 6.2 Types of Human Induced Direct Threats

DEVELOPMENT
- transport
- construction
- mining/drilling
- resource extraction
- pollution
- drainage/canalization
- flooding

ENCROACHMENT
- settlement
- agriculture
- forestry
- cultivation
- grazing/browsing
- habitat destruction/change
- hydrological change
- erosion
- siltation

EXPLOITATION
- poaching/illegal hunting
- food gathering
- sport hunting
- trophies/specimens
- firewood/minor forest products/subsistence
- scientific/educational
- trade (national/international)
- destructive techniques (eg dynamiting)

HUMAN-INDUCED DISASTERS
- natural hazards (see section)
- major oil spill
- local nuclear accident

MANAGEMENT OF NATURAL RESOURCES
- fire
- hybridization
- competition
- genetic uniformity
- predation
- disease
- low population/restricted range
- lack of pollinator/dispersal agent
- exotic species
- blocked migratory routes
- inadequate water for wildlife
- inadequate food for wildlife

MANAGEMENT OF HUMAN RESOURCES
- inappropriate land-use
- negative attitudes
- inadequate management resources
- lack of effective management
- tourism development/impact
- conflicting demands
- human harassment
- litter
- noise

POLITICAL ISSUES
- armed conflict
- civil unrest
- military activities
- reduction in size of protected area
- change in use/tenure/legal status
- people pressure
- persecution

For each threat occurrence, the following information is required to determine the appropriate response:
- type of threat
- geographical coverage of country
- source of threat
- likely effect of impact (see box 6.1)
- severity, on a low (=1), medium (=2) and high (=3) scale
- imminence and duration
- reversibility
- feasibility of action to remove threat or mitigate its effects
- any appropriate international protocol to address threat
- international legal implications
- costs of remedial action

6.2.4 Natural Hazards

While natural hazards are largely unavoidable and potentially very destructive, some, such as seasonal flooding or wildfire, behave in a predictable way so that remedial and avoiding action can be taken. Such hazards may include:

- volcanic activity
- earthquakes and other seismic activity
- avalanche and land-slip
- flooding (fresh water and sea water)
- adverse weather conditions
- epidemic
- wildfire

To plan remedial action, for any given location it is necessary to know:

- probability of occurrence
- likely severity

For particularly valuable biodiversity features, such as endangered species or critical sites and habitats, it is also necessary to ascertain:

- relative vulnerability (which may vary during the year)
- potential impact
- possible remedial or avoiding action
- likely costs of remedial action

6.2.5 It is important to address the issue of threats in an impartial and open-minded way. Many actions that generate a threat are deliberate: they are designed to provide a human benefit even if some loss of biological diversity is involved. Before remedial action can be decided, it is essential to identify any beneficiaries and the trade-offs involved in mitigating the threat. In some instances, the costs involved in reducing or eliminating the threat may exceed the loss of benefits from the continued operation of the threat, although such cost/benefit analyses must include appropriate methodologies to ascribe monetary values to the direct and indirect intangible benefits (see section C). To determine appropriate remedial action, the following information is necessary:

- who benefits from the activity generating in the threat?
- was the threat to biological diversity quantified before the activity commenced?
- was an environmental impact assessment carried out?
- how significant is the biological diversity under threat?
- what alternative provisions could be made for the beneficiaries?
- what are the costs of mitigating action, including compensation or other trade-offs?

7 MONITORING

7.1 General Considerations

7.1.1 One of the basic objectives of the country study process is to develop an information baseline against which to monitor the effectiveness of national strategies and action plans. The purpose of such strategies is to determine the needs, priorities and investments to achieve predetermined goals, and then to consolidate these priorities into an action plan with targets, timetables and costs. Amongst these priorities are likely to be specific recommendations both to monitor progress in the implementation of the strategy and action plan measured against predetermined targets, and to evaluate the positive results of such actions upon the conservation and sustainable use of biological diversity. This subsection will consider this latter

evaluation process and will involve the gathering of data to meet the following strategic needs:

- to fill key gaps in the information coverage to improve the biological diversity planning capability
- to monitor changes in the status, security and utilization of biological diversity
- to meet the needs of biodiversity managers to improve the effectiveness of their management

7.1.2 The country study comprises the first step in an incremental process for building the knowledge base for more enlightened resource planning (see guideline 4). The additional data derived from implementing the action programmes will contribute to the generation of revised strategies. Once the initial country assessment has been completed, further data-gathering will be part of the monitoring progress. This incremental process must be driven forward by an expanding database capable of continuous updating that can provide reliable outputs of direct practical application to biodiversity planning. The country study must contribute to building this data management capability, both through the provision of a comprehensive baseline and through identifying the needs for further research in filling important gaps.

7.1.3 As stressed in guideline 6, in determining these needs, the relevance to the biodiversity planning process must be the deciding criteria. It is also essential to ascertain from managers what additional data, or improvements in the analysis and presentation of existing information would improve their management effectiveness. The data-gathering must be user-driven, with priorities based on an analysis of the relevance and urgency of the users' needs rather than on the perceptions of the data managers.

7.1.4 At the national level, a primary requirement for this information-gathering will be the repeated standardized collection of data on certain parameters that can be adopted as indicators of the status and use of biological diversity. What are these national biodiversity monitoring indicators or, put in another way, what is the minimum set of parameters that a country needs to monitor?

7.2 National Monitoring Programme

7.2.1 Because of the divergent circumstances, capabilities and needs facing different countries, it is unrealistic to prescribe a panacea minimum database for national monitoring. Flexibility will be necessary in determining priorities, particularly as national planning goals will differ; so, the factors to monitor performance will vary.

7.2.2 To develop and maintain the sort of database required for effective planning, the following are likely to be needed:

(a) A national **biodiversity information strategy**, which should be developed as a component of the overall biodiversity strategy, and which would address:

- types of information required/available
- current/required information management capabilities
- identification of information priorities
- actions that need to be undertaken
- allocation of responsibilities
- costs involved

(b) A **monitoring programme**, which would then need to be developed, identifying:
- specific parameters to be monitored
- methodology and timescale for data-gathering
- management of the information
- priorities and responsibilities
- output specifications and means of dissemination
- costs involved

(c) The means of **information management**, which should then be developed and must allow for:
- gathering of information from a variety of sectoral sources
- production of outputs of direct relevance to planning needs
- reconciliation of scales
- assessment of data quality and reliability
- cataloguing and indexing data holdings
- reporting formats and data distribution mechanisms

7.2.3 In identifying priorities for the sorts of parameters to be included in a national monitoring programme, the criteria presented in box 7.1 may be useful. Countries will need to interpret these criteria in the context of their own national requirements.

Box 7.1 Criteria for Selecting Parameters for Monitoring Biodiversity at the Country Level

1. Parameters that are indicators of:
   - diversity at the genetic, species and ecosystem levels
   - effectiveness of management of biological resources
   - levels of threat and the causal agents
   - socio-economic benefits accruing from biologial diversity
   - institutional capacity-building

2. Parameters with the following attributes:
   - scientific and quantitative rather than descriptive and qualitative
   - adaptable to a range of data collection methods from remote sensing to ground survey
   - suitable for monitoring at a variety of scales from specific sites to whole regions

3. Parameters that allow for:
   - simple data-gathering procedures so that local communities, schools and individuals can contribute
   - standardized data collection so that comparable results are produced
   - easy incorporation into data management systems

4. Parameters that will provide:
   - relevant information that meets the needs of managers
   - feedback on management activities
   - assessment of the effectiveness of the national strategy and action plan
   - an integrated picture

7.2.4 A provisional list of key biodiversity factors that meet these criteria is presented in box 7.2. This list is not intended to be all inclusive, but is presented as a starting

point to stimulate the thinking about long-term monitoring requirements at the time of initial data-gathering.

7.2.5 To succeed, a national monitoring programme must include a broad cross-section of factors outside the narrow biological purview. A multi-sectoral approach is essential, drawing upon a variety of demographic, socio-economic and legal measures to generate a comprehensive overview of the factors influencing biological diversity. For example, monitoring might show that the proportion of threatened species in a country was increasing due to accelerating forest loss, yet that same country might be significantly increasing its investment in protected areas management, training and public education. The monitoring programme must be sufficiently flexible to accommodate such internal trade-offs rather than focusing exclusively upon biodiversity status.

7.2.6 It is not intended to present a comprehensive list of monitoring parameters in these non-biological sectors as these must be determined in the recognition of the socio-political and development circumstances of each country. However, a few key factors might include amongst others:

(a) Human demography:
- population density and distribution in rural areas on a district or provincial level
- size and pattern of human settlements, particularly in rural areas
- population migrations and seasonal movements
- population density, distribution and movements of indigenous and local communities

(b) Land tenure and resource access:
- changes in land ownership and rights to resource use at the community level
- illegal land occupation and resources illegally exploited
- mining rights, logging concessions, marine fishing rights, and changes in other grants and licences for resource use at the government level
- recognition of ownership or resource use rights of indigenous peoples

(c) Economic sector:
- per capita annual income, particularly in rural areas
- fiscal policy and tax incentives relating to resource use
- agricultural and forestry price subsidies affecting land-use
- infrastructure developments, particularly proposed road and rail developments

(d) Legal sector:
- national legislation (existing and proposed) relating to the management and exploitation of species and habitats
- law enforcement, including number of convictions and size of penalties
- national legislation (existing and proposed) relating to genetic prospecting, commercial use of genetic materials and the release of genetically modified organisms
- ratification of international conventions and protocols, including date of last report, financial contributions and activities undertaken

(e) Education and public awareness:
- incorporation of environmental education programmes into national school curricula
- training in natural resource management at universities, technical colleges, and wildlife management colleges (number of courses, level of qualification, number of graduates)

Box 7.2 Provisional List of Key Parameters for Monitoring Biodiversity at the Country Level

Monitoring Genetic Diversity:

- *in situ* plant and animal genetic resources, including landraces and non-improved crop varieties, medicinal plants and wild ancestors of domestic breeds and cultivars
- numbers of varieties of crop (or livestock) grown *in situ* in sample localities
- coefficient of genetic diversity or kinship of crop (or livestock) grown *in situ* in the same sample localities
- number of accessions of crops and livestock held in *ex situ* storage within the country
- percentage of these accessions regenerated over a specified time period
- numbers of microorganisms, microbial strains, and other cultures held in *ex situ* storage in the country
- full data on the propagation and release of any genetically modified organisms into the wild
- release, introduction or reintroduction into the wild of any captive bred or cultivated plant or animal from *ex situ* collections

Species Monitoring

- species threatened at the national level
- trends in numbers of nationally threatened species measured as changes in the proportion of species listed in national threat categories
- country-specific endemic species
- species of commercial value for sustainable use at both the national and community levels
- flagship species that serve as a focus for the conservation of a diversity of other species and habitats
- indicator species that can serve to monitor ecosystem disturbance, particularly predators and invasive colonizing species
- alien or introduced species that threaten indigenous biological diversity
- percentage of species with declining, stable or increasing populations, particularly amongst the categories of species listed above
- time-interval data on changes in population of a few key species of particular ecological or economic significance
- percentage of threatened and country-endemic species in protected areas
- percentage of threatened and country-endemic species held in national and international *ex situ* collections
- changes in species composition and yields of important food resources for human consumption such as fisheries and game meat production for local use and export
- agents identified as direct threats to species diversity
- implementation of priority actions for species conservation and use identified in the latest strategic plan, assessed against specified success indicators

Habitat Monitoring

- mapped distributions of natural habitats of conservation concern, using national habitat classification system
- rates of change of habitat areas
- state or condition of habitats of conservation concern using some simple measure of biodiversity quality (see subsection 3.3.5)
- rates of change of habitat condition
- percentage of remaining natural habitats occurring in patches greater than 10km^2, 100km^2 and 1000km^2 as a measure of habitat fragmentation
- rates of change of ecologically sensitive areas (see box 3.2)
- percentage of remaining habitats within protected areas
- percentage of identified centres of species diversity and endemism within protected areas
- changes in the area and identified benefits of the mapped distributions of categories of biodiversity function (see box 3.5)

(continued)

Box 7.2 (continued)

Protected Areas Monitoring

- agents identified as direct threats to habitat diversity
- areas of habitat restored or reinstated to a more natural condition
- implementation of priority actions for habitat conservation and use identified in the latest strategic plan, assessed against specified success indicators
- number, area and location of protected areas
- percentage of terrestrial and marine ecosystems under conservation management
- protected areas that have management plans
- protected areas with inventories of species and habitats
- effectiveness of management of protected areas to achieve specified objectives
- agents identified as threats to protected areas
- protected areas infrastructure, such as staff numbers and budgets
- sustainable use benefits to local communities generated by protected areas
- economic values of protected areas, including visitor numbers and income generation

- extension training in the community, village level training schemes, wildlife camps, etc. (number of programmes, approximate number of people reached, sources of funding, etc.)
- media exposure (column inches in newspapers, hours of broadcasting on television and radio)
- number and membership of NGOs and citizen groups

(f) Resource investment:

- annual financial investment in biodiversity conservation by government and by national NGOs using the allocation pattern presented in section C, table 8.6
- annual financial investment in biodiversity conservation within the country by the international community, including multilateral, bilateral and non-governmental sources, using the allocation pattern presented in section C, table 8.6
- size of budget of the government agencies responsible for the conservation of biological diversity, split into payroll costs, capital expenditures and operational costs
- staff levels of government agencies responsible for the conservation of biological diversity, split into managerial, administrative and field staff
- budgets and staff levels of principal national NGOs, split as above

(g) Land-use:

- areas under different types of land-use (km^2 and percentage of total country)
- rate of change of land-use (percentage)
- marine and coastal areas used for human activities (km^2 and percentage of total)
- changes in agricultural and livestock production (crop types, stocking densities, method and intensity of production)
- areas under different types of forest, including natural and plantation km^2 and percentage of total)
- areas under different forestry practices, including logging (complete, partial and selective) and replanting (indigenous or exotic species)
- total annual catch (metric tons) for each fisheries area
- total annual yield (metric tons) for each fish species (or genera)

7.2.7 Clearly this list of non-biological factors, together with the biodiversity parameters presented in box 7.2, adds up to a substantial programme, and countries will need to select those factors for which baseline data can be readily compiled and where a monitoring capability is in place. It is recommended that responsibility for the sectoral programmes proposed in subsection 7.2.6 is delegated to the appropriate government departments and that the NBU or other identified institution should play a coordinating and integrating role (guideline 2).

Box 7.3 **A Minimum Set of Indicators for Monitoring Biodiversity at the Country Level**

INDICATOR	BIODIVERSITY CONSERVATION CONCERNS		
	Genetic Diversity	Species Diversity	Community Diversity
Wild Species and Genetic Diversity			
1. Species richness (number, number per unit area, number per habitat type)	●	●	
2. Species threatened with extinction (number or percent)	●	●	
3. Species threatened with extirpation (number or percent)	●	●	
4. Endemic species (number or percent)	●	●	
5. Endemic species threatened with extinction (number or percent)	●	●	
6. Species risk index	●	●	
7. Species with stable or increasing populations (number or percent)	●	●	
8. Species with decreasing populations (number or percent)	●	●	
9. Threatened species in protected areas (percent)	●	●	
10. Endemic species in protected areas (percent)	●	●	
11. Threatened species in *ex situ* collections (percent)	●	●	
12. Threatened species with viable *ex situ* populations (percent)	●	●	
13. Species used by local residents (percent)	●	●	
Community Diversity			
14. Percentage dominated by non-domesticated species		●	●
15. Rate of change from dominance of non-domesticated species to domesticated species		●	●
16. Percentage of area dominated by non-domesticated species occurring in patches greater than 1000km²		●	●
17. Percentage of area in strictly protected status		●	●
Domesticated Species			
18. Accessions of crops and livestock in *ex situ* storage (number)	●		
19. Accessions regenerated in the past decade (percent)	●		
20. Number of crops (livestock) grown as percent of number 30 years before	●		
21. Number of varieties as percent of number 30 years before	●		
22. Coefficient of kinship or parentage of crop	●		

Source: Reid, W.V., McNeely, J.A., Tunstall, D.B. and Bryant, D. (in prep.). World Resources Institute, Washington DC.

7.2.8 As an alternative to the direct monitoring of biodiversity status, **indicators of change** can be used. A set of such biodiversity indicators at the country level is presented in box 7.3. This dataset provides a matrix combining the major conservation concerns with a working set of indicators that can be used to assess long-term trends in the conservation and use of biological diversity. However, an assessment of the availability and quality of the data for just this minimum set shows the inadequacy of the information: although the coverage at the country level for mammals and birds is reasonable, for most other species the data are lacking or of poor quality. Time-series data are non-existent except for a few "megafauna" species, tropical forests and the land-use estimates produced by FAO. Of particular concern is the lack of data on genetic varieties of agricultural crops grown in developing countries, and the absence of base-line data for monitoring ecosystem change. These conclusions emphasize the urgent need to build the monitoring capacity at the country level.

7.2.9 A key component of any effective monitoring programme must be the early detection of threats to biodiversity and the capacity for a rapid response. A primary recommendation of the *Global Biodiversity Strategy* (WRI/IUCN/UNEP, 1992) is the establishment of an **early-warning network** with the objective of providing a swift response to the emergence of new threats through the rapid mobilization of information. The best sources of early-warning information are field workers, farmers and local communities, backed by journalists, environmental lawyers and enforcement authorities. These sources need to be linked into a **national monitoring network** for the rapid communication of threats and correction measures. The sorts of parameters that an early-warning network should monitor are presented in box 7.4.

Box 7.4 Parameters that an Early Warning Network must Monitor at the Country Level

1. Traditional crop or livestock varieties threatened by planned development projects or the introduction of new varieties
2. Increasing genetic uniformity of crops
3. Natural ecosystems subjected to new inappropriate management practices, human encroachment, or unsustainable exploitation
4. Protected areas in urgent need of financial, technical, or other support
5. Accelerating habitat loss
6. Evidence of the over-exploitation of species
7. Introductions of exotic species
8. Genebank facilities with germplasm at risk due to lack of funding for recurring costs
9. Climatic threats to biodiversity - including desertification, floods, drought, and global warming
10. Communities denied access to resources when protected areas are established
11. Pollutant discharges presenting immediate threats or chronic pollution that might pose longer-term threats
12. Changes to the legislation relating to land and other resource ownership that may disenfranchise local communities
13. Changes to national budgets that may affect the allocation of funds for conservation
14. Political or institutional developments that may influence the infrastructure for effecting conservation
15. Implementation of obligations undertaken through international conventions

Source: WRI/IUCN/UNEP 1992. *Global Biodiversity Strategy.*

7.2.10 With the rapid advances in remote sensing, environmental measurement techniques and information technology, the limiting issue is not how to monitor but what to monitor. A minimum set of parameters must be agreed, along the lines presented in boxes 7.2, 7.3, and 7.4, that provides a country with a framework for determining priorities and goals for biodiversity planning, that generates the data necessary to monitor how well the country is doing in achieving its strategic planning objectives, and that supplies the early warning information necessary for the rapid response to new threats. The rationale for building the planning capacity of countries through improved biodiversity data management and monitoring must be to achieve these long-term strategic objectives.

SECTION C: VALUATION AND CURRENT EXPENDITURES

8 INTRODUCTION

Resources for the conservation of biological resources and diversity are not infinite. This forces nations and the global community to set priorities. One step that can be taken by countries to begin the process of setting priorities is to take stock of the value of their biological resources and diversity. Another step is to identify the expenditures currently being made within a country to conserve biological resources and diversity and to compare these expenditures with the sources of value. The present section presents guidelines for the collection and compilation of information to assist countries with these steps. The exercise is intended to aid countries in identifying potentially high priority areas for study and action and identifying information gaps that are critical for setting priorities for conservation efforts. The exercise may also contribute to the incorporation of the values of biological resources and diversity into national income accounts. Taking stock of the value of biological resources and diversity and expenditures to conserve them should occur periodically to aid countries in monitoring their status over time.

Estimating the value of biological resources and diversity and expenditures to protect them are useful steps in identifying priorities, but are not sufficient for evaluating competing options for their conservation. To evaluate specific options it is necessary to evaluate the expected effects of options on biological resources and diversity, the benefits of these effects, and the costs of implementing the options, along with any other effects these options may have. Benefit-cost analysis of options for conserving biological resources and diversity is beyond the scope of the present section. Guidelines for such analysis will be produced in a separate UNEP document.

Countries will find that their efforts to measure the value of biological resources and diversity are hampered by tremendous uncertainty. There is uncertainty regarding biological measures of the qualities, quantities, diversity and interactions of biological resources. There is uncertainty of the various goods and services that flow to us from these resources, or that may flow to us in the future. There is also uncertainty about the values members of our society place upon the flows of these goods and services and the values that future generations may place upon them. There is uncertainty about how human actions may impact biological resources and diversity and their associated goods and services but we face the very real risk that the impacts of our actions may be irreversible. This is clearly the case for extinction of a species due to unsustainable use or disruption of habitat.

Expenditures to conserve biological resources and diversity are less uncertain, but still difficult to estimate precisely. Expenditures of government agencies and other organizations are not typically reported in a form that allows for easy identification of the relevant expenditures. Estimating the effectiveness of these expenditures is even more difficult and is beyond the scope of these guidelines.

However, we do not have the luxury of waiting until all uncertainty is resolved. To make rational choices about current activities and policies which carry implications for the sustainability of biological resources and diversity, available information can be used to inform our choices. The present section offers guidance on how available information on values and expenditures might be organized to contribute to this process.

8.1 The Concept of Economic Value

Economic value is measured from the perspective of humans. It does not include any intrinsic value a good or service may possess or any value it may have to other living organisms. The economic value of a good or service is defined in terms of the quantities of

other things that members of society are willing to forgo in exchange. For comparability, these quantities are often translated into monetary units. Economic value is then measured as the maximum amount individuals are willing to pay for a good or service.

It is important to recognize that a good or service need not be bought and sold in markets to have economic value. It is also not necessary that a good or service be used or consumed directly by individuals for it to have economic value. Anything that individuals are willing to pay for, or make sacrifices for, has economic value. For example, although access to a forest may be open and not traded in a market, some individuals may nonetheless be willing to pay for the opportunity to visit the site for recreation if access were contingent upon payment. Furthermore, individuals' preferences to preserve species or ecosystems, even if they have no intention of ever using these resources directly, can have economic value so long as individuals are willing to pay for preservation.

Measuring economic value demands a great deal of information and sophisticated techniques. The requirements are most easily met in the case of marketed goods and services because data on prices and quantities traded are often available. In the case of non-marketed goods there are no observed prices, and often there will be no or poor data on quantities. Economists have developed a variety of techniques to estimate values of non-market goods and services, but the techniques can require considerable data, time, and expertise. It is not suggested that countries apply these techniques in their initial country studies. However, results of existing studies may be transferable to a country's situation and be used to estimate values of non-marketed goods and services.

Even in the case of marketed goods and services, available information may only permit countries to estimate expenditures and not economic value. Expenditures may differ from economic value for a variety of reasons. First, market prices may be distorted by government price controls or subsides on inputs, causing market prices to diverge from the economic value. In fact, market prices will coincide with the economic value of an additional unit of a good or service only if a set of very restrictive conditions regarding the functioning of markets are met, which typically does not happen. Second, expenditures measure the actual payments made by individuals, not the maximum amounts they would be willing to pay to obtain the good or service. However, when estimates of economic values of biological resources and diversity are not available, countries will have to find proxies that are suggestive of the economic values of these resources. For marketed goods and services derived from biological resources and diversity, expenditures may provide a good proxy. The subsections below provide further guidance on possible methods to estimate or proxy economic values.

8.2 The Economic Value of Biological Resources and Biological Diversity

In sections 2.2.5 and 2.2.6 of the guidelines, a distinction is made between biological resources and biological diversity. From the perspective of economic valuation there is an important difference between the value of biological resources and the diversity of those resources. In some cases the degree of variation in biological systems contributes to economic productivity. For example, the value of maize production is related to a number of inputs which include the genetic variability of maize cultivars, technology, human ingenuity, and other factors. In this case the value of biological diversity is a component of the total value of the biological resource. Whilst estimation of the economic value of biological resources may be straightforward, for example in the value of maize production, calculation of the marginal contribution of genetic diversity will be much more difficult to achieve.

On the other hand, there may be additional attributes of biological diversity that are not incorporated into biological resource values. For example, society may not value individual species of beetles for their own sake, yet attribute value to the conservation of a variety of beetles for ethical or cultural reasons. In addition, a practical complication is that many of the contributions to productivity made by biological diversity will be indirect and therefore unlikely to be represented in conventional analysis of biological resources.

A framework (or taxonomy) of the components of economic value facilitates the distinction between the economic value of biological resources and biological diversity. Direct-use values refer to the productive or consumptive values of ecosystem components or functions. Direct uses may be marketed or non-marketed. Indirect use values refer to the value of environmental functions that support or protect economic activity. The economic value of these functions reflects their contribution to productive and consumptive activity.

In addition to use values, there may be additional economic values associated with biological resources and diversity. For example, preservation of biological diversity can preserve opportunities for future uses, such as the development of a new pharmaceutical or new agricultural cultivar. The values of preserving these opportunities is referred to as option values. Option values are often likened to an insurance premium which society is willing to pay in order to ensure future access. Existence, or non-use, values refer to society's willingness to pay to conserve resources for their own sake, regardless of their productive or consumptive uses.

Table 8.1, on page C-60 below, presents a generic conceptual framework for presenting the economic value of biological resources and biological diversity. In compiling data on economic values, this framework may be applied for a number of different levels of analysis. Biological diversity and resources are generally characterized at the ecosystem, species or genetic level. Data on economic values may be available at each of these levels.

When evaluating an ecosystem, the value of a certain number of species may already be aggregated. For example, data on fuelwood from a wetland area will implicitly include the fuelwood value of individual tree species. Alternatively, catch data from a single fishery may be available on a species-by-species basis. In these cases, care must be taken to avoid double-counting. Nevertheless, the type of data available should guide the level of analysis.

8.3 Economic Data

This subsection indicates the connection between the types of economic value outlined above and the types of economic information that may be available to country study teams. As stated in the guiding principles for the country studies, the focus of data collection should be on data that can contribute to improving the biodiversity planning process. While the interpretation of this statement will vary from country to country, it is possible to suggest that countries should consider collecting three types of economic information:

- data on economic values - both non-monetary and monetary
- data on the major distinctions between the different individuals or groups within society who capture these values
- data on the major threats and opportunities that are likely to impact on the sustainability of resource or diversity values

Generally speaking, the data source will determine the relevant level of analysis, namely, sectoral, geographic, ecosystem, community, etc. However, some types of data, such as tourism receipts, may be available at many different levels, for example, sectoral, regional and local levels. It is suggested that before beginning this exercise, countries give considerable thought to the different levels of analysis for which data may be available and at which level the presentation of data would be most informative to the biodiversity planning process. Coordination with the data gathering expenditures at this point would be helpful for future analysis based on the two data sets. This may greatly reduce the unnecessary duplication of data input, the development of excessively long and repetitive tables and the potential for double-counting of values.

8.4 Data Sources

Data on the value of biological resources and biological diversity comes in many different forms and from many different sources. In conducting their first biodiversity country studies, countries may wish to consider how internal capacity to obtain and store such information may be improved through the country study process. One possibility is for the NBU to serve as a library for housing basic sources of economic information on biological resources and biodiversity for that country. A bibliographic database to accompany this library would be an additional component of building in-country ability to provide biodiversity information to the conservation planning process.

For most of the primary resource sectors - agriculture, fisheries, forestry, tourism, etc. - data on biological resource values is accessible from government sources. In this case NBUs will want to collect published sources and extract relevant data for use in the study. For example, countries may wish to indicate the relative percentage of GNP stemming from these primary resource sectors. However, it is important to stress that these values represent the full value of biological resources and not the portion of this value attributable to biological diversity *per se*.

Thus, efforts should be made to identify additional measures of the economic value generated by biological resources and biological diversity. In most countries, such information may be more readily available in the form of individual case studies of species, ecosystems, communities, etc. These data sources are unlikely to provide comprehensive coverage of a country's biological resources and biological diversity. At first glance, it may appear in some countries that little or no economic research of this nature is available. One reason for this is that much case-study research into economic valuation in developing countries has been conducted by foreign university researchers, non-governmental research-based organizations and donor agencies and their consultants. As part of the country study process, countries may want to make an effort to begin obtaining copies of economic researchand biodiversity undertaken in their country.*

8.5 Valuation

As indicated above, the economic values of biological resources and biological diversity can be defined as direct-use, indirect-use, option or existence values. In order to present a consistent framework for presenting value data in a table (or database) format, sources of valuation data may be classified according to these value categories. Indicative lists of a large range of biological resource and biodiversity values are presented in tables 8.2-8.4 below organized according to whether they are direct-(extractive and non-extractive) or indirect-use

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* The next step would be to undertake measures to ensure that in the future copies of all such research are deposited with the NBU.

values. In addition, data on the valuation of biological resources and biodiversity will tend to refer either to biological resource values or the value of biodiversity *per se*. Data sources may, therefore be labelled as pertaining to one or the other of these types of values.

Data on valuation should not be limited to monetary figures. If monetary figures are not available, non-monetary indicators of economic activity may also provide a gauge of the economic significance of genes, species, ecosystem functions, etc. These two types of indicators are explored further below.

Finally, it should be noted that valuation estimates tend to represent the lower end of the spectrum of values and should be taken as a measure of magnitude of value, rather than a precise assessment. Countries should attempt to determine the full value of their biological resources and diversity, and not be pursuaded to under- or over-estimate values for potential funding reasons.

Non-Monetary Indicators. For each of the values identified, available data that measures or indicates the physical scale of the use should be collected. This would include data such as fish catch, timber production, and number of visitor days engaged in recreation activities at a site. In some instances, particularly in the cases of non-marketed uses, data on quantities may not be available. One way around this difficulty is to extrapolate from typical quantities collected, produced, harvested, etc., from other areas. Another solution is to use other data that conveys information about the extent of economic activity related to the good or service being valued. For example, if data on the quantities of fuelwood gathered in a particular locale do not exist, quantities might be estimated by extrapolation from case-study or census data from other, similar regions. If such extrapolations do not exist or are judged unreliable, local data on populations living in or near an area known to be used for fuelwood might provide a qualitative indicator of the potential scale of economic value.

In the case of non-use values such as option and existence values, data might be collected that are suggestive of the numbers of individuals who potentially hold high option or existence values for a selected resource. For example, the extent of local and national membership in environmental and conservation organizations or memberships in organizations that focus on specific biological resources may indicate such values. As option and existence values can transcend national boundaries, quantitative data on memberships in international environmental and conservation organizations may also be relevant.

Monetary Indicators. There are a number of techniques available for placing monetary values on biological resources and biological diversity. The primary source of valuation data is likely to be observations of market prices and quantities actually exchanged. However, there are a range of additional valuation techniques that may be employed in valuing biological resources and biological diversity. These techniques may be used to value goods and services that do not pass through markets, as well as those that are marketed. As the focus of the country study is on the compilation of existing data these techniques are not reviewed or explored in the present annex. Countries requiring reference material on these techniques should contact UNEP or one of the international research centres specializing in environmental economics listed in section E below.

It is, therefore, important that countries collect any case-studies that have generated monetary values for the country's biological resources or biological diversity. As with non-monetary data, these studies may also be useful in extrapolating values for other studies. Countries may also wish to identify and obtain case-studies completed in other countries where economic, biological and social conditions are generally comparable. Extrapolation to home country resources may be possible in some cases. For example, estimates of the economic value of

recreation activity days developed for other countries may be roughly transferable. Again, a number of the international research centres listed in section E may serve as prime sources of such country case-studies.

It is important to indicate that valuation case studies are likely to be progressively scarcer as the topic moves from direct extractive uses through to existence values. Tables 8.1 and 8.2 provide indicative lists of the extractive and non-extractive uses of biological resources and the types of data sources that may provide indicators of economic values. The most easily accessible data on the value of biological resources will come from the commercial sectors of society - e.g., direct extractive activities such as agriculture, fisheries, tourism, and forestry. Monetary estimates of the value of subsistence and other non-marketed goods and services are more difficult to obtain. Non-monetary data may be required to indicate the economic importance of these values.

It may also be necessary to collect non-monetary data in the case of indirect-use values which support or protect economic activity. Table 8.3 provides an indication of frequently encountered indirect use values and the types of data and sources of data that may be collected by country study teams. Finally, there are very few case-studies that have actually calculated monetary estimates of option and existence values. Country teams are advised tocollect whatever data may be available, but not to be concerned if there is little to be found. Instead, country study teams may wish to examine if non-monetary measures are available. If not, simple qualitative statements may be appended to the tables or the country study report.

8.6 Data on the Distribution of Economic Values Amongst Social Groups

The economic value of biological resources may accrue to different levels of society. For example, certain values may accrue at the global level, others at the regional or national, others at the local or community level. Related to this issue of the distribution of economic value is the capture of that value, so that in some cases not all of the economic value may be appropriated.

For example, the carbon sequestration and storage functions of forests, classified here as an indirect value, may have an economic value in terms of the amount of global warming damage avoided by not emitting carbon dioxide to the atmosphere. This is a global value because one ton of carbon dioxide emitted in one country mixes in the atmosphere with emissions from all other countries. The impacts of the greenhouse gases are global, although of course manifest themselves more critically in certain places; for example, small island States are especially vulnerable to sealevel rise. The value of carbon sequestration is unlikely to be captured at the national or local level unless the international community chooses to make a payment for those services.

The use of a protected area, say a national park, provides an example of where economic value of a biological resource may accrue at a local, national and international level. Income-generating opportunities may exist for local communities as a result of tourism development, and local communities may also be able to benefit from some extractive uses, as well as the ecological services provided by the park. Entrance fees may generate revenue for the Government at a national level, and tourism benefits are international if experienced by overseas visitors.

International and domestic policies, as well as national and local property rights regimes, will affect the distribution and capture of economic benefits of biological resources. In addition, there may in some instances be conflicts or trade-offs between different levels of capture.

8.7 Sustainable Use: Threats and Opportunities

Threats and opportunities to ensure continued or extended sustainable use of biological resources and diversity occur on several levels (international, national, regional and local). Access to and analyses of data regarding such threats and opportunities are important for the strategic planning process. Section A of the present technical annex describes social, political and economic factors which could be important in this context. Data on the more precise impacts of these factors on the actual or potential use and value of biological resource and diversity impacts may be collected and included in table 8.4. Additional factors not covered in section A, such as, for example, effects of potential climate change and consumption patterns, could, of course also be added to the table.

The Convention on Biological Diversity emphasizes the conservation of biological diversity through the sustainable use of biological resources. The economic values of resources should be carefully assessed on the basis of sustainable use or yield. Whilst there is uncertainty over the measurement of sustainability, an assessment of whether stock is declining, increasing, or remaining constant will provide an approximate indication of sustainability of activities. The monetary values of extractive uses of biological resources which are assessed should only be of that proportion based on sustainable yield. In the event that stock is being over-harvested or permanently removed, it is necessary to take account of the cost of regeneration of the stock.

In some cases the economic value of a biological resource may be demonstrated to be high, but as a result of an unsustainable level of harvest or off-take which in the long term leads to depletion, and perhaps the eventual extinction of a species. For example, the hunting of a particular species, whilst maximizing the use value of meat and other products, reduces the population to a level which is no longer viable. In addition, such activities may have indirect effects on ecosystem functions or services, or impact on other species, which also need to be examined. For example, certain agricultural techniques, whilst adding to the productive value of the harvest of a particular crop, may have impacts on wild species threatened through the use of pesticides, and may undermine ecosystem function by loading nutrients into watercourses. These effects need to be accounted for in the economic analysis.

Table 8.1 **Economic Values of Biological Resources and Biological Diversity**

	Direct-use Values		Indirect-use values	Option values	Existence values
	Extractive	Non-Extractive			
Generic	Subsistence Commercial Recreational Medicinal Habitat	Recreation Education Scientific research Transport	Nutrient cycling Sink functions Watershed protection Climate regulation Habitat (migratory)	Potential future direct and indirect uses	Ethical Cultural Altruism Bequest Heritage
Ecosystem e.g., wetlands	Fuelwood Fish Crops	Bird watching Sailing	Flood and flow control Shoreline/bank stabilization Nutrient retention Over-wintering for birds	Potential future supply of ecosystem goods and services	Desire for descendants to view migratory species. Preferences for protection of wetlands by non-users
Species e.g., various tree species	Timber Fuelwood Fruit Fodder Local medicinal Construction materials	Pharmaceutical research and development	Carbon sequestration Nitrogen-fixing Soil conservation Bird habitat	Potential future supply of tree products and services	Preferences for protection of trees for ritual purposes
Genetic e.g., food crops		Plant Breeding	Evolutionary	Potential improvements of crop seeds	Preference for conservation of genetic stock

Table 8.2: Economic Values of Direct Uses of Biological Resources

Uses	Indicators of Value	Potential Data Sources
1) **SUBSISTENCE**: e.g. hunting, fishing, gathering nuts, fruits	Non-market valuation of production e.g. valuing the subsistence use of fuelwood through calculating the traded value, the cost of substitutes or alternatives, or the value of the time spent collecting it	Census data on subsistence production Socio-economic surveys and case studies
2) **RECREATION**: e.g. sportfishing, sporthunting	Market valuation and non-market valuations. e.g. the market value of species consumed, the amount of money paid for licences	Census data on fishing, hunting etc. License revenues
3) **MEDICINES**: e.g. use of plant and animal genetic material in pharmaceutical industries, traditional medicines	Market and non-market values, e.g. market value of medicines and pharmaceuticals, costs of alternative treatment	Socio-economic research and case studies
4) **COMMERCIAL/INDUSTRIAL**: a) **Fishing Production** Commercial fishing in salt or inland waters	Market value of production, the quantities caught, revenue generated etc.	Fisheries ministry Yearbooks FAO
b) **Forest Production** e.g. timber, wood products, pulp and paper	Market value of production	Forest Department statistics Timber industry FAO
c) **Agricultural Production** e.g. livestock and livestock products, field crops, fruit and vegetables, and other crops such as oils, spices, latex, honey, ornamental plants etc.	Market value of production	Agricultural census data FAO
d) **Textile Production** e.g. silk, wool, cotton	Market value of production	Agricultural statistics Industrial production statistics and annual reports FAO
e) **Leather Production** e.g. hides, leather goods	Market value of production	Agricultural and industry statistics
5) **INTERNATIONAL AND DOMESTIC BIODIVERSITY RELATED TOURISM**: photographic nature safaris, fish/whale watching, bird watching	Tourist expenditures	Ministry of Tourism data Industry statistics, domestic and international
6) **VISITS**: e.g. to zoos, botanical gardens, museums, national parks and other protected areas	Visitation rates, revenue from entrance fees	Ministry of Tourism data Industry statistics Visitation rates from individual parks, museum etc.
7) **BIODIVERSITY-RELATED SPORTS**: e.g. horse riding, pony-trekking, hiking	User expenditures	Surveys of visitors
8) **TRANSPORTATION**: e.g. horse and camel riding, horse, camel and ox carts, draught animals, pack animals	Value of the services, e.g. the market value if they are traded, the cost of alternatives, value of time or energy or other savings	Census data and socio-economic surveys

Table 8.3: Economic Values of Indirect Uses of Biological Resources

Indirect Uses	Indicators of Economic Values	Potential data sources
Groundwater recharge and filtration, flood control, watershed protection and catchment, etc.	Proxy values for the services provided e.g. number of people reliant on water from the catchment area, water quality indicators	Socio-economic surveys Water industry statistics
Soil fertility maintenance, erosion protection, sediment control, nursery function, etc.	Proxy value for the services provided e.g. agricultural production reliant on maintenance of soil fertility	Socio-economic and agricultural surveys Production data from agricultural research Data on soil erosion and conservation from Ministry of Agriculture/ Natural Resources
Migratory habitat, wind breakers, pollination, pest control, etc.	Proxy value for the services provided e.g. data on species populations	International conservation agencies such as Bird Life, WCMC etc. for data on migratory birds Scientific studies
Storage and recycling of nutrients, organic matter, human and industrial wastes, etc.	Proxy value for the services provided e.g. data on volumes of waste, analysis of waste disposal policies and practice, incidence and costs of pollution	Water industry, environment agencies and NGOs
Climate regulation, carbon-fixing, solar energy fixing, etc.	Proxy value for the services provided e.g. based on carbon assimilatory capacity of vegetation and soils, biomass and organic matter volumes required	Vegetation cover and soil data from international databases such as UNEP

Table 8.4 Summary Table of Economic Information on Biological Resources and Biological Diversity (an example)

›brindi Land Biodiversity Country Study Summary Table 5b: Sun Bay Coral Reef and Marine Area Reserve							
	Non-Monetary Indicators	Monetary Indicator	Type of Value	Data Source	Distributional Analysis	Threats/Opportunities	Priority Areas for Research
1. Direct-Use Values							
a. Fishing	50,000 kg catch per year	$500,000 / yr (market value)	Biological resource	Fisheries Department Statistics - 1992	20% local artisanal 80% foreign fleet	Lack of fisheries management plan Sedimentation from deforestation	
b. Curio Trade	100 shop keepers	$20,000 / yr	Biological resource	Marshall (1991) - Masters thesis work	100% small shopkeepers	No harvest controls/fees Potential export market	
c Ecotourism	8,000 tourist arrivals / yr 60,000 bed-nights	na		Ministry of 'Tourism	Most revenues to hotels and restaurants of which 75% foreign owned	Rapid increase in new hotels and arrivals needs to be monitored	
d. etc . . .							
2. Indirect Uses							
'aste .ssimilation	Sink for waste from town of 30,000	na	Service			Impact of increase in tourism uncertain	high
b. Breeding Grounds	reef is sole breeding site for on-shore fisheries	na	Service				medium
3. Option Values							
e ›harmaceutical ospecting	US drug company interested in exploring potential of coral diversity	na	Service		Local option on collecting revenues and royalties		
4. Existence							
Ethical	Membership of 'Friends of Sun Bay Foundation'	$10 pp/yr, currently 1,250 members		'Friends of Sun Bay'	80% overseas membership		low

9 THE CURRENT EXPENDITURES

9.1 Nature of Current Expenditures

There are many activities currently undertaken which directly work towards the goals of the Convention on Biological Diversity. Knowing the present level of expenditures on these activities is a first step for planning national strategies. This section provides guidance on how to gather relevant data. In this section, a matrix is suggested to assist the organization and analysis of data available on expenditures on biological diversity. Likely data sources and categories are also presented.

There are three major sources of expenditures: national government expenditures, multilateral and bilateral funded expenditures, and others such as NGOs and private enterprises. For each of these sources, only expenditures related directly to biological diversity should be considered. For example, conservation-related education comprises only a small proportion of the Department of Education's budget, and only that amount should be included in the calculations. Using total budgets of ministries or NGOs would result in an overestimate of biodiversity-related expenditure. Focusing on expenditures per activity may be a useful way of determining what portions of the budgets are allocated to biodiversity conservation and sustainable use.

National Government Expenditures

The majority of expenditures are met from public funds allocated by different government agencies, such as the department of wildlife conservation, forestry, fisheries, agriculture, education, waterways, energy and other departments. It may be advantageous to focus on these sources of expenditure as it is likely to be both the most significant among funds and the easiest data to find.

Multilateral and bilateral funding

Multilateral and bilateral assistance may also finance a proportion of in-country conservation and sustainable use programmes. These funds are largely routed through national Governments or NGOs; however, for the purpose of understanding the sources and quantities of expenditures, it is recommended that these activities which are funded by external sources should be listed separately.

Others

National and indigenous NGOs, local governments and local communities also contribute financially to biodiversity maintenance and management. In addition to these sources of funds, there are also expenses borne by national and international NGOs, foundations, and the private sector.

9.2 Methodologies

9.2.1 A framework matrix for allocating expenditures on biodiversity is presented in Table 8.5. The data are broken down by resource, agency, and activity. This framework is not meant to be exclusive, but rather to serve as a starting point. Column headings are by resource (forest, fisheries, etc.), under which expenditures are listed by funding source (Governments, bilateral and multilateral, other). Under each funding source, the expenditures are broken down by activity. For example, funding for forest conservation may come

from the Government through the forestry department, from international conservation NGOs, and from a local community development group. The Government may finance the extension service, the NGO might fund buffer zone rehabilitation, and the local development group may sponsor a public awareness campaign on non-timber forest products. If data are available at this level, they should be in disaggregated form. The matrix then becomes a flexible tool for analysing policy, planning, monitoring and evaluation. Input for this matrix can be compiled step by step, using tables 8.6 and 8.7 as a guide.

Table 8.6 lists major categories of activities which may support biological diversity. Again, this is neither an exhaustive nor exclusive list, but rather a first step. The category 'economic incentives' recognizes that distorted economic incentives can lead to loss of biological diversity. Those policy changes which influence incentive structures and any expenditure related to those changes should be listed here. For example, this might include reversing subsidies that promote clearing forest lands for agricultural use which requires government expenditures, such as education programmes on sustainable forest management techniques.

Table 8.7 lists possible sources of data on biodiversity expenditures. Government budgets are usually published by the relevant ministries or departments, and multilateral and bilateral budgets are usually public information. The level of expenditure incurred by non-governmental sources is likely to vary by country and may be substantial in some countries. This data may not be readily available, and a survey of NGO and other private sources of funding may be required as a second step in data-gathering.

Estimating expenditures by each funding source for the categories in table 8.6, may require different methodologies. For government expenditures, expenditures by relevant ministries and departments should be attributed per activity in the main categories given in table 8.7. Gathering disaggregated data may be difficult. If such data are not available, budget figures of relevant agencies can be used as an approximation. However, only that portion of the expenditure should be included which is directly attributable to biodiversity-related activities.

In section 2 of table 8.5, multilateral and bilateral funding of Government activities or NGO activities should be listed by activity per resource. Earmarked funds for biodiversity activities, as well as grant in aid and loans, which support biological diversity activities should be included.

In section 3 of the same table, private sector contributions and NGO spending for biological diversity should be presented. Care must be taken to prevent double counting. Many local NGOs are funded by contributions from Governments, bilateral aid or the private sector. These contributions may already be included in the matrix under the donor to the NGO.

Finally, if detailed data are available, the distinction should be made between capital and revenue expenses. Capital expenditure should be discounted appropriately and the method adopted should be explained clearly in the accompanying text.

9.3 The Distinction between Expenditures and True Costs

The data on current expenditures will help planners identify areas which are current priorities within their country. More importantly, this data can serve as a baseline for creating national strategies. However, expenditures are not the equivalent of total costs. Costs are much broader, and many components of cost will not appear as part of expenditures. For example, the cost of a protected area may include the opportunity costs of lost crop production, and the indirect costs of overgrazing outside the park borders. All of these costs need to be included when assessing projects and policies. This is the next step in strategic planning.

10. Conclusion

10.1 Priority Areas for Future Data Collection and Research

Much of the data necessary for in-depth economic analyses for strategic planning and action is lacking in most countries. It will therefore be important for countries to identify priority areas for future data collection, assessment and research. Generally speaking, it would be helpful if countries could rank data collection in order of importance. This could take into consideration the following criteria: data on sectoral policies, data on high risk use (irreversible effects on biological diversity), data on market prices for biological resources, data on the correlation between changes in income with changes in biological diversity (including ecosystem services), data on biological resources with high marketable potential, data on biological diversity and resources of critical socio-economic importance.

10.2 Data Presentation

While countries are free to use whichever format they feel most appropriate for presenting their results, a possible format for presenting valuation data is presented in table 8.4 and for expenditure data in table 8.5. Table 8.4 incorporates the different data and observations that may be made by country study teams in gathering economic information regarding the value of biological resources and biodiversity. Different tables would be required for each of the different levels of analysis employed in the study. For instance, there might be a set of tables for sectoral information, for ecosystems, for genetic resources, etc. Table 8.5 compiles the main types of activities that Governments or others may fund by resource sector. As with the valuation tables, different tables may be created to keep data desaggregated either by activity or by resource. For example, site or species management can be broken down into activities suggested in table 8.6 and resource categories may be organized to reflect the different levels of analysis used in the valuation tables.

10.3 Conclusion

The present section provides guidance on how countries might collect and organize data on the value of biological resources and diversity and identify current expenditures in their country. The data will serve as a baseline of economic information for developing national strategies and action plans, the next step in the country case study process. Guidelines are being prepared for creating national strategies and action plans, which will provide outlines and options for economic analysis of alternatives and the way such analysis might be used to aid priority-setting and choosing between resource-use options.

Table 8.5 Major Sources of Expenditures by Resource Categories

Year..... Currency.....

Resource	Agriculture	Forestry	Livestock	Protected Areas	Fisheries	Marine	Total
Source: **1. Government** . Site or Species Management . Economic Incentives . Education . Data Management . Policy Planning and Analysis . Institutional Capacity-Building							
Subtotal 1							
2. Multilateral and bilateral . Site or Species Management . Economic Incentives . Education . Data Management . Policy Planning and Analysis . Institutional Capacity-Building							
Subtotal 2							
3. Others . Site or Species Management . Economic Incentives . Education . Data Management . Policy Planning and Analysis . Institutional Capacity-Building							
Subtotal 3							
Total (1 + 2 + 3)							

Table 8.6: Major Categories of Activities and Expenditures

. **Site or Species Management**

-protected areas
-planning and assessment management
-buffer zone management
-ecosystem restoration and rehabilitation
-monitoring and assessment
-ex-situ conservation measures
. defensive expenditure

. Economic Incentives

-changes in land use
-changes in production system
-changes in land tenure and property rights

. Economic Analysis

. Education

-public awareness and participation
-curriculum development
-technical training
-capacity building

. Data Management

-biological survey and inventory
-biodiversity research and evaluation
-networking and information exchange
-socio-economic studies and survey

. Policy Planning and Analysis

-legal instruments
-environmental impact assessment
-natural resource accounting
-program and project planning
-institutional coordination

. Institutional capacity-building

-technology transfer
-training and skills transfer
-equipment nd facilities

Table 8.5 Major Sources of Expenditures by Resource Categories

Year..... Currency.....

Resource	Agriculture	Forestry	Livestock	Protected Areas	Fisheries	Marine	Total
Source: **1. Government** . Site or Species Management . Economic Incentives . Education . Data Management . Policy Planning and Analysis . Institutional Capacity-Building							
Subtotal 1							
2. Multilateral and bilateral . Site or Species Management . Economic Incentives . Education . Data Management . Policy Planning and Analysis . Institutional Capacity-Building							
Subtotal 2							
3. Others . Site or Species Management . Economic Incentives . Education . Data Management . Policy Planning and Analysis . Institutional Capacity-Building							
Subtotal 3							
Total (1 + 2 + 3)							

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-public awareness and participation
-curriculum development
-technical training
-capacity building

. Data Management

-biological survey and inventory
-biodiversity research and evaluation
-networking and information exchange
-socio-economic studies and survey

. Policy Planning and Analysis

-legal instruments
-environmental impact assessment
-natural resource accounting
-program and project planning
-institutional coordination

. Institutional capacity-building

-technology transfer
-training and skills transfer
-equipment nd facilities

Table 8.7 Source of Data on Biodiversity Expenditures

Governments:

. Published Ministry/Department Budgets
. Auditor General's Reports
. Country Economic Reports
. UNDP Country Project Reports

Multilateral

. Annual Reports
. Development Assistance reports published by OECD.

Bilateral

. Department of Finance
. Memorandum of Understanding (project basis)
. Donor country budget reports

Others

. Statement of Accounts of major NGOs
. Surveys

SECTION D: CURRENT CAPACITY FOR BIODIVERSITY CONSERVATION AND SUSTAINABLE USE

11 CURRENT CAPACITY

11.1 Introduction

11.1.1 The aim of the country study is to initiate a process for gathering data concerning the biological wealth of the country, the economic importance of its biological resources and the threats to their future uses. It is an open-ended process that will enable a country to assess its biological diversity and to improve the planning and management of its biological resources for sustainable use.

11.1.2 A basic level of capacity at the country level is necessary not only to initiate this process of national assessment but also to continue its expansion on a long-term basis. Components of this basic capacity include:

- a strategic planning capability
- a programme development capability
- a capability to implement prescribed actions
- data gathering, analysis and monitoring capabilities
- a capability to evaluate all the activities involved in biodiversity management

11.1.3 The capabilities of countries to undertake such duties can be determined from an assessment of a number of key requirements:

- institutional and organizational capacities
- human resources
- national environmental legislation
- technological facilities
- information resources

11.1.4 A matrix showing the relationships of these capacities with the data-gathering activities proposed in these guidelines is proposed. Countries should complete this table as the first step in assessing their capabilities. As an illustration, some example capacities relating to the activity of gathering biological data are shown.

11.2 Institutional Capacities

11.2.1 An essential early step in planning how best to undertake a national assessment is for the country to identify its institutional capacity for the conservation and sustainable use of biological resources. This capacity will compromise both Government and private sectors with the relative importance of these varying between countries.

11.2.2 Within the **Government sector**, it is important to identify clearly and unambiguously the lead responsibility of ministries and departments for implementing the various activities essential for preparing the national assessment and biodiversity strategy. A convenient mechanism to undertake this assessment is to identify the responsible Government agency for each of the priority actions determined by Panel 1** to implement the

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** In response to resoluton 2 adopted by the Conference for the Adoption of the Agreed Text of the Convention on Biological Diversity, UNEP established five Panels of Government-nominated experts to advise on specific issues for the advancement of the Convention. Panel 1 considered the priorities for action to implement the Convention and the international agenda for science and technology. Panel 5 was responsible for the preparation of the revised country study guidelines.

Convention on Biological Diversity. A two-way matrix should be prepared listing the Panel 1 actions against all the Government departments and agencies, even those only distantly connected to biological diversity: within each column the agencies taking lead or secondary responsibility should be identified. For countries with a federal structure, this

In-Country Capacities to Undertaking the National Assessment Process

Data-collecting Activities	Institutional Capacity	Human Resources	Legislative Framework	Technological Facilities	Information Resources
A. Socio-economic and political Issues					
B. Biological	Sectoral: National→Local Government Parastatal University NGO Community Private sector Cross-sectoral: NBU Working Group	Taxonomists Ecologists Botanists Zoologists Geneticists Ethnobotanists Biogeographers Resource economists Sociologists Anthropologists Journalists Farmers Teachers	National: Species and habitat protection laws National environ-mental law International: Conventions Treaties	Remote sensing Biotechnology Farming systems *Ex situ* collections Seed technology Microbial cultures	Databases Bibliographies Libraries Information networks International data sources Socio-economic surveys
C. Economic Benefits					
D. Economic Costs					

exercise should be repeated at the state level as well as the national, where the allocation of responsibilities between the state and federal levels of government must be demarcated. Government-controlled parastatal organisations should be included as well as ministries. This exercise should not be confined just to the traditional wildlife management and tourist sector, but to all branches of government whose activities directly or indirectly influence biological diversity, agriculture, forestry, fisheries, energy, transport, finance, central planning and so on. This is a fundamental planning exercise both to promote inter-departmental coordination and to demonstrate the cross-sectoral interdisciplinary nature of biodiversity management.

11.2.3 In some countries, **local government** at the district level may have a formulative influence upon biological diversity, particularly through its effect on land settlement and agricultural development. In a few cases, local government may be directly involved through the ownership of game reserves, receipt of game licence permits, or a share of revenues from local tourism. Local authorities are often unaware of their influence upon biological diversity and are under-resourced to play their required role. Reinforcing this tier of government, one that is often more appreciative of the needs of local communities, may be regarded as an important consideration in the development of national strategies. For preparing the national assessment, it is important to define the role of local government, identify its responsibilities and analyse its influence. If its influence is significant, the sort of assessment proposed in paragraph 11.2.2 above should be undertaken.

11.2.4 This assessment of institutional capacity must also cover the **private sector**. Obviously this must include the environmental non-governmental organizations (NGOs) as they can be extremely effective in raising public awareness and mobilizing public involvement. It is essential that the preparation and implementation of the national biodiversity strategy is a fully participatory process involving all sectors of society, and this will mean bringing the NGOs into the process at an early stage. It is proposed that a list be prepared of the main national NGOs, including their principle sectors of operation and some indication of their effectiveness — this is not necessarily a factor of size but of their activities, for many small local NGOs are highly effective. For countries with an extensive NGO community, it will be possible to list only those that operate at the national level; for others, it would be desirable to include and district and community organisationz as well.

11.2.5 The private sector also includes a number of other **key non-governmental agencies**. The universities, particularly the biological, social and economic sciences, will be a primary source of both data and expertise, which must be incorporated in the national assessment process. Industry, particularly in the agricultural and forestry sectors, obviously has a formulative influence and must be involved. The Church and religious bodies can also be highly influential in generating an awareness amongst the public about the issues involved, as can the media and journalists. The potential involvement and contribution of these discrete components of the public sector should be examined and quantified as part of the national assessment process.

11.2.6 As proposed in guideline 2, one of the first steps in undertaking the country study is to establish a national biodiversity unit (NBU) or similar institutional arrangement responsible for coordination and integration of the various sectoral components of the assessment. Countries will need to decide for themselves the host institution, structure and organization of the NBU, but it is urged that the process of undertaking the country study is made as participatory as possible involving all the sectors mentioned in this chapter.

11.3 Human Resources

11.3.1 The lack of **human skills and expertise**, and the corresponding needs for training and practical experience, is one of the fundamental considerations in building the capacity of developing countries for biodiversity conservation and sustainable use. It is therefore important to establish a baseline of current human resource capacity as a key component of the national assessment process upon which to build through the actions identified in the national strategy.

11.3.2 To establish this baseline, the example table below is presented as a mechanism to quantify **current human resources**. This table identifies a number of sectors, such as agriculture, forestry, environmental education and so on, which should include all the main governmental and non-governmental agencies identified in subsection 11.2 above. The table then divides the human resources amongst a number of activities, such as *in situ* and *ex situ* conservation, utilization and research. Differentiation is made between "professional" with degree-level of qualification, "technical" with a lower level of training combined with expertise based on experience, and traditional" such as game scouts or field research assistants who may have no formal training but still have a wide knowledge of biological diversity based on personal experience

Example Table: Human Resources Availability

BASIC

APPLIED

Sectors[a]/ / Activities [b]/	Forestry	Agriculture	Fisheries	Environmental Education	→ i
	Prof/Tech/Trad	Prof/Tech/Trad	Prof/Tech/Trad	Prof/Tech/Trad	
Conservation *in situ* in protected areas outside protected areas on farms					
Ex situ living collections - zoos - aquariums - botanical gardens gene banks seed banks *in vitro* collections - cells, tissues, sperm museums herbaria					
Utilization selection breeding farming systems biotechnology manufacturing/processing marketing					
Research (*Basic* ↓ *Applied*) biosystematics and taxonomy reproductive systems ecology biochemistry					

a/ Other sectors might include district or local government, national legislation, non-governmental organizations, environmental protection agencies within the private sector and so on.

b/ Data sources might include surveys and employment census, national or regional government statistics, professional associations, published anthropological papers, indigenous peoples organizations, NGOs, etc.

11.3.3 The problem in this sort of exercise is to determine where to place the boundaries for data gathering. Clearly it is meaningless to include all peasant farmers or indigenous peoples despite their obvious interaction with biological diversity: the objective is to quantify resources not sections of the population, so only those directly involved in using saving or studying biological diversity should be included. However, this must cover the social and economic sciences, and not just the natural sciences.

11.3.4 The complexity of the institutional arrangements for biodiversity management, utilization and research demands the establishment of a multidisciplinary unit within an appropriate host institution to coordinate all activities at the national level. This unit, or NBU, must be able to draw upon the full range of human skills identified in the assessment, including scientific, administrative, business management, educational, information management and communication. It is essential that the NBU or other identified agencies responsible for coordinating the country study is reinforced by the infusion of these necessary skills.

11.4 National Legislation

11.4.1 Programmes for the conservation, study and sustainable use of biological diversity must be backed by an appropriate **legislative framework**. The country study must include a review of the existing national legislation and its adequacy to support future actions. This review should include not just legislation aimed directly at the protection of species and habitats, but also legal instruments that may indirectly affect biological diversity, such as planning regulations, agricultural tenancies, and security of rights of use of biological resources. Such instruments must be examined from the viewpoint of their impacts upon biological diversity.

11.4.2 Adequacy of the existing legal framework also implies **enforcement**. If possible, information should be gathered on the commitment of the relevant authority to enforce compliance. Thus for each legal article or instrument, the following information should be collected:

- name of legal instrument
- date of original enactment
- subsequent revisions or extensions
- brief summary of coverage
- actual and potential impact on biological diversity
- authority responsible for enforcement
- number of personnel engaged in enforcement
- numbers of arrests and convictions
- average size of penalty
- further modifications or extensions required to improve adequacy

11.5 Technological Facilities

11.5.1 **Modern technology**, such as remote sensing, telecommunications, and *ex situ* facilities, can contribute directly to biodiversity planning and management. The ability to interpret satellite imagery can reinforce monitoring, aerial photography can back up the enforcement of legislation, communications systems can support anti-poaching operations, and *ex situ* germplasm collections can long-stop *in situ* recovery programmes. In some countries, the basic facilities may be available but the ability to maintain them or use them to their full potential is deficient because of the lack of skilled personnel.

11.5.2 As part of the capacity assessment, it would be useful to gather the following information on the technological facilities available for biodiversity management within each of the sectoral institutions, both government and private, identified in subsection 11.2 above:

- technological facilities available of direct application to biological diversity
- are they adequately maintained?
- what is the source of funding and its security for maintenance?
- what human skills are available and are they adequate?
- are the facilities operating at full potential capacity?

11.6 Information Resources

11.6.1 To undertake the country study, full advantage must be made of all available information resources, both those held within and outside the country. Section E lists the main international data sources: those in-country must be identified and listed. Relevant information resources may be of a variety of types:

- computerized databases
- remote-sensing data
- libraries, including both published and unpublished literature
- other bibliographic materials such as newspaper cuttings, abstracting services or card index files
- information networks with data drawn from other sources
- personal knowledge, field notebooks, unpublished data held in filing cabinets, etc.

11.6.2 To mobilize these resources, a concerted effort should be made to document all **in-country information sources**. Although the first iteration of the country study does not envisage the commissioning of fieldwork to provide new data, it does assume that countries will endeavour to deploy their current knowledge drawn from all existing information sources. For each source, the following information should be provided:

- name and address of the agency or individual
- name, address, telephone and fax number of the main contact person
- brief description of data holdings — is there a list or catalogue?
- format in which the data can be supplied
- date information last reviewed — information about maintenance and up-dating
- data networks, if any, into which the source is linked.

11.6.3 The process of compiling such data sources into a **national directory** can produce a valuable tool to promote conservation. Countries seldom appreciate the extent of their own data holdings until these are seen together — if real efforts are made to locate all national sources, countries may be surprised at how much they do know rather than disheartened at how much they do not know. The coordinated mobilization of these information resources can provide the catalyst for building **data management capacities** (see subsection 11.7 below). The directory can also stimulate the development of **in-country networks** — these do not need to be sophisticated electronic communication systems but a group of agencies or individuals that are prepared to share information using facsimile machines or the postal service.

11.6.4 An essential component of the country study must be the **repatriation of relevant data held out-of-country**, and financial provision must be allocated to these activities. Many natural history museums, botanic gardens and other collections may hold valuable historic data on the past distributions of species, and some international conservation agencies have acquired sizeable data holdings on the countries with which they work (see section E below). The transfer of these resources is relatively straightforward: more problematic is to secure the personal data collected by expatriate scientists, and this can be done only on an individual basis. Of great importance is the transfer of **bibliographic materials**, for many developing countries cannot afford to subscribe to the primary scientific journals. The country study should aim to generate a central catalogued repository of everything published about the resources of the country.

11.7 Data Management and Monitoring Capacity

11.7.1 Responsibility for the data compilation in the country study process will lie with the national biodiversity unit or similar designated institution, even if this task is partially delegated to the sectoral agencies. This role will evolve from the short-term aim of data- gathering for the country study to the long-term goal of serving as the centre for national biodiversity monitoring. In turn, the analyses from what will become the national biodiversity monitoring unit will sharpen and focus the identification of the priorities to be incorporated in further iterations of the strategy and action plan (see figure 1 between pages 2 and 3 of the guidelines). Planning is a dynamic process, backed by appropriate information technology, that

enables biodiversity considerations to be built into development programmes. Monitoring both th implementation of such programmes and their effectiveness in achieving pre-set targets is an essentia component of capacity building.

11.7.2 At the core of this process must be a data-management capability that can provide decision makers with reliable up-to-date information of direct practical application. It is strongly recommended that the analytical power of a geographic information system (GIS) is harnessed for long-term integrated resource management (see box 3.3 on page 14 of the guidelines). A particular effort should be made to identify agencies operating a GIS facility, or for whom a GIS would be a valuable planning tool, as part of the assessment of current data management capacity. The process of building the capacity of the central biodiversity planning unit must therefore include the transfer of the relevant information technologies, in-programme training, and long-term technical and logistic support. This in turn will necessitate sustainable funding, although the dependency for core funding can be reduced through the provision of services once the agency becomes fully operational.

11.7.3 Capacity-building also means participation by the people. Although the production of national strategies and action plans is a political process, it must be based upon full public involvement. This participator planning process is essential not just for ethical considerations and democratic principles but because th people are the central mechanism for the implementation of the strategy. It is only when interested parties form an integral part of the planning process that they become committed to the plans that emerge. It is essential that the monitoring programme includes unsophisticated data gathering procedures so that with a minimum of training, local communities, school groups and farmers can contribute.

SECTION E: DIRECTORY OF DATA SOURCES

A list is presented of the major international sources of information and expertise that may be able to assist a country to undertake its national assessment. The list includes not just agencies holding biodiversity data but also the names and addresses of key people and institutions that have already participated in preparing Country Studies. If in doubt about whom to approach for assistance, countries should first contact the United Nations Environment Programme, Biodiversity and Biotechnology Programme, P.O. Box 30552, Nairobi, Kenya (Phone: 254 2 621234; Fax: 254 2 219270 (direct)/226890).

Note: Throughout this section phone and fax numbers are given where known. The international country code is given first, followed where appropriate (i.e. in the majority of countries) by the city code. Both are included in parentheses.

1. INFORMATION CENTRES

General biodiversity data

Conservation International
1015 18th Street N.W.
Suite 1000
Washington
DC 20036
USA
Phone: (1 202) 429 5660
Fax: (1 202) 887 5188

The Nature Conservancy
1815 N Lynn Street
Arlington
VA 22209
USA
Phone: (1 703) 841 5300
Fax: (1 703) 841 1283

United Nations Environment Programme (UNEP) - Global Environment Monitoring System (GEMS)
PO Box 30552
Nairobi
Kenya
Phone: (254 2) 621234
Fax: (254 2) 226 890

UNEP - INFOTERRA (International Environmental Information System)
PO Box 30552
Nairobi
Kenya
Phone: (254 2) 621234
Fax: (254 2) 226 890

World Conservation Monitoring Centre (WCMC)
219 Huntingdon Road
Cambridge CB3 0DL
UK
Phone: (44 223) 277 314
Fax: (44 223) 277 136
Telex: 817036 SCMUG

IUCN - The World Conservation Union
Rue Mauverney 28
CH 1196 Gland
Switzerland
Phone: (41 22) 999 00 01
Fax: (41 22) 999 00 02

World Resources Institute (WRI)
1709, New York Avenue
N.W.
Washington
DC 20006
USA
Phone: (1 202) 638 6300
Fax: (1 202) 638 0036

In situ species data

IUCN Species Survival Commission
Rue Mauverney 28
CH 1196 Gland
Switzerland
Phone: (41 22) 999 00 01
Fax: (41 22) 999 00 02

Species Unit
World Conservation Monitoring Centre (WCMC)
219 Huntingdon Road
Cambridge CB3 0DL
UK
Phone: (44 223) 277 314
Fax: (44 223) 277 136
Telex: 817036 SCMUG

BirdLife International
Wellbrook Court
Girton Road
Cambridge CB3 0NA
UK
Phone: (44 223) 277 318
Fax: (44 223) 277 200

Natural History Museum
Cromwell Road
London SW7 5BD
UK
Phone: (44 071) 938 9123
Fax: (44 071) 938 8937

Royal Botanic Gardens
Kew
Richmond
Surrey TW9 3AB
UK
Phone: (44 081) 332 5114
Fax: (44 081) 948 1197

Royal Botanic Gardens - Edinburgh
Inverleith Row
Edinburgh EH3 5LR
UK
Phone: (44 31) 552 7171
Fax: (44 31) 552 0382

Missouri Botanical Garden
PO Box 299
St Louis
MO 63166
USA
Phone: (1 314) 577 5100
Fax: (1 314) 577 9521

New York Botanical Garden
Bronx
NY 10458
USA
Phone: (1 212) 220 8700
Fax: (1 212) 220 6504

Muséum National d'Histoire Naturelle
57 rue Cuvier
75281 Paris Cedex 05
France
Phone: (33 1) 40 79 30 30
Fax: (33 1) 40 79 34 84

American Museum of Natural History
Central Park West at 79th Street
New York
NY 10024
USA

Field Museum of Natural History
Roosevelt Road at Lake Shore Drive
Chicago
IL 60605
USA
Phone: (1 312) 922 9410
Fax: (1 312) 427 7269

Smithsonian Institution
1000 Jefferson Dr,
S.W.
Washington
DC 20560
USA
Phone: (1 202) 357 1300
Fax: (1 202) 786 2563

Internationaal Agrarish Centrum (International Agricultural Centre)
Lawickse Allee 1
PO Box 88
6700 AB Wageningen
The Netherlands
Phone: (31 8370) 90111

Ex situ species data

International Board for Plant Genetic Resources (IBPGR)
C/O FAO
Via della Sette Chiese
00145 Rome
Italy
Phone: (39 6) 5797 4779
Fax: (39 6) 5797 5137

FAO Commission on Plant Genetic Resources
Via della Sette Chiese
00145 Rome
Italy
Phone: (39 6) 5797 4779
Fax: (39 6) 5797 5137

Botanic Gardens Conservation International
Descano House
199 Kew Road
Kew
Richmond
Surrey TW9 3BW
Phone: (44 81) 940 4547
Fax: (44 81) 948 4363

International Species Information System
12101 Johnny Cake Ridge Road
Apple Valley
MN 55124
USA
Phone: (1 612) 432 2757
Fax: (1 612) 432 9292

International Mycological Institute
Bakeham Lane
Egham
Surrey TW20 9TY
UK
Phone: (44 784) 470 111
Fax: (44 784) 470 909

Microbial Strain Data Network
Biotechnology Centre
307 Huntingdon Road
Cambridge CB3 03Q
UK
Phone: (44 223) 277 628

Rijksherbarium (National Herbarium)
Rapenburg 70-74
Leiden
The Netherlands
Phone: (31 71) 273 500
Fax: (31 71) 273 511

International Zoo Year Book (IZYB)
The Zoological Society of London
Regent's Park
London NW1 4RY
UK
Phone: (44 71) 722 3333
Fax: (44 71) 483 4436

Ecosystem data

UNEP Earthwatch Programme
PO Box 30552
Nairobi
Kenya
Phone: (254 2) 333 930
Fax: (254 2) 520 711

Habitats Data Unit
World Conservation Monitoring Centre (WCMC)
219 Huntingdon Road
Cambridge CB3 0DL
UK
Phone: (44 223) 277 314
Fax: (44 223) 277 136
Telex: 817036 SCMUG

Food and Agriculture Organization of the United Nations (FAO)
Via delle Terme di Caracalla
00100 Rome
Italy
Phone: (39 6) 5797 4779
Fax: (39 6) 5797 5137

National Oceanic and Atmospheric Administration
National Marine Fisheries Services
Southeast Region
9450 Koger Blvd
St Petersburg
FL 33702
USA

National Aeronautics and Space Administration (NASA)
600 Independence Avenue
S.W.
Washington
DC 20546
USA

European Space Agency
8-10 rue Mario Nikis
75738 Paris Cedex 15
France
Phone: (33 1) 42 73 76 54
Fax: (33 1) 42 73 75 60

Protected areas data

Commission on National Parks and Protected Areas (CNPPA)
Rue Mauverney 28
CH-1196 Gland
Switzerland
Phone: (41 22) 999 00 01
Fax: (41 22) 999 00 02

MAB Programme Secretariat
UNESCO
7 Place de Fontenoy
F-75700 Paris
France
Phone: (33 1) 45 68 10 10
Fax: (33 1) 45 67 16 90

Protected Areas Data Unit
World Conservation Monitoring Centre (WCMC)
219 Huntingdon Road
Cambridge CB3 0DL
UK
Phone: (44 223) 277 314
Fax: (44 223) 277 136
Telex: 817036 SCMUG

Wildlife utilization data

CITES Secretariat
6 rue du Maupas
Case Postale 78
CH-1000 Lausanne 9
Switzerland
Phone: (41 21) 20 00 81
Fax: (41 21) 20 00 84

Wildlife Trade Monitoring Unit
World Conservation Monitoring Centre (WCMC)
219 Huntingdon Road
Cambridge CB3 0DL
UK
Phone: (44 223) 277 314
Fax: (44 223) 277 136
Telex: 817036 SCMUG

Agriculture data

Australian Centre for International Agricultural Research (ACIAR)
GPO Box 1571
Canberra
A.C.T. 2601
Australia
Phone: (062) 48 8588

Centro Internacional de Agricultura Tropical = International Centre for Tropical Agriculture (CIAT)
Apartado Aereo 6713
Cali
Colombia
Phone: (57 23) 675 050
Fax: (57 23) 647 243

Centro Internacional de Mejoramiento de Maiz y Trigo = International Maize and Wheat Improvement Centre (CIMMYT)
Apartado 6-641
Mexico D.F. 06600
Mexico
Phone: (52 5) 761 3311

Centro Internacional de la Papa = International Potato Centre (CIP)
Apartado 5969
Lima
Peru
Phone: (51 14) 350 842

CAB International (CABI) (Formerly Commonwealth Agricultural Bureaux)
Headquarters
Wallingford
Oxfordshire
OX10 8DE
UK
Phone: (44 491) 32111
Fax: (44 491) 33508

CAB International (North America)
845 North Park Avenue
Tucson
Arizona
AZ 85719
USA
Phone: (1 602) 621 7897
Fax: (1 602) 621 3816

CAB International (Asia)
PO Box 11872
50760 Kuala Lumpur
Malaysia
Phone: (60 3) 255 2922
Fax: (60 3) 255 1888

CAB International (Caribbean & Latin America)
10 Gordon Street
Curepe
Trinidad and Tobago
Phone: (1 809) 662 4173
Fax: (1 809) 663 2859

Consultative Group on International Agricultural Research (CGIAR)
1818 H Street
N.W.
Washington
DC 20433
USA
Phone: (1 202) 334 8021

International Board for Plant Genetic Resources (IBPGR)
c/o FAO
Via della Terme di Caracalla
I-00100 Rome
Italy
Phone: (39 6) 574 4719
Fax: (39 6) 575 0309

International Centre for Agricultural Research in Dry Areas (ICARDA)
PO Box 5466
Aleppo
Syria
Phone: (963 21) 213 433

International Crops Research Institute for the Semi-Arid Tropics (ICRISAT)
Pantancheru PO
Andrha Pradesh
50234
India
Phone: (91 842) 224 016
Fax: (91 842) 241 239

International Food Policy Research Institute (IFPRI)
1776 Massachusetts Avenue
N.W.
Washington
DC 20036
USA
Phone: (1 202) 862 5600
Fax: (1 202) 467 4439

International Institute of Tropical Agriculture (IITA)
PMB 5320
Ibadan
Nigeria
Phone: (234 22) 400 300

International Laboratory for Research on Animal Diseases (ILRAD)
PO Box 30709
Nairobi
Kenya
Phone: (254 2) 592 311
Fax: (254 2) 593 499

International Livestock Centre for Africa (ILCA)
PO Box 5689
Addis Ababa
Ethiopia
Phone: (251 1) 613 218
Fax: (251 1) 611 892

International Rice Research Institute (IRRI)
PO Box 933
Manila
Philippines
Phone: (63 2) 818 1981
Fax: (63 2) 818 2087

International Service for National Agricultural Research (ISNAR)
PO Box 93375
NL-2509 AJ
The Hague
The Netherlands
Phone: (31 70) 49 61 00
Fax: (31 70) 381 96 77

West African Rice Development Association (WARDA)
BP 2551
Bouaké 01
1384
Côte d'Ivoire
Phone: (225) 63 45 14
Fax: (225) 63 47 14

Forestry data

Oxford Forestry Institute
Department of Plant Sciences
University of Oxford
South Parks Road
Oxford
OX1 3RB
UK
Phone: (44 865) 275 000

Centre Technique Forestier Tropical
Forest Management Programme
45 Bis, Avenue de la belle Gabrielle
97436 Nogent/Marne Cedex
France

Centre for International Forestry Research (CIFOR)
c/o ACIAR
GPO Box 1571
Canberra ACT 2601
Australia
Fax: (61 6) 257 3051

Fisheries data

International Center for Living Aquatic Resources Management (ICLARM)
MCC PO Box 1501
Makati
Metro Manila
Philippines
Phone: (63 2) 818 0466

Economic and development data

International Institute for Environment and Development (IIED)
3 Endsleigh Street
London
WC1H 0DD
UK
Phone: (44 71) 388 2117
Fax: (44 71) 388 2826

United Nations Development Programme (UNDP)
1 United Nations Plaza
New York
NY 10017
USA
Phone: (1 212) 906 5000
Fax: (1 212) 826 2057

International Bank for Reconstruction and Development (IBRD, more commonly known as the World Bank)
1818 H Street
N.W.
Washington
DC 20433
USA
Phone: (1 202) 477 1234
Fax: (1 202) 477 6391

World Tourism Organization (WTO)
Capitan Haya 42
E-28020 Madrid
Spain
Phone: (34 1) 571 0628
Fax: (34 1) 571 3733

2. CONVENTION SECRETARIATS

Addresses of secretariats charged with monitoring the implementation of major international conventions concerning biological diversity and its preservation.

International Convention for the Regulation of Whaling, 1946

International Whaling Commission (IWC)
The Red House
135 Station Road
Histon
Cambridge CB4 4NP
UK
Phone: (44 223) 233 971
Fax: (44 223) 232 876

Convention on Wetlands of International Importance, Especially as Waterfowl Habitat, 1971 (The Ramsar Convention, sometimes known as the Wetlands Convention)

Ramsar Convention Bureau
Rue Mauverney 28
CH 19196 Gland
Switzerland
Phone: (41 22) 999 0170
Fax: (41 22) 999 0169

Convention Concerning the Protection of the World Cultural and Natural Heritage, 1972 (The World Heritage Convention)

World Heritage Convention
UNESCO
7 Place de Fontenoy
F-75700 Paris
France
Phone: (33 1) 45 68 10 10
Fax: (33 1) 45 67 16 90

Convention on Trade in Endangered Species of Wild Fauna and Flora, 1973 (CITES - also known as the Washington Convention)

CITES Secretariat
6 rue du Maupas
Case Poatale 78
CH-1000 Lausanne
Switzerland
Phone: (41 21) 20 00 81
Fax: (41 21) 20 00 84

Convention on the Conservation of Migratory Species of Wild Animals 1979 (The Bonn Convention, abbreviated as CMS)

UNEP/CMS Secretariat
Wissenschaftszentrum
Ahrstrasse 45
D-5300 Bonn 2
Germany
Phone: (49 228) 302 152
Fax: (49 228) 302 270

United Nations Convention on the Law of the Sea, 1982 (UNCLOS)

Office for Ocean Affairs and the Law of the Sea
Office of the Secretary General
United Nations
New York
NY 10017
USA
Phone: (1 212) 963 1234

International Tropical Timber Agreement, 1983 (ITTA)

International Tropical Timber Organisation (ITTO)
5F, International Organizations Center
1-1, Minato Mirai
Nishi-ku
Yokohama 220
Japan
Phone: (81 45) 223 1110
Fax: (81 45) 223 1111

3. COUNTRY CONTACTS

Contact addresses for those countries which have already undertaken a national assessment and may therefore be able to share relevant experience.

Ir. Aca Sugandhy
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Jl. Merdeka Barat 15
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Phone: (62 21) 380 7566
Fax: (62 21) 570 5321

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Environmental Management Development in Indonesia
Jl. Medan Merdeka Barat 15
Jakarta 10110
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Phone: (62 21) 380 7566
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Office of National Environment Board
60/1 Soi Phibuwantant 7, Rama VI Road
Bangkok 10400
Thailand
Phone: (66 2) 279 7180
Fax: (66 2) 279 0672

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National Foundation for Environmental Protection
Krzywickiego 74/66
02-078 Warsaw
Poland
Phone: (48 22) 336 504 / 252 127
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Phone: (1 809 322) 4908
Fax: (1 809 323) 3863

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PO Box 41395
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Phone: (254 2) 742 131
Fax: (254 2) 741 424

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Ministry of Water, Energy, Minerals and Environment Protection
PO Box 9629
Kampala
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Centre for Land and Biological Resources Research
Agriculture Canada
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Central Experimental Farm
Ottawa
Ontario K1A OC6
Canada
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Dr Rodrigo Gamez-Lobo
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Fax: (506) 362 816

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ANPWS
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Canberra ACT 2617
Australia
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Phone: (61 62) 500 271
Fax: (61 62) 500 228

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Executive Secretary of the National Environment Commission
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Piso 13
Casilla 520-V, Correo 21
Santiago 60
Chile
Phone: (56 2) 699 6127 / 699 2476
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Names and addresses of members of the UNEP Editorial Advisory Panel (Panel 5) on the guidelines for the preparation of biodiversity country studies

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