PROTECTED AREAS MANAGEMENT INFORMATICS HARMONIZATION FOR LATIN AMERICA AND THE CARIBBEAN
VOLUME I:
USER NEEDS AND DATA SET REQUIREMENTS

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0. ABSTRACT

The Inter-American Biodiversity Information Network (IABIN) is an Internet-based forum for technical and scientific cooperation, which seeks to promote greater coordination among Western Hemisphere countries in the collection, sharing, and use of biodiversity information relevant to decision-making and education, as well as a liaison with international initiatives. One of its five thematic networks is the "protected areas thematic network" (PATN). Exchange of information and data among users require compatibility of data and good measurement practices. The objective of this report is to promote compatibility of information and data based on concepts of good measuring practices; it has been formulated as follows:

" For the Western Hemisphere,

1.identify current protected areas data sets,

2.propose minimum information needs,

3.standardize protected areas natural resources informatics for ensuring consistency and compatibility of data in the hemisphere, and

4.prioritize data collection needs".

Protected areas informatics has been defined as follows:

"Protected areas informatics integrates biological, physical, chemical, social and/or mathematical sciences and principles with digital techniques for data storage and processing needed (i) to assess and evaluate changes occurring in protected areas and the ecosystems and species that find shelter within them (ii) to provide the information needed to prevent or mitigate unacceptable change or to restore them to previously existing conditions and (iii) to optimize their socio-economical and cultural benefits to society"

Stakeholders in protected areas informatics include: Ministers BD portfolio; Parties to the CBD; United Nations; Directors of the protected areas agencies; Directors of protected areas; Bi- and multilateral financing agencies; Universities and scientists; NGOs; Local stakeholders; The tourism sector; Tourists; Project executors; Prosecutors and defense lawyers; Interested citizens. For each stakeholder group the primary topics of interest have been identified from the following options: Legal status and management objectives; Species distribution; Ecosystem distribution; Representativeness species in PAS; Representativeness ecosystems in PAS; Overall state of conservation of SSC; State of conservation single SSC; Ratio protected areas/territory; Land area covered by forest; Overall state of conservation species; State of conservation Ecosystems; Harvesting of products; Illegal felling; Poaching; Construction; Habitation; Forest fires and other vegetation transformation; Visitation; Management costs; Budget; Achievement budget goals.

In order to be able to address the primary informatics needs effectively, the report presents a thorough review of data collecting options and their technical effectiveness and their efficiency in data collection time, human resources and in costs. As species conservation is considered a fundamental objective of protected areas in the context of the Convention of Biological Diversity, the document reviews the essential information characteristics that would allow the protection of a diverse selection of species and the monitoring of the effectiveness of their conservation. It concludes that the following data sets are essential for protected areas informatics: Detailed ecosystem maps based on physiognomic ecological characteristics, complemented with locations where fauna elements congregate periodically or permanently. Ecosystems thus identified and mapped provide very efficient

and representative selections of partially distinct assemblies of species. They also allow the assessment of minimum area requirements (MAR) for all species and can thus be used to assess the chance of survival of such species with high MAR requirements in a specific area or a national protected areas system. Minimum ecosystem requirements have been proposed on the bases of the known information on MARs for all macrofauna of the hemisphere and the size requirements have been grouped in "typically small, medium and large ecosystems" Over time, mapped based information needs to be consolidated with field data of species of special concern and some of their specific population and / or habitat requirements. In certain problem areas, additional field data may be needed on water and soils. In areas or locations in areas with human use of the natural resources, data may need to be collected on species harvested, visitation, soil intervention, etc. For the effective management of all protected areas, base administrative information is essential: budgets, availability of staff, infrastructure and maintenance / replacement schedules of equipment and infrastructure.

After the review of all these informatics needs, the document proposes the different data storage options with the characteristics of their fields in databases. The document emphasizes that there are no minimum data fields other than those recommended for the World Protected Areas Database. The reason for that is that each area is different, and it is not possible to recommend the collection of data any specific species of special concern or ecological condition. Each protected areas agency should identify which data need to be collected and where. This document merely provides a solid collection of options for data collection and storages, while its application would facilitate the integration of data across borders of protected areas and nations.

The data options provided include both terrestrial and aquatic ecological conditions and all the climatic conditions varying from glacial to humid and dry tropical. These conditions can be encountered in any part of the Hemisphere and often in just one individual country, with all the gradients in between. Therefore, regionalization of protected areas informatics in the Hemisphere of the Americas is not useful, and it is highly recommended that data storage be done so in the same fashion without distinction by region.

Finally, it must be emphasized, that the document provides a solid collection of data storage options, so that data storage needs may be addressed consistently throughout the region, but it is not the intention of the report to strife for the systematic collection of all these data for each protected area. On the contrary, such all embracing data collection effort would be far too costly and completely unnecessary. It is recommended that the managers of each protected area makes a selection of a very limited number of data to be collected (may be one or a few species), so that those data may be collected over a prolonged period of time, without creating too much pressure on budget and human resources.

Keyword list

baseline
biocenose
biocoenose
biodiversity
Braun-Blanquet
CBD
ecology
ecosystem
ecosystems map
forest
habitat
IABIN
indicator
informatics
keystone species
LCCS
limnic
marine
minimum area requirement
minimum viable
monitoring
national park
nature
physiognomic classification
phyto-sociological classification
population
protected area
reserve
species
species area curve
classification
vegetation map
Zürich-Montpellier School

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Important contributions and recommendations have been made by representatives of the protected areas agencies present at the technical meeting of the Protected Areas Thematic Network in Foz de Iguacu in June 2007.

ACRONYMS AND ABBREVIATIONS

BD	Biodiversity
CBD	Convention on Biological Diversity
CI	Conservation International
CCAD	Comisión Centroamericana de Ambiente y Desarrollo
CFCs	Chlorofluorocarbon
COP7	Conference of the Parties + number (of the CBD)
dbh	Diameter at breast height
DCMI	Dublin Core Metadata Initiative
DES	Dirección de Evaluación y Seguimiento de la CONANP
DSA	Daily Subsistence Allowance
EBA	Endemic Bird Area
FAO	Food and Agricultural Organization of the United Nations
FNP	Fundacão o Boticario de Protecão à Natureza
GEF	Global Environment Facility
GIS	Geographical Information System
GPS	Global positioning system. The term usually refers to the GPS receiver.
IABIN	Inter-American Biological Network
IBA	Inportant Bird Area
IEC	International Electrotechnical Commission
ISO	International Organization for Standardization
ITC	International Institute for Geo-Information Science and Earth ObservationInternational Institute for Geo-Information Science and Earth Observation
IUCN	The World Conservation Union
Lat	Latitude position
LCCS	Land Cover Classification System
Lon	Longitudinal position
MAR	Minimum area requirements
MEE	Management Effectiveness Evaluation
M,E&R	Monitoring, Evaluation & Response
MET	Major Ecosystem Types
MHT	Major Habitat Types
MICOSYS	Minimum Conservation System Modeling Programme
MODIS	Moderate Resolution Imaging Spectroradiometer
MPA	Marine Protected Areas
MVP	Minimal Viable Population
NGO	Non Governmental Organization
OAS	Organization of American States
OASIS	Organization for the Advancement of Structured Information Standards
ODP	Ozone Depletion Potential
OGC	Open Geospatial Consortium, Inc
PAA	Protected Areas Agency
POA	Programa Operativo Anual
PATN	Protected Areas Themetic Network
SAR	the species/area relationship
TME	Typically medium size terrestrial ecosystems
TNC	The Nature Conservancy
TSE	Typically small ecosystems
UN	United Nations Organization
UNEP	United Nations Environment Programme
UNEP-WCMC	UNEP World Conservation Monitoring Centre
UNESCO	United Nations Educational, Scientific and Cultural Organisation
USNVC	United States National Vegetation Classification
UTMU	niversal Transverse Mercator
WDPA	World Database on Protected Areas
WICE	World Institute for Conservation and Environment
WWF	Worldwide Fund for Nature

1. INTRODUCTION

1.1. GEF ASSISTED PROJECT "BUILDING THE INTER-AMERICAN BIODIVERSITY INFORMATION NETWORK" (IABIN) PROJECT

Responding to the importance in the Americas of protection of biodiversity, the Inter-American Biodiversity Information Network (IABIN) was officially mandated at the Summit of the Americas on Sustainable Development, convened by the Organization of American States in Santa Cruz de la Sierra, Bolivia, in December 1996. IABIN is an Internet-based forum for technical and scientific cooperation that seeks to promote greater coordination among Western Hemisphere countries in the collection, sharing, and use of biodiversity information relevant to decision-making and education. The objective of IABIN is to promote sustainable development and the conservation and sustainable use of biological diversity in the Americas through better access to and management of biological information. While IABIN is envisioned as a distributed system of data providers in which the data are maintained and controlled by the provider, coordinated access to the integrated resources of the network is a key component of IABIN.

A five year Global Environment Facility (GEF) Grant of US$6.0 million for the Building the Inter-American Biodiversity Information Network (IABIN) Project (the project) is executed by the General Secretariat Organization of American States (GS/OAS) and Implemented by International Bank for Reconstruction and Development (the Bank).

Six Thematic Networks have been identified as a priority for IABIN:

1. Specimen Network
2. Species Network
3. Ecosystems Network
4. Invasive Species Network
5. Pollinators Network
6. Protected Areas

The study subject to this document **"Protected Areas Management Informatics Harmonization for Latin America and the Caribbean"** is part of the work of the Protected Areas Thematic Network.

UNEP-WCMC and the Dutch Ministry for Environment (MNP-RIVM) designed a project on biodiversity indicators for national use (BINU) and the this document draws on many of the recommendations of that project. One of the first issues dealt by the BINU project was to develop a question-led approach as they lived among the stakeholders.

Because of the broad range of instruments and sectors concerned in the conservation and sustainable use of biodiversity, the BINU project found that it was often difficult for the participating countriies to identify and analyse relevant policies comprehensively. Obvious policies that were relatively accessible included national biodiversity strategies and action plans (NBSAP), protected areas systems plans and endangered species legislation. Relevant policies in natural resource management sectors included national forest plans, fisheries policies, water policies, land-use plans and environmental impact legislation. Even when the relevant policies could be found, their objectives were often framed very generally and no mechanisms for measuring progress were specified. In other instances the declared indicators did not match the policy objectives and targets. Through engaging different stakeholder groups, it was possible to identify critical policy related questions. In the next paragrahp, the documents lists some strategic and tactical questions that protected areas managers and planners may be confronted with.

Strategic questions

Strategic questions to protected areas managers, planners and decision makes may include:

- What is the contribution of protected areas systems to the conservation of biodiversity?

- How effective is the protective area system at protecting biodiversity?
- Is the protected areas system representative of the species of our country?
- Are all the ecosystems represented?
- There still are so many beautiful natural areas in the country. On the basis of which, can we select the best there is in a protected areas system that our country can effort?
- How much staff, infrastructure and materials do we need to effectively manage our protected areas and how much budget do we need to finance that?
- The public interest in the protected areas is not really as high as we would like. How can we get the public more involved in the protected areas? What kind of information should we provide?
- Who are our greatest supporters with the greatest political impact? How can we reach them and what kind of information do they need?
- Our protected areas agency is deplorably under-budgeted. What kind of information could we give our Minister to help him/her to get more funding from the Minister of Finance and from Parliament?

Tactical questions

Questions of more tactical nature might be:

- What is an ecosystem anyway, and how can I distinguish in in the field?
- On which criteria can I map the ecosystems so that I can overlay them with the protected areas map layer?
- What are indicator species for protected areas and what do they tell me about the area or ecosystem?
- How can we tell if we are successful at protecting the species of each protected area if we don't even know them?
- Everybody asks us to monitor, but we don't even have staff in every area.
- Local stakeholders need benefits from the protected areas in order to collaborate with the overall conservation effort. How can we generate benefits, while durably protecting the resource? How can we get reliable information on resource use?

1.2. OBJECTIVE OF THE STUDY AND ORGANIZATION OF THE DOCUMENT

Exchange of information and data among users require compatibility of data and good measurement practices. The objective of this report is to provide such compatibility of information and data based on concepts of good measuring practices as formulated as follows:

" For the Western Hemisphere,

1. **identify current protected areas data sets,**
2. **propose minimum information needs,**
3. **standardize protected areas natural resources informatics for ensuring consistency and compatibility of data in the hemisphere, and**
4. **prioritize data collection needs".**

The reader is taken through both political and scientific information needs and technical and financial restrictions on the nature of the data that can be collected. Before choices can be made on a "minimum and desirable" data set, the reader must understand which data collection options exist and what the restrictions their use may bring. These issues are analysed and presented in **VOLUME I: USER NEEDS AND DATA SET REQUIREMENTS.**

The BINU project explains how creative thinking is paramount in developing methods for identifying required data sets and presenting them to non-specialists. The art in developing indicators is to simplify without losing scientific credibility. This requires a thorough understanding of the concepts being dealt with, competence in handling data and the confidence to experiment and innovate. None of these is straightforward, and it is important not to underestimate the challenges in developing robust, resonant indicators. Whatever procedures are followed, and whatever indicators are produced, it is of fundamental importance that they remain scientifically defensible. This requires a rather detailed scientific analysis based on extensive literature review to determine which methods can be used most effectively. The scientific bases of these principles are reviewed in **VOLUME II: CIENTIFIC BACKGROUND ON THE IDENTIFICATION OF ECOSYSTEMS AND SPECIES ASSEMBLAGES AND ANNEXES**

2. PROTECTED AREAS INFORMATICS

2.1. DEFINITION OF "PROTECTED AREAS INFORMATICS"

Informatics includes the science of information, the practice of information processing, and the engineering of information systems. Informatics studies the structure, behavior, and interactions of natural and artificial systems that store, process and communicate information. Informatics has been defined for a variety of fields. (National Institutes of Health 2007, Merriam-Webster 2007, Wikipedia 2007, European Environment Agency 2006, Encarta 2007, Britannica 2007, Oxford Dictionary 2007). In analogy of definitions for other fields, this document formulates the following definition for protected areas informatics:

"Protected areas informatics integrates biological, physical, chemical, social and/or mathematical sciences and principles with digital techniques for data storage and processing needed (i) to assess and evaluate changes occurring in protected areas and the ecosystems and species that find shelter within them (ii) to provide the information needed to prevent or mitigate unacceptable change or to restore them to previously existing conditions and (iii) to optimize their socio-economical and cultural benefits to society" It can have any of the following main characteristics or combination thereof:

1. Biological, chemical and physical;
2. Socio-economical, cultural and religious;
3. Digital, mathematical and mathematical modelling;
4. Printed (including photographs);
5. Artistic expressions (photographs, drawings, paintings, sculptures, written).

This study primarily deals with elements 1 and 3, while the studies on management effectiveness of protected areas deal with socio-economical informatics. Printed informatics are not dealt with, as nowadays they first pass through a digital phase, dealt with in this document. Artistic expressions, are systematically highly undervalued in the context of protected areas, but in this context, they would not benefit from the objectives of this document, as they should never be subject to any form of standardization or normation.

2.2. STAKEHOLDERS AND THEIR INFORMATION NEEDS

Governments of any country need to inform the stakeholders (administrators, beneficiaries, local communities, politicians, citizens, NGOs, etc.) about the policies they execute and about the effectiveness of the programs to reach the objectives of those policies. This implies that the effects of the policies and the actions to achieve their objectives have to be measured and assessed continuously through a Monitoring, Evaluation & Response (M,E&R) program that is firmly embedded in the organization and operation of the management administration. The stakeholders and their information needs shall be reviewed in Chapter 3#.

2.3. INFORMATION NEEDS

The needs for protected areas information gathering strongly centres around the Convention of Biological Diversity, to which most of the IABIN countries are signatories and to which most national legislation is compliant. In this document we shall review them by the following 4 main needs categories:

I. Assessment of the degree of compliance with policies;
II. Provision of knowledge about the natural and cultural resources of and processes in protected areas for cultural (the enjoyment of nature, history, ancestral ties and religious worship), scientific and commercial (e.g. Tourism) use;
III. Representation of natural phenomena;
IV. Facilitate knowledge about and the option of response to change, threats, impacts and if potential response options.

Each one of those prime-needs categories is closely related. The information needs shall be systematically analysed in Chapter 8#.

2.4. STANDARDIZATION OF PROTECTED AREAS INFORMATICS

Main standardization issues

For the standardization of Protected Areas informatics, one needs to consider 3 major criteria:

1. Biological and physical information gathering techniques;
2. Digital information storage techniques and formats;
3. Metadata.

Biological and physical information gathering techniques

Biological and physical information gathering techniques and data storage are dealt with by the Species and Ecosystems Thematic Networks respectively. This document reviews some specific needs from a protected areas needs perspective.

Digital information storage techniques and formats

Digital information storage techniques are defined by international consortia of users, producers and governments to reach industry wide compatibility and interoperability. This document reviews some specific needs from a protected areas needs perspective.

Digital information for Protected areas informatics consists of the following prime data sets:

1. Office applications (text documents, spreadsheets, databases);
2. Geographical Information Systems;
3. Remotely Sensed Data;
4. Photographic images.

In principle the IABIN nations don't define the industry standards, but follow them. This document summarizes the main discussion and proposes choices in the best interest of the IABIN nations, when cross-industrial agreement appears to be lacking.

Metadata

While metadata provide information about data to make them more accessible to users, there seem to be no compelling reasons to create special criteria for their standardization in the context of protected areas informatics. In Chapter 7.2 # a brief overview is presented on the main types of metadata in the context of protected areas informatics.

2.5. PRIORITIZATION OF DATA COLLECTION NEEDS

Data can be gathered in seemingly endless forms and quantities, and the needs for potential uses and applications will always exceed the possibilities of their production, which leads to the need for prioritization. Important limitations on data gathering may include:

I. Inadequate financing to perform all tasks desired.
II. Not all tasks can be performed simultaneously;
III. Some tasks are easier, more economical or faster than others;
IV. Some information is more urgently required than other;

In Chapter 8 # minimum and desirable requirements are suggested for different data sets.

2.6. CURRENT PROTECTED AREAS DATA SETS

The national institutions mandated with protected areas policy formulation and execution have been approached through the focal points of each country of Latin America. These institutions have been requested

I. To fill out the questionnaire shown in Annex #;
II. To send a copy of their databases or an exported file that could give insight in their database structure, and
III. To provide a copy of the manual and or instructions for their field staff.

An overview of the collected data is shown in Annex #.

3. ANNOTATED ASSESSMENT OF PRINCIPAL USERS OF PA INFORMATICS AND THEIR REQUIREMENTS

A protected areas data gathering program should be oriented to the needs of the principal users or stakeholders. This Chapter reviews the principle information users by category and reviews their information needs. Stakeholders have been identified on the basis of a questionnaire, interviews, reviews of international commitments and project documents of development projects. In compliance with the terms of reference, the principal users have been prioritized in three levels of prioritization: High (H), Intermediate (M) and Basic (B) in Table 1#.

3.1. PARTIES TO THE CBD

The parties to the CBD have committed themselves to inform each other on the progress made on the conservation of biological diversity including the conservation of protected areas. They have committed themselves to achieve a significant reduction of biodiversity loss by 2010. The parties to the CBD present progress reports during the Conference of the Parties (COP+number). One of the earlier decisions made by the Conference of the Parties to the CBD urged Parties to identify indicators of biological diversity as a high priority. It also called on Parties to collaborate on a voluntary pilot project to demonstrate the use of successful assessment and indicator methodologies UNEP-BINU 2007). As biodiversity conservation is most effectively achieved in protected areas systems, this requires that protected areas be representative of the species of each country and that the state of conservation of each area be effective in terms of species conservation.

3.2. THE UNITED NATIONS

The UN Millennium Goals are to be achieved by 2015. It lists 7 Goals, 18 Targets and 48 Monitoring Indicators, of which relevant in this context are:

I. Goal VI "**Ensure Environmental Sustainability**",
II. Target 9 "**Integrate the principles of sustainable development into country policies and programs and reverse loss of environmental resources**" and
III. Monitoring indicators:
    a) Indicator 25: **Proportion of land area covered by forest**
    b) Indicator 26: **Ratio of area protected to maintain biological diversity to surface area**
    c) Indicator 28: **Carbon dioxide emissions per capita and consumption of ozone-depleting CFCs (ODP tons)**

The integration of the principles of sustainable development into country policies and programs also requires the effective integration of protected areas in the lives of the citizens of a country, both rural and urban. Compliance requires information on use, such as harvesting of wood and non-wood products and visitation to the areas, without compromising the integrity of the areas concerned.

Reporting on the reverse loss of environmental resources, requires the possession of a baseline on the environmental (or rather natural) resources and transformation of environmental resources over time. Particularly ecosystem recovery after effectuation of management actions might fall under this sub-goal of the UN Millennium Goals. In practice, this fall under M,E&R.

Indicators 25 and 26 coincide with the reporting needs for the CBD.

Indicator 28 needs attention in so far as the national vegetation cover changes, but this is rather much beyond protected areas informatics.

Reporting is done in the context of the Millennium Goals.

3.3. MINISTERS DEALING WITH THE BIODIVERSITY PORTFOLIO

Ministers dealing with biodiversity may include the Ministers of Agriculture, of Natural Resources and/or of Environment and those mandated with the promotion of commercial activities and export.

The Minister mandated with the BD policy would need information that facilitates him/her to formulate, adapt and defend the biodiversity conservation policies before parliament, the general public and specific stakeholders (NGOs). Without exception, the protected areas agencies in Latin America are very severely under-budgeted and understaffed. The mandated Minister needs information to defend before the Minister of Finance and Parliament why increase of budget and staff is necessary. In this context, information on the management effectiveness of the protected areas agency and the state of conservation of the protected areas system are very important as well as reports on the benefits to society, which is reflected in the use of the areas, particularly visitor use. Therefore, ministers need a periodic (probably annual) report on compliance with targets set, while the Minister mandated with the protected areas agency needs a baseline on budget requirements as well as information on the gap between the desirable and available budget and staffing situation.

In some cases, the Minister mandated with the biodiversity related policy may not be the same as the one mandated with the management of protected areas. For the promotion of biocommerce and the production of wild species or products made from them, the Ministers of Agriculture, and/or economic promotion may be involved in such activity. In so far as the development and production of products from wild species stems from protected areas, these ministers are interested in:

- the availability of (potential) products in the protected areas – particularly in those with sustainable use options (categories IUCN IV, V and VI);
- their state of availability for sustainable use;
- their actual use when it takes place and their degree of sustainability.

Particularly in the case of actual use, quantitative monitoring will be required on the products harvested. Products may include wood, fruits, skins, meat from wildlife, mushrooms, ornamental fishes, orchids and other ornamental plants, etc.
The ministers receive their information through annual reports from the Protected Areas Agency and through briefings by their directors.

3.4. THE DIRECTORS OF THE NATIONAL PROTECTED AREAS AGENCIES

The directors of Protected Areas Agencies (PAA) are responsible for running their agencies efficiently and effectively so that the protected areas system as a whole may durably accommodate as much biodiversity as possible. Their focus is on the effectiveness of the system as a whole and on the effectiveness of the organization. Directors of PAA need information to make decisions on the administrative and organizational management of the entire system and for reporting to the minister. S/He needs information on

I. The state of conservation in the protected areas nationwide of species of special concern;
II. Ecosystems and the changes taking place within them (both deterioration and improvement) through change detection;
III. Harvesting of products in IUCN category IV, V and VI areas;
IV. Visitation;
V. Management costs;
VI. Budget for the entire system;
VII. Achievement budget goals of the system;
VIII. Staffing of the system;
IX. Income from various sources benefiting the administration;
X. Quantified economic benefits for society.

Directors of PAAs need annual reports prepared by one or several monitoring coordinators or a monitoring director. Collected data by the protected areas should ideally be periodically collected and integrated into a central database, and non-sensitive data should be accessible by internet, as well as the annual reports.

3.5. THE DIRECTORS OF PROTECTED AREAS

The directors of protected areas are responsible for the effective conservation of the biodiversity of their individual protected area and on satisfying the reasonable expectations of society from their area. To that end, the directors of each protected area need information on the impact of interventions on the local stakeholders to justify specific measures (both positive measures which promote economic benefits as well as corrective measures to prevent deterioration of the state of conservation). They also need timely information on changes and threats in order to respond accordingly; on a very short notice if necessary.

Their immediate information needs are:

I. Changes in the conservation status of species of special concern of their areas beyond normal deviations;
II. Illegal harvesting of wood- and non-wood products;
III. Illegal settlement;
IV. Illegal construction;
V. Forest fires;
VI. Any sudden significant change;
VII. Stakeholder complaints.

Directors need routine reporting on:

1. Budget use and deviation from program costs;
2. Monitored species of special concern;
3. Change detection reporting;
4. Visitation and visitor data;
5. Harvesting of wood and non-wood products;
6. Income from fees and royalties.

Monitoring coordinators need to prepare an annual monitoring report and they need to periodically send the data in the database to a central data point in the headquarters. In the case of an emergency, rangers need direct access to the director of a protected area.

3.6. BI- AND MULTILATERAL FINANCING AGENCIES

For their planning of financing portfolios, donors and multilateral banks require:

I. General sectoral information on biodiversity conservation,
II. The country's compliance with international agreements and its performance record in their contexts;
III. The contribution of biodiversity conservation to poverty alleviation, particularly on the local level
IV. The contribution of biodiversity conservation to the national economy through sectoral benefits (such as the facilitation of ecotourism and all derived benefits to the entire tourism sector);
V. The financial commitment of the government and the commitment per donor and lender.

For their ongoing programs, these institutions need progress reports based on performance indicators and financial data in order to justify these investments before their board of directors (World Bank and IDB) or ministers of development cooperation in the cases of respectively multi- or bilateral cooperation agencies.

Bi- and Multilateral agencies receive reports on request from the PAAs and they can download the annual reports that are published on the PAA website.

3.7. UNIVERSITIES AND SCIENTISTS

Scientists need verifiable and statistically sound quantitative data for scientific research. In general, scientific research needs data collected based on good measurement practices, carried out by well-trained data collectors. The data needs for research purposes are extremely varied and often specific for

each individual study. In general, it is not possible in the context of this study to provide standardization other than general standardization guidelines for data collection and storage. With regard to storage of data on species and ecosystems, further criteria are provided by the other IABIN thematic networks.
Universities and scientists can download monitoring reports from the internet and they should have access to publicly available data over the internet.

3.8. NGOS

Depending on their missions, non-governmental organizations require information to

I. assess the impact of government programs;
II. lobby their point of view (which may differ from one NGO to another) with all levels of government and/or with the public;
III. carry out their activities;
IV. watch over compliance with promises and policies of authorities;
V. monitor the state of conservation;
VI. spread information and educate the public, etc.

NGOs can download monitoring reports from the internet and they should have access to publicly available data over the internet.

3.9. LOCAL STAKEHOLDERS

Local communities (ethnic groups, farmers and local entrepreneurs) demand transparency and information to enable them to participate in decision-making processes related to management programs, which may well have a bearing on their rights, economic opportunities and cultural life. On the one hand, their interest may be focussed on restrictions imposed on traditional land use opportunities as well as the effectiveness of enabling activities from the government to generate employment and economic opportunities (like visitation infrastructure and opportunities to provide services and sell products in or near protected areas). Local stakeholders may have particular interest in land-use data, unless they fear that such data may lead to additional restrictions.
Local stakeholders can download monitoring reports from the internet and they should have access to publicly available data over the internet.

3.10. THE TOURISM SECTOR

Tourism agencies and outfitters require information for their clients, as well as for marketing purposes. Their needs may include data on species of special concern, "flagship" and conspicuous species, environmental tolerance, best visitation options, information about presence and condition of biodiversity, accessibility of an area, etc.;
Tourism agencies and outfitters can download monitoring reports from the internet and they should have access to publicly available data over the internet. Moreover, the tourism sector needs webpages listing all the protected areas with their highlights and information on how to benefit from visits to the protected areas, as well as a protected areas map for downloading..

3.11. PROJECT MANAGERS

Data on the effects of projects are needed, whether they are protected areas management projects or infrastructure projects. In the case of the latter, the data that have already been collected for an area may serve for an in-depth baseline for an environmental impact study. In the context of a management project, data are needed to provide technical evidence on management effectiveness.
Project managers should have access to all the data and reports on the protected area of their interest if that is in the context of public procedures of their management function.

3.12. PROSECUTORS AND DEFENCE LAWYERS

To carry out the due course of justice when violations are called to court and when impacts need to be compensated or reflected in punitive action, prosecutors need information on violations and impacts, while defense lawyers need the same information for defending their clients.

Prosecutors and defence layers should have confidential access to all the data in the possession of the PAA. They should have access to all reports and the entire database.

3.13. INTERESTED CITIZENS

Both nationally and abroad citizens are concerned with the fate of plants and animals in the world. While probably very few would want to know the details of the state of conservation of all plants and animals, they would like to know that conservation is on track and if not, what the main problems are and what can be done to improve the situation. Moreover, many people want to visit nature reserves and national parks and like to get basic information on what to see, where and how.

Interested citizens can download monitoring reports from the internet and they should have access to publicly available data over the internet. Moreover, citizens needs webpages listing all the protected areas with their highlights and information on how to benefit from visits to the protected areas, as well as a protected areas map for downloading.

PROTECTED AREAS INFORMATION NEEDS BY STAKEHOLDER AND TOPIC

INFORMATICS STAKEHOLDERS	RESOURCES INFORMATON																		MANAGEMENT EFFECTIVENESS									
	Legal status and management objectives	Species distribution	Ecosystem distribution	Representativeness species in PAS	Representativeness ecosystems in PAS	Overall state of conservation of SSC	State of conservation single SSC	Ratio protected areas/territory	Land area covered by forest	Overall state of conservation species	State of conservation Ecosystems	Harvesting of products	Illegal felling	Poaching	Construction	Habitation	Forest fires and other vegetation transformation	Visitation	Management costs	Budget	Achievement budget goals	Staffing	Income resource use	Quantified benefits for society	Stakeholder satisfaction/complants	Socio-economic information local stakeholders	Contribution protected areas to national economy	Stakeholder prioritization
Ministers BD portfolio	3	2	2	3	3	3		3	3	3	3		3	3			3	3	3	3	3	3	3	3	3	2	3	H
Parties to the CBD	3	1	1	3	3	3		3		3	3									3		3						H
UN Millennium Goals								3	3	3	3																	M
Directors of the protected areas agencies	3	3	3	3	3	3		3	3	3	3																	H
Directors of protected areas	3						3					3	3	2	2	2	3	3	3	3	3	3	3	3	3	2	3	H
Bi- and multilateral financing agencies	1			3	3	3		1	1	1	1	2	1	1				2	2	3		3	2	3	1	2	3	M
Universities and scientists	2	3	3	3	3	3	3	2	2	3	3																	B
NGOs	3	1	1	3	3	3	3	1	1	3	2	2	2	2		1	2	1	1			1			3		2	M
Local stakeholders	1					2	2						3	2	2	2	2	3		1	2	2	2	3	3	3		H
The tourism sector	1					3	3			3								3				1					3	M
Tourists	3					1	3			1																		B
Project executors	1						3		3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3		H
Prosecutors and defense lawyers	3						3						3	3	3	3	3											M
Interested citizens	1			2	1	3	1	1	1	2	1						2	1				1		2	1		2	B

Table 1: Protected Areas information needs by stakeholder and topic: 1= low; 2=moderate; 3=high; overall prioritization of stakeholders: H = high, M=intermediate, B=basic.

4. ASSESSMENT OF COMPLIANCE WITH POLICIES

4.1. PROTECTED AREAS INFORMATICS IN THE CONTEXT OF THE CBD

As almost all nations in the American Hemisphere are party to the Convention on Biological Diversity, (CBD), this convention is normative for national policies on biological conservation of most IABIN countries. It sets the framework for the protected areas systems and the national legislation that define their management regimens as well as for the protected areas informatics required for management and reporting. The protected areas informatics needs in the context of the CBD overlaps with those of most stakeholders. This chapter analyses the precise relevant text of the CBD and interprets the consequences, among other things using analytical publications of the IUCN (inter alia Glowka 1994, IUCN 2003, the IUCN Best Practice Protected Area Guidelines Series, etc.).

Most relevant in the case of protected areas informatics is:

Article 8. In-situ Conservation

"Each Contracting Party shall, as far as possible and as appropriate:

- Establish a system of protected areas or areas where special measures need to be taken to conserve biological diversity;
- Develop, where necessary, guidelines for the selection, establishment and management of protected areas or areas where special measures need to be taken to conserve biological diversity;
- Regulate or manage biological resources important for the conservation of biological diversity whether within or outside protected areas, with a view to ensuring their conservation and sustainable use;
- Promote the protection of ecosystems, natural habitats and the maintenance of viable populations of species in natural surroundings;
- Promote environmentally sound and sustainable development in areas adjacent to protected areas with a view to furthering protection of these areas;
- Rehabilitate and restore degraded ecosystems and promote the recovery of threatened species, inter alia, through the development and implementation of plans or other management strategies."

The word "system[1]" implies that the protected areas of a Party should form a coherent collection of areas, in which the various components conserve different portions of biological diversity. It also implies the need for geography-based information (maps) to relate spacial information about species with the spaces of the areas in the system. Annex I of the CBD is to give guidance to the nature of the components to be identified and monitored by a Party. The latter is to take in consideration the indicative list of biodiversity components defined in that annex:

"Identification and Monitoring:

- Ecosystems and habitats: containing high diversity, large numbers of endemic or threatened species, or wilderness; required by migratory species; of social, economic, cultural or scientific importance; or, which are representative, unique or associated with key evolutionary or other biological processes;
- Species and communities which are: threatened; wild relatives of domesticated or cultivated species; of medicinal, agricultural or other economic value; or social, scientific or cultural importance; or importance for research into the conservation and sustainable use of biological diversity, such as indicator species; and
- Described genomes and genes of social, scientific or economic importance."

[1]A system is a set of entities comprising a whole where each component interacts with or is related to at least one other component. Any object which has no relation with any other element of the system is not part of that system (Wikepedia 2007).

By means of the phrase "Identification of components of biological diversity are important for its conservation and sustainable use", the CBD emphasizes the importance of the biological components of in the nations of the parties. is an essential step in the process of compozing a representative system of protected areas. It requires the identification and finding of species as well as ecosystems (See the definitions of the CBD in Annex 1).

Two years after the Earth Summit, the IUCN published a "*Guide to the Convention on Biological Diversity"* (Glowka et al. 1994); this guide provides a solid basis on how to work with the CBD. The document stated that it considers protected areas to form the principal element of any national strategy to conserve biodiversity. It concludes that a good network of protected areas forms perhaps the pinnacle of a nation's effort to protect biodiversity, ensuring that the most valuable sites and representative populations of important species are conserved in a variety of ways. This viewpoint has not changed much since then.

When talking about biological diversity, the CBD may be in need of some interpretation. Biological diversity suggests a certain relationship between the size of an area. Dinerstein et al. (1995) argue against the significance of biological diversity alone, because "The emphasis on species richness as an indicator of priority ecoregions has skewed interest to tropical moist broadleaf forests and caused us to neglect the diverse ecosystems and biota found in the drier, non-forested or semi forested ecoregions."

Fjeldsa (2002) warns that "rain-drenched" areas will need to be complemented by areas along the Pacific slopes of the Andes, which South of Guyaquil, Ecuador, become increasingly dry. Some biounits[2] (IUCN 1976, ABC 1987, DHV 1994), like mangroves, paramo grasslands, (Ant-)Arctic tundra and equatorial low open vegetation on sandstone table mountains or Inselbergs are very species-poor compared to tropical lowland forests, even if the latter are in heavily intervened condition (A.M. Cleef, pers. com 2001). Neglect or exclusion of such ecosystems on the basis of their biodiversity scores would have very little consequences for the overall biodiversity of, for instance, many of the Andean countries, but it might lead to the exclusion of some highly appreciated ecosystems and organisms from a country's protected areas system. Apart from their coral reef ecosystems, the species richness per area unit of all but the larger Caribbean islands would score very low compared to any most moist tropical ecosystems in the mainland countries of the Americas. And yet, they are the accommodate nesting grounds to oceanic birds and are the home to many endemic species. Discounting the importance of less species rich ecosystems and islands certainly is not the intention of the CBD. The intention of the CBD must be interpreted as to strife after a **diverse representation of species of each of its parties.** As such, the species and ecosystems in the protected areas systems of the parties need to be representative of the nations' natural heritage. The parties need to report to the convention to which extent the national protected areas system:

I. Has successfully included a representation of its natural heritage in natural surroundings;
II. Are adequate to harbor viable populations of the species within its borders;
III. Is successful at keeping the species alive that it was set out to do.

These are common information needs among all the stakeholders, whether they are concerned with polit-

[2] In literature many terms have been found for geographical units used to denote a geographical unit with distinct ecological, biogeographical and or species composition characteristics. Following ABC, 1997, the term "biounit" is used, when the characteristics of the geographical unit are not specified, but somehow related to the organism in their natural surroundings.

ical reporting responsibilities in the context of international commitments or local service providers that want to inform visitors about the marvels of the protected area where they exercise their business.

Estimates of global species diversity have varied from 2 million to 50 million (Erwin 1997) species, with an intermediate estimate of 4.9 – 6.6 million (Stork 1997) and a best estimate of somewhere near 10 million (WRI 2003), while only 1.8 million have actually been named (M. Kappelle pers. com.). Scientists have been classifying species for over 200 years, and at present rates of progress, it may take several hundred more years to classify all organisms. To select and conserve a representation of the species of a party, it is necessary to know not only what species exist in a country, but their distribution within the country as well. It would be highly improbable that any but maybe the smallest among the Parties could identify the vast majority its species of animals, plants and microorganisms within its jurisdiction within a reasonable period of time, let alone assess their national distributions. The speed of loss of natural habitats means that information on species is needed now. As the Convention requires that species as well as their ecosystems be protected, it is also essential to identify ecosystems as well as their whereabouts. What makes up an ecosystem, however, is much less defined and agreed upon than what makes up a species. It may be argued that the only complete ecosystem is the biosphere. The CBD defines an ecosystem as follows: **"Ecosystem" means a dynamic complex of plant, animal and micro-organism communities and their non-living environment interacting as a functional unit”**.

While assuming that conserving biodiversity in protected areas systems is the most efficient way to reach the goal of the convention, the big question remains: how does one identify biodiversity, in casu, the representative assemblage or set of species? Should one identify all species of a country? If making complete inventories would be feasible, then how should one determine that the assemblage of species of a protected areas system are representative of the natural heritage of a country? To do so, one must also know the geographical distributions of each individual species, which is impossible, given the fact that the majority of species is probably still unknown to science. With regard to ecosystems, the definition of the CBD does not provide sufficient framework for distinguishing between different ecosystems and demarcate their boundaries. In order to assess representativeness of ecosystems in a protected areas system and report on their conservation, a system is needed for their identification, based on unambiguous, clearly defined parameters that can be recognized in the field. This is an essential part of protected areas informatics, and this report deals with these issues in a scientific treatise in Volume II.

The CBD deals with the selection of biodiversity as follows:

“**Article 7. Identification and Monitoring**

Each Contracting Party shall, as far as possible and as appropriate, in particular for the purposes of Articles 8 to 10:

- Identify components of biological diversity important for its conservation and sustainable use having regard to the indicative list of categories set down in Annex I;
- Monitor, through sampling and other techniques, the components of biological diversity identified pursuant to subparagraph (a) above, paying particular attention to those requiring urgent conservation measures and those which offer the greatest potential for sustainable use;
- Identify processes and categories of activities which have or are likely to have significant adverse impacts on the conservation and sustainable use of biological diversity, and monitor their effects through sampling and other techniques; and
- Maintain and organize, by any mechanism data, derived from identification and monitoring activ-

ities pursuant to sub-paragraphs (a), (b) and (c) above."

The CBD combines "identification of components of biological diversity important for its conservation and sustainable use" and monitoring. It clearly links both issues. To a significant extend, identification overlaps with the concept of a baseline data set. Once a Party to the Convention knows what its national biological resources are, it should have an idea how successful it is at setting aside and maintaining a viable representation in the national protected areas system. Following the logic of the Convention, it makes very good sense to design a methodology for biodiversity monitoring that builds on the "identification" referred to in the CBD as being the baseline data set. In the following chapters we shall review the options for minimum baseline needs.

4.2. PROTECTED AREAS INFORMATION SYSTEM DEVELOPMENT

In order to evaluate how well one is doing in reaching a set of management objectives of a protected area, one needs some form of description of the situation in the past. For protected areas several essential issues come to mind:

1. Legal status and management objectives;
2. Representation of the nation's species within the protected areas system and their conservation status;
3. Representation of the nation's ecosystems within the protected areas system and their conservation status;
4. Species conservation status in the protected areas;
5. Environmental quality of the protected areas;
6. Resource use within the protected areas.

To some extend, all these themes overlap, but this document will discuss each one of those themes and analyse what stakeholders would need to know as minimum requirement, what complementary data would be appreciated and how this would translate into data gathering standardization.

The document makes suggestions on what could be considered as minimum desirable data for protected areas: minimum baseline. Point of departure is the text of the Convention on Biological Diversity and the UNEP-WCMC World Database on Protected Areas (WDPA). Intensive use has been made from the experience gathered by the Map of the Ecosystems of Central America and the Ecosystems and Protected Areas Management Database, both developed in an international context under the Auspices of the Comisión Centroamericana de Ambiente y Desarrollo (CCAD), the World Bank and various GEF projects. From the beginning, both products have been developed as fully integrated components, while their development involved the participation of the ministries of the 7 countries that make up the CCAD and about 30 senior scientists from the region as well as some very experienced managers and directors of protected areas. Both have been extensively field tested and used in a variety of applications. Moreover, the analysis builds on the experience of an international IUCN task force on Protected Areas Composition Management and Monitoring, who's IUCN report was distributed at the World Parks Congress in Durban in 2003. Experience on financial analysis and monitoring has been built upon - among other things – experience from the financial working group on the Sistema Nacional de Unidades de Conservação (SNUC) under coordination of the Protected Areas Department of the Ministry of Environment of Brazil, Financial monitoring procedures of the Dirección de Evaluación y Seguimiento de la Comisión Nacional de Áreas Naturales Protegidas (CONANP) of Mexico, and the study on the Costing of Protected Areas Systems of Developing and Transition countries of the world by Conservation International and WICE presented at COP7 in Kuala Lumpur and the Conservation Financing Alliance in Cambridge.

The requirements on the minimum information data set are not necessarily static. It would obviously be ideal if a minimum baseline for each protected areas could be created from the start. However, this is not feasible and this document merely makes suggestions with what to start and how to expand in a consistent way if the necessary resources are available. The information baseline may be developed gradually and improve over time, as new techniques and additional funding, knowledge and data become available. The typology of administrative, technical and biodiversity data needed to respond to the information needs of the different stakeholders and conventions are elaborated in Volume II.

Legal status and management objectives

In the legal status of a protected area, much basic information become explicitly or implicitly available, such as the official name, the geographical position, the management objectives. The world's depository for the protected areas legal status and basic characteristics is at the UNEP-WCMC protected areas database. When evaluating the database, it became clear that for some countries the data are incomplete and/or inconsistent. The information is primarily available as a shapefile and underlying information must be extracted from that file. These and other issues shall be dealt with in Chapter 7.1#. The document takes into considerations an ongoing effort of the UNEP-WCMC to enlarge its database for Marine Protected Areas (MPA).

Representation and conservation status of species

Species representation and the conservation status of species is essential in protected areas informatics. As was shown previously, it is impossible to deal with complete species assemblies and proxy methods are necessary. This will be dealt with in Volume II and Chapter 6.2#. On the other hand, a certain degree of the protected areas informatics must be based on direct observations of species. That will be dealt with in Chapters 6.2 and 7.6 #.

Representation and conservation status of ecosystems

Equally important is the representation and conservation status of ecosystems. In Volume II, it will be demonstrated that species and ecosystem representativeness have a great deal of overlap. For the identification and classification, observations will be made, that deal with the modifiers reigning the differentiation between ecosystems.

Environmental quality of protected areas

External chemical and physical factors may influence the effectiveness of protected areas and suggestions will be made on in which cases specific action is needed and what the minimum data needs would be. This will be dealt with in Chapter 6.2, 7.7 and 7.8#.

Resource use within the protected areas

All protected areas may have some degree of land-use, which may vary from research in IUCN categories I areas, visitation in categories II areas and extractive use in categories V and VI areas. Apart from that, illegal land use may take place as well. Information about these land uses is essential for reporting on compliance, socio-economic benefits as well as the state of conservation of species and ecosystems. This will be dealt with in Chapter 7.9#.

Costs and requirements

As financial and human resources are some of the most essential limiting factors in protected areas information gathering, special chapters are dedicated to minimum and desirable data sets (Chapter 6.2) and to estimating their principle costs factirs (Chapter 6.3)

Digital information standards

There are no digital information standards set specifically for PA informatics. The required standards are briefly reviewed in Chapter 5#.

5. DIGITAL INFORMATION STANDARDS

5.1. OPEN OFFICE DOCUMENT

OpenDocument or ODF, short for the OASIS Open Document Format for Office Applications, is an open format for saving and exchanging office documents such as memos, reports, books, spreadsheets, databases, charts, and presentations. This standard was developed by the Organization for the Advancement of Structured Information Standards (OASIS) industry consortium and based upon the XML format originally created by OpenOffice.org. ODF was approved as an OASIS standard on May 1, 2005, and was approved for release as an International Organization for Standardization, (ISO) and the International Electrotechnical Commission, (IEC) International Standard (ISO/IEC 26300) on May 8, 2006.

The OpenDocument standard has been developed by a variety of organizations and is publicly accessible. This means it can be implemented into any system, be it free software/open source or a closed proprietary product, without royalties. The OpenDocument format is intended to provide an open alternative to proprietary document formats so organizations and individuals can avoid being locked in to a single vendor. ODF is the first standard for editable office documents that has been vetted by an independent recognized standardization body.

The International Organization for Standardization (ISO) is an international standard-setting body composed of representatives from national standards bodies. Founded on February 23, 1947, the organization produces world-wide industrial and commercial standards, the so-called ISO standards. While the ISO defines itself as a non-governmental organization (NGO), its ability to set standards which often become law through treaties or national standards makes it more powerful than most NGOs, and in practice it acts as a consortium with strong links to governments. Participants include several major corporations and at least one standards body from each member country. ISO cooperates closely with the International Electrotechnical Commission (IEC), which is responsible for standardization of electrical equipment.

The Organization for the Advancement of Structured Information Standards (OASIS) is a not-for-profit, international consortium that drives the development, convergence, and adoption of e-business standards. The consortium's expanded scope of technical work includes the Extensible Markup Language (XML) and other related standards, while it produces more Web services standards than any other organization along with standards for security, e-business, and standardization efforts in the public sector and for application-specific markets. Founded in 1993, OASIS has more than 5,000 participants representing over 600 organizations and individual members in 100 countries.

Cross platform software is available to produce these documents in MS Windows, the Macintosh platform and Linux, among other things as a public domain free software. Given the broad sectoral support, it is recommended that IABIN adopts the OAS, ISO and IEC approved Open Document Standards for text documents, spreadsheets and databases and presentations, by distributing in the following file formats:

formatted text documents : .odt, open document format
databases : .odb, open data base
spreadsheets : ods, open document spreadsheets
presentations : odp, open document presentation
portable documents : .pdf, portable document file
non-formatted text documents : .txt text

5.2. METADATA

The Dublin Core Metadata Initiative, DCMI is an open forum engaged in the development of interoperable online metadata standards that support a broad range of purposes and business models. DCMI's activities include consensus-driven working groups, global conferences and workshops, standards liaison, and educational efforts to promote widespread acceptance of metadata standards and practices.

5.3. GIS

The Open Geospatial Consortium, Inc (OGC). is a non-profit, international, voluntary consensus standards organization that is leading the development of standards for geospatial and location based services. GIS standards are formulated in the context of this consortium.

6. DESIGN OF A MINIMUM AND DESIRED INFORMATION SYSTEM

6.1. DESIGN PRINCIPLES

The analysis and design suggested in this document has been guided to a considerable extent on the Biodiversity Indicators for national Use (BINU) project, endorsed by the UNEP-WCMC. More than a decade of experience has been accumulated in CONANP of Mexico, the Biological Corridor projects in Central America, as well as monitoring projects in Honduras (GEF) and Panama (monitoring in the context of the Panama Canal) as well as the ECOSCIENCIA participation in the BINU project. The document builds on this rich experience in the region.

Above all, protected areas information systems should facilitate effective management of protected areas and provide stakeholders with information on management effectiveness without demanding significant demands on budgets and staffing time. They should be built and operated on the following principles:

- Low cost and high cost-efficiency;
- Facilitate management and administrative adaptability;
- Operable by field staff (user-friendly);
- Transparent and able to be verified, internally and externally;
- Designed through a participatory process;
- Compatible with the IABIN and the UNEP-WCMC.

Low costs and high cost-efficiency

Protected area management agencies everywhere are subject to strong pressure to execute costly research studies and monitoring, evaluation & response programs. Main stakeholders (scientists, NGOs, international donors, etc.) in countries all over the world recognize the need for a monitoring program, but each stakeholder wants his/her particular parameters of interest to be monitored. It will never be possible to satisfy the needs of all the users, so it will always be necessary to decide which data, for which clients, can be collected in the context of a protected areas information system. Experienced administrators have concluded that a management administration should not spend more than 10% of its budget (including the costs of the time spent its own staff with their equipment, such as transportation, computers, buildings) in a management information system and applied research (IMEconsult 1987). This practical rule of thumb significantly reduces the scope of data collecting and storage and applied research. The prioritization in this document is based on that philosophy, but even so, they are just general suggestions. In the following paragraphs some criteria are suggested for the design of effective and yet affordable and manageable PA information systems.

Continuity

Ecosystems and species show continuous variation, depending on many factors, particularly weather. As a result, quantitative data only start becoming valuable for understanding trends and significant deviations, after data have been collected for many years, as a rule of thumb, a minimum of 10 years. It is a common but unfortunate practice to initiate and then discontinue data collecting programs and start with something entirely new. Data collecting should be discontinued only if the original methodology cannot generate the expected information or if the information is no longer relevant or important. Bearing this is mind, it is always better to start very modestly with in-house staff.

Adaptability is mandatory for any protected areas administrations, given the fact that each protected area is unique both in terms of natural resources and the stakeholders. The threats to protected area systems change continually, and the protected areas information system must be able to adjust accordingly. It is important, however, that the changes be compatible. Therefore, when a database needs to be adapted, it is preferable to add a field, rather than change the characteristics of an existing field or eliminate it.

Participation of field staff

Because of their permanent presence in the field, park rangers are the most suited professionals for making observations on the state of conservation status of protected areas as a whole. Particularly the National Parks Administration of Argentina and Ministry for Environment have reported to intensively use park rangers for data collecting. With some training, park rangersf can make frequent observations on selected (indicator) species. When interfacing with local communities, they often receive indications about problems and irregularities and while patrolling the trails, they can see inflicted damage when or shortly after it has occurred. Being in the field and having the mandate to act on behalf of the management authority, rangers can interact with stakeholders. This is what sets them apart from contracted observers who carry out monitoring under contract. Not only can rangers make observations, but in many cases they can give immediate response, which is arguably the most important use of protected areas informatics. Moreover, in the majority of the protected areas, the use of rangers for data gathering is the **only** option for monitoring in the field. As protected areas are so gravely under-funded, usually there is no financing is available for carrying out any field observations by third parties. As rangers are needed as an integral part of protected areas information systems, the routines and computer programmes for PA informatics must be extremely user-friendly.

Rangers can collect data as part of their daily routines, like carrying out their patrols, serving the public, making observations (monitoring) and carrying out small maintenance in the park. If properly trained, it can be estimated that they spend about a third of their time on data gathering. From calculations on protected areas costs (Ministry of Environment of Brazil 2007) it is known that the costs of ranger salaries in a properly-staffed protected area is about two/third of the total management costs. So if rangers spend about one third of their time on monitoring, the financial value of their input is about 20% of the total management costs of a protected area. With that, a protected areas administration is more than compliant with carrying out its monitoring obligations if estimated at 10% of the budget.

Transparency and verification

NGOs, research institutions and the media have vested interests in the conservation status of protected areas. It is therefore important that the data produced by the protected areas information systems be publicly accessible and that the data collection methods be carefully described. Since the interpretation of the data is always dependent on the analyst’s vision, it is essential that NGOs, research institutions and other actors have access to the data in order to voice their opinions about their validity, offer advise on the methodology and be facilitated to produce their own data in order to have a second opinion, if they so wish. It is therefore recommended that the information on the databases be of public domain and that the stored data be distributed freely, preferably through the Internet.

M,E&R

Monitoring requires the collection of data, but data are of little use, if they are not periodically compared and **evaluated**.

It became increasingly evident to the BINU project that indicators were likely to be of only very limited use to most stakeholders unless they could be directly linked to actions – that is responses – of some kind. The main interest, for example, of users of renewable natural resources such as fishers was in ensuring that their resource base was maintained and could continue to deliver benefits to them into the future. In the case of species of special concern, a noticed decline in an area or nationwide would require a certain management action, the least of which the analysis of potential causes and potential management actions to reverse the trend. To ensure that responses as well as the systematic reporting on them are built into the protected areas informatics system it is better to use the term Monitoring, Evaluation and Response, M,E&R. In the annual M,E&R resports, it is very important to report on the type of response to any given deviation from the expected trends.

Participatory design

The creation and maintenance of a protected areas information system in not an end in itself. The data are generated for different stakeholders who's needs are likely to be different. Only through a participatory design by the stakeholders in each individual country can the benefits of the program be maximized. Stakeholders need to be involved in choosing parameters and setting the limitations to their scope, thereby avoiding disappointment in the data. The BINU project found that a major barrier to meaningful interaction with stakeholders proved to be the lack of common concepts and understanding of what biodiversity is and why it may be important. As a general rule it is evident that consultation processes need to include discussions of these issues from the beginning, to ensure that stakeholders understand each other as clearly as possible. The BINU project found out that it also was important for to track who asked which questions as this information is key to subsequent effective communication concerning the indicators.

Each protected area has to identify its specific species of special concern, its vulnerable ecosystems and specific threats. For example, certain regions may be threatened by illegal felling of trees or by poaching, others by invasive species, and in the case of tourist areas, by the over-use of certain sections of the area.

Primary users like the directors of protected areas systems, the directors of the areas and their staff should always be involved as they are likely to be both the most intensive collectors as well as users of the information. While the BINU project focussed on national indicators, workshops on monitoring in inter alia Mexico and Honduras made it very evident, that for protected areas, in fact, indicators also need to be identified at the level of each protected area, while the BIODAMAZ project in Perú uses several specific indicators for the Amazon region of the country.

On a national PA system level, the representation of ecosystems and species of special concern must be dealt with. This requires a representativeness / gaps analysis and reporting by the managers of the areas that shelter such species.

For individual areas, local indicators and appropriate measures need to be developed with the participation of the staff who will ultimately be responsible for the collection of the information. Design workshops may cover some of the following subjects:

- Ecosystem representation;
- Identification and representation of species of special concern (they may be very different for the national PA system and an individual protected area);
- Analysis of threats, actors, measures;
- Identification of general data which will be collected in all protected areas;
- Field methods: collection of basic data, methods and routines for patrolling, perimeter mapping, social training, community relations, training needs, etc.;
- prioritization of data to be collected;
- Definition of the frequency with which the data will be collected;
- Data analysis, reporting and access to data;
- Estimate of (non-staff) budget.

IABIN and UNEP-WCMC compatibility

IABIN and UNEP-WCMC compatibility is important in international contexts, and since the national policies of most of the member nations of the American Hemisphere are signatories to the United Nations and/or the CBD, it is important that information can be made available in international contexts.

6.2. CURRENT INFORMATION GAPS

The Terms of Reference request a list of the current information gaps and inconsistencies for protected areas informatics. It was hoped to receive information regarding the information gathered by the protected areas agencies through the questionnaire listed in Annex 10, which has been officially sent to all the focal points by the PATN secretariat. Unfortunately, only 5 agencies have responded, and there is not sufficient response bases to make any solid analysis. Nevertheless, from some discussions with representatives at the II Latin American Congress on National Parks and Other Protected Areas for and the data acquired through the questionnaires, it appears that the protected areas agencies of many countries are still in a very early stage of setting up their protected areas informatics systems. Several countries informed us that they are using a spreadsheet for their data storage, while collecting mainly seems to be focussed on a limited number of species. The countries of Central America, Mexico, Chili and Ecuador have country covering vegetation / ecosystem maps, while Peru has one for the Amazon region, and no doubt other countries have at least partial maps. On various occasions requests were made to the ESTN with requests for inputs, and comments for this document, but no response has been received. NatureServe has made a continent wide vegetation / ecosystem map, but the early version of that map that has been seen in the context of this document had serious gaps in crucial modifiers. Moreover, ecosystems maps should be made at the national level, with the most commonly used projection, to facilitate optimal overlays with national data.

So, while this may seem a bit disappointing in terms of the progress made, the situation – if consistent with reality - actually would provide a great opportunity in which the protected areas could work together and jointly develop a solid system at relatively low costs, while working at it together. If such collaboration would be desirable, they could collaborate through a common web forum in which they could share experiences and request mutual advice.

6.3. MINIMUM DATA SET

Ecosystems Map

No protected areas information system will do much good if it requires decades of study and hundreds of millions of dollars to create. As we have seen in previous chapters, one of the most cost effective ways of collecting information on species, their distribution and minimum area requirements, is through the creation of ecosystems maps.

BOX 1: PRODUCTION OF THE MAP OF THE ECOSYSTEMS OF CENTRAL AMERICA

The "Map of the Ecosystems of Central America" production has shown that a fairly detailed map may be produced over a territory spanning more than 1,500 km and 7 nations in less than a year of fieldwork and mapmaking. The level of detail entailed about 140 ecosystems encountered, or 30 to 60 different classes of ecosystems per country. Such level of detail requires that a team of field biologists with 15 or more years of experience, and who know the country well, determine which parameters should make up the distinguishing characteristics, thus building on decades of fieldwork of many researchers. Floristic detail may considerably expand the number of ecosystems, but that would require that many areas would need to be visited and sampled. That would be extraordinarily costly and it would extend the fieldwork period with several years. It is possible however, to gradually expand the data with information collected later.

Maps of this detail have been used in a variety of countries in Central America to analyse the representativeness and effective protection of ecosystems: Costa Rica, Belize and Honduras also received broad consensus by conservationists participating in the analysis, which are indications that the level of detail reached in Central America leads to the considerable satisfaction among different stakeholders.

Ecosystem maps serve some of the following analyses essential for management purposes and reporting obligations:

- Minimum baseline;
- Proxy identification and distribution of assemblages of species;
- Representiveness and gaps of ecosystems and species assemblages in protected areas systems;
- Minimum area requirement compliance for species and assemblages of species;
- Conservation security of ecosystems and species assemblages through plural representation in different protected areas;
- Change detection regarding changes in vegetation structure like deforestation (cutting, fires, hurricanes, etc.) and regeneration (spontaneous or through management actions), land use, etc.
- Management and protection of wildlife habitat of species of special concern;
- Modelling vegetation flammability and fuel loading implications for fire management;
- Analyses for site development suitability;
- Evaluation of resources at risk."

Detailed national maps of natural and semi-natural ecosystems are quintessential as baseline information for national protected areas information systems. The importance of such information may be illustrated by the USA National Parks Service (2002) that states that it "considers vegetation information arguably the most critical piece of information needed for park resource management and protection." The United States 240 national parks outside of Alaska have comprehensive vegetation inventories and corresponding spatial information based on aerial photography; in Alaskan parks, vegetation and associated landcover features are being mapped from satellite imagery because of their large size.

The minimum required ecosystems modifiers for an ecosystems map to satisfy the needs for PA informatics should combine both terrestrial and aquatic ecosystems of the entire study area. For the terrestrial ecosystems, the modifiers should include:

- Vegetation structure;
- Elevation levels;
- Seasonal phenology changes;
- Leaf morphology;
- Special soils like saline and calcareous soils, white sands in the Amazon region and peat (but **NOT the full suite of soils** of an entire soil map);
- Drainage;
- Concentrations of gregarious faunal species of special concern;
- Scarcely vegetated areas, including large intertidal zones, like mud flats and sand bars.

For aquatic ecosystems distinctions should be made for:

- Division marine, estuarine and fresh water systems;
- Non-marine saline and alkaline waters;
- Distinction between different classes of freshwater bodies (river, lake and lakes without outlet, swamps / marshes);
- Distinction between waters in the Pacific versus the Atlantic drainage;
- Subdivision of rivers in Upper, middle and lower stream;

- Concentrations of gregarious faunal species of special concern, both permanent and seasonal;
- Submerged vegetation if possible;
- Coral reefs if possible.

The minimum level of mapping detail should be 1:250,000 but desirably 1:100,000 as it can be done at no additional work or costs, using Landsat or images of similar detail and characteristics (E,g. Aster). The target minimum size should be 150 ha but for some rare phenomena smaller sizes or point markings may be required, such as for colonies of animals or very rare and small ecosystems, like an isolated pool or stream with an endemic species.

Moreover, a layer with the polygons of all the protected areas of the country should be part of the baseline, preferably as a separate file.

Based on the overlays of the ecosystems and the protected areas layer, a representativeness / gaps analysis should be part of the minimum data set, which allows to assess the relative importance of each ecosystem (determine which ones are absent, scarce and or small) with its species assemblage and determine which ecosystem(s) is/are in each protected area. This may also be helpful in prioritizing the monitoring program.

Once an ecosystems map has been prepared, a change detection analysis should be made every 2 years as a minimum, annually would be more desirable however. On the basis of the change detection analysis, it will be possible to quantify how much of each affected ecosystem is lost and how this may effect the durable conservation of the affected ecosystem and the species assemblage that belongs to it.

Relevés on permanent plots

In the process of preparing a national ecosystems map as a biodiversity baseline, it is **desirable** to consolidate the baseline of each protected area with a relevé in a permanent plot in each ecosystem (primarily vegetation on land and in marine areas, coral reefs and benthos on mudflats and non-coral covered hard surfaces). This should not be considered a minimum requirement however, as the process is rather specialized and requires contracted external expertize, while the monitoring value often only becomes evident after rather long periods of time, possibly several decades. But onces established, permanent plots are very long lasting points of references on the vegetation structure and floristic species composition. Permanent plots should be reanalyzed every 5 years; more frequently if there is evidence of change affecting the vegetation or coral reefs, or after major disturbances like forest fires.

As permanent plots focus on sessile species, their response to change is primarily based on the health and survival of a set of species on a certain location. As sessile species can't actively abandon a location in response to certain forms of disturbance (like the sight of humans), they may inform about certain change in the composition of the ecology of an ecosystem, like fire, pollution, change in climatic conditions or species composition, increase of invasive species, etc. For their immobility, the response to change by sessile species may often be rather slow, but of course, in the case of major disturbances, like fire and hurricanes, the effects are immediate.

Species of Special Concern and indicator species

Most protected areas should have some monitoring of mobile species, primarily fauna elements. Because of their mobility, mobile species can respond to change by re-location. At the one hand, this may make their response very quickly, but at the other hand, responses may be easily misread, as mobile species may simply change their behaviour in such a way that their observation becomes more difficult, for instance by changing daily feeding routines from daytime to dusk and dawn or even to the night. Also, the mobility of an animal may allow it to respond to a more favourable condition elsewhere, for which a certain area may be abandoned, even though the conditions of that area have not changed. Whether or not the monitoring of a mobile species should be part of the minimum dataset will vary from area to area. E.g. it should obviously be part of an area created for the conservation of a nesting colony with marine birds, but it would not necessarily make much sense to monitor a fauna element in a protected area that has been created to protect a rear vegetation on an isolated mountain top.

Even though the term indicator species is used over and over again, no species are indicative of the conditions of an entire ecosystem or protected area. At best they can be indicators of special conditions, like pollution, disturbance, eutrophication, etc. As a result, the use species as indicators of ecosystem health should be well thought through and only a set of several species could be used for ecosystem health monitoring. The selection of such set of indicator species should, as a whole, possess the majority of the following characteristics:

1. well identifiable taxonomy;
2. well understood ecology;
3. representative of the main ecosystems;
4. Species must facilitate simple and standardized methods of data collection in the field, which can then be easily verified;
5. A typical and measurable behavior in relation to disturbances or relevant environmental changes, and a fast response;
6. Patterns observed in the indicator species must reflect the behavior of other populations of species;
7. Include species of tourist importance so as to attract visitor interest (charismatic)
8. Include species which, by their behavior, are indicative of the presence or absence of hunting pressures;
9. Play an ecologically important role;
10. Financial feasibility.

Obviously, two taxa qualify for these criteria: birds and large mammals. Birds are well known and there is an abundance of experience readily available of the status of bird populations through mere observation. Zoological macro fauna – particularly deer, agouti, tapir, large cats, red coatis, peccaries and monkeys – because they are subject to poaching, may also work out well in a set of indicators. L. E. Marineros (pers. com) provides evidence of the fact that the degree of visibility and shyness of species whose timidity greatly diminishes in the absence of poaching, are important indicators of success in the reduction of poaching. Some examples include deer, agouti, coatis, peccaries and monkeys.

In each protected area the set of species is different and therefore the species of special concern and indicator species vary. More than anything, the observation of a species tells about the success or problems of a species itself, and therefore monitoring of species should primarily be directed at the species in a protected area that interest us most, the species of special concern. Concern about the viability of macro fauna populations will definitely decrease as the extension of natural habitats outside the protected areas decreases. In particular, species with large territories such as Pumas, Jaguars, Tapirs, the Harp Eagle, Scarlet Macaw and the King Vulture are at risk of inbreeding and other risks inherent to isolated populations. In order to completely understand their conservations status, these animals merit special monitoring.

Invasive species

In general, when invasive species have been discovered in a protected area, their monitoring should be part of the minimum dataset. It will vary from species to species and case to case whether this should be done the bases of individual observation with the data stored in a database or through GIS-mapping. There is no need for creating a special field for storing the observation of invasive species in a database, although it would be convenient to include a check box for invasive species.

If management actions are undertaken, it is desirable to record the nature of the control, its immediate impact and monitor the species' response to the measures.

Fire

As fires increase due to changing climatic conditions, the monitoring of forest fires should be part of the monitoring routines in protected areas. In part, the results of forest fires may be detected in change detection analyses, but more information is necessary. Important information can be acquired through the MODIS Rapid Response System, maintained by a collaboration consortium of

- NASA;
- University of Maryland;
- United States Department of Agriculture Foreign Agricultural Service;
- US Forest Service.

The consortium provides a free – close to real time - wild fires warning system by email to which anybody can sign up as well as a free images that can be downloaded from http://rapidfire.sci.gsfc.nasa.gov/

As this service is free, the occurrence of wildfires should be part desirable part of a protected areas information data set. The analysis of the imagery can be part of the change detection routines.

Pollution

The measurement of pollution is expensive and should not make part of a standard protected areas information system. Only if certain pollutants are clearly threatening the health of an ecosystem certain parameters may need to be monitored, and preferably financed by the potential polluter, such as oil companies in the Amazon region. In aquatic ecosystems, the tissue of certain fauna species may be used, as they accumulate pollutants in their bodies at higher concentrations than in the water where they live.

Finance and staff

Finance and staff provides one of the most powerful sources to evaluate if a protected area indeed can be managed effectively. If a protected area has staff and a budget, the protected area agency has the potential of carrying out management. Without it, the management effort may expected to be close to non-existing. Therefore POAs should be part of the minimum protected areas information data set. Among other things, it should register the achievements of the previous year, the executed budget of the previous year[3] as well as the number of staff members working in the area.

Visitation

Visitation is an important part of the use of protected areas and the data can be collected at no additional costs to the protected areas agency. Data on visitation should be part of the minimum protected areas information data set. As a minimum, a distinction should be made between paying and non-paying visitors. Desirable additional data include visitor characteristics by group, such as child, student, adult, senior citizen, nationality. Suggestions on data gathering are made in Annex #.

Public information on the protected areas

Public information on the protected areas in fact is part of a reporting routine. In simple presentations, websites nowadays can be the most economical way of providing pubic information. Each protected areas

[3] Usually there is a difference between the planned budget for a budget year and the actual amount of money spent. In many countries the ministry of finance doesn't actually make all the money available for spending or release part of it so late in the year (e.g. during the last budget month) that it is impossible to spend them, given the spending regulations, like bidding procedures, etc. This occurs both in developing countries and in the wealthy countries.

agency should have a website as a minimum part of the minimum data set. On it it should have the complete list of the protected areas providing public data date of creation, legal status. etc., as well as available for downloading public documents, public announcements and monitoring reports.

As part of the responsibility of protected areas agencies is facilitating permissible use of the areas to the public and special stakeholders, it is desirable to provide information on use options, particularly visitation options and – if available – services for each area. It would be desirable to have a printable image of a map for downloading and printing of each protected area. This may be derived from the map layer of protected areas.

Documentation on gazetting protected areas

The public announcement and/or legal document gazetting a protected area are the first and foremost minimum dataset. Without this document a protected area cannot exist. Each protected areas agency and mandated Ministry should have a full set of the documents gazetting all the areas in the protected areas system. It would be desirable to provide a scan of each document for downloading from the website from the website of each protected areas agency. This allows each stakeholder to precisely know the legal framework of a protected area and its legal boundaries without having to consult the PAA on issues like legal status and precision of the polygons of protected areas.

The UNEP BINU project, the CCAD - World Bank Central America Ecosystems Mapping project and GEF project for the protected areas in respectively Mexico and Honduras were begun at a time when few had a considerable understanding of what biodiversity indicators were. These projects have shown that, even from very modest starting points and with limited resources, it is possible to make great strides in the development of biodiversity indicators in a relatively short period of time. The international understanding of biodiversity indicators has increased considerably while these projects were in progress. Most importantly, they are closely linked to the 2010 biodiversity target, agreed by the Parties to the Convention on Biological Diversity at their 6th meeting in April 2002 and by the participants at the World Summit on Sustainable Development in the autumn of that year. This target is to achieve, by 2010, a significant reduction in the current rate of biodiversity loss at global, regional and national levels. The building of protected areas information systems based on the criteria suggested in this document would provide a solid and yet realistic bases for reporting on the degree of compliance in this context.

6.4. INDICATIVE COST FACTORS FOR THE DEVELOPMENT AND MAINTENANCE OF A PROTECTED AREAS DATASET.

The costing of data collecting will vary from country to country depending on cost factors such as:

- Salary levels;
- Travel costs;
- Accessibility and field conditions;
- Country size.

To deal with such great variability in costs, the document makes estimates on the basis of which each country can calculate and budget the costs of creating and maintaining a Protected Areas information system and developing and maintaining its dataset. It should be realized that the suggested costs and estimates of production time are general indications, and that for each area and/or protected area system a detailed plan is needed that incorporates a financial and staff time budget.

With current technology and the use of userfriendly GIS software, the following cost factors would determine the cost of producing an ecosystems map, assuming the availability of an experiences GIS specialist:

- Recent Satellite image: $400 or free;
- Processing 1 image for interpretation: 1 day;
- Mosaiquing of imagery per image used; 1 day;
- Interpretation per image: 3 days;
- Field verification (ground truthing) per image: 1 – 5 days of travel per image, depending on access, density of natural ecosystems and their variability. High variability requires more field verification. Travel costs amount to $100 per day for fuel and vehicle use and $100 per day for Daily Subsistence Allowance (DSA);
- Air verification: 3 – 4 flying hours per image with fixed-wing airplanes;
- Integration of map, printing and reporting: 15 – 60 days, depending on the size of the country.

Change detection analysis would need to be carried out every two years and for budgeting purposes one should consider the following cost factors:

- Recent Satellite image: $400 or free depending on availability of recent imagery;
- Processing 1 image for interpretation: 1 day;
- Mosaiquing of imagery average per image: 1 day;
- Change detection analysis per image: 1 day
- Integration of map, printing and reporting: 10 – 30 days, depending on the country size.

Monitoring of species in the protected areas can most economically be achieved by rangers or by students in the context of university teaching programmes. Assuming that rangers record data of anywhere from 1 – 15 species of special concern as well as invasive species while in the field, no additional costs are made, assuming they have access to computers to enter their data in a database. They will however require the support of a monitoring coordinator. Based on experience in Honduras, we would suggest one salary plus the costs of the full time use of a vehicle per year for a monitoring coordinator for a number of protected areas with a combined number of 100 to 200 rangers. Costs for transportation may be higher in areas of difficult access, like in the Amazon region, where long distance travel over water and by air may be necessary. Workshops for the rangers for periodic training and data evaluation, usually cost about $500 per event plus transportation and accommodation costs for the participants. There should be a minimum of one event per year per 50 rangers.

Monitoring contracts involving studenst as part of their training can be made with universities by paying group transportation, lodging and feeding. This can be achieved for a number of targeted areas. Costs usually range from anywhere from US$500 - US$2,000 per year (P. R. House, pers. com.), depending on the duration of the monitoring assignment, the travel distance and the number of student participants and supervisors involved.

Monitoring coordinators can take care of staff, budget, POA[4] and visitation monitoring and reporting. The data collected on staff, budget, POAs and visitation are part of respectively the administrative and visitation registration protocols and require no additional costs for collecting. The interpretation and reporting of the data should be estimated at 2 - 6 weeks per year by a monitoring coordinator, depending on the number of protected areas. Reporting should be part of the annual national monitoring report on the protected areas system. For printing the annual reports US$1,000 to US$2,000 should be budgeted.

Software and applications

A variety of user friendly open source programs and applications are available, so no license fees of any kind are necessary for software needed in the context of protected areas informatics:

[4]POA stands for Programa Operativo Anual. The abbreviation has become a common notion in Latin America.

High quality extremely user-friendly open source integrated raster and vector GIS software is available from http://www.ilwis.org. It is extremely powerful and capable of doing all the processing one needs for any analytical and image processing task necessary in the context of protected areas management and monitoring.

Adequate user-friendly open source PC based database software is built into OpenOffice. With the use of this software, no licence fees are necessary and it can be downloaded from http://www.openoffice.org. Moreover, OpenOffice office suite incorporates an outstanding word processor, spreadsheet, powerpoint and mathematics editor, all compatible with Microsoft software. The built-in drawing program is still a bit weak for high-end drawing applications, but it is adequate for drawing figures in documents.

The terms of reference request the definition of organizing the information in agreement with the IABIN sub-regions. The data options analyzed in this document include both terrestrial and aquatic ecological conditions and all the climatic conditions varying from glacial to humid and dry tropical. These conditions can be encountered in any part of the Hemisphere and often in just one individual country, with many the gradients in between. Making different requirements and fields for the different IABIN regions would undermine the compatibility of the data involved. Therefore, it is recommended that data collection and storage be done without distinction by region.

The database with detailed documentation in both Spanish and English, built in the context of the Map of the Ecosystems of Central America, developed under the auspices of the CCAD/World Bank/GEF, is compliant with many fields recommended in Chapter 10 #. It runs under MSAccess, and it would need to be expanded and updated to become fully compliant with the recommendations.

It is recommended that the protected areas agencies in the American Hemisphere consider jointly developing a database in OpenOffice so that they can mutually support each other and have a common support-group web-page. Building on the design of the Protected Areas and Ecosystem Monitoring Database for Central America has considerable advantages:

- It has been developed jointly by more than 30 lead scientists from the 7 countries in the region under the auspices of the CCAD/World Bank/UNDP and is compatible with the Map of the Ecosystems of Central America;
- It can be used with ecosystem maps of any design (UNESCO, LCCS, USNVC and others)
- It has been heavily tested in the field for protected areas monitoring;
- It can operate on an individual computer without dependency on an expensive and/or complicated centralized database;
- Additional costs for making it compliant with the recommendations in this document and conversion to OpenOffice would be minimal.

Such initiative would eliminate all future costs and strengthen the mutual support among users and warrant continued updating and development by the user PAAs of the hemisphere and no or very little future costs and full PA data compatibility throughout the Americas.

The current Protected Areas and Ecosystem Monitoring Database for Central America with manuals and field forms in English and Spanish can be downloaded from: http://www.monitoring-nature.info .

7. FIELDS FOR A PROTECTED AREAS BIOLOGICAL AND MANAGEMENT DATABASE

A wide variety of data can be collected on protected areas. For each field the level level of prioritization will be determined in H(igh), M(edium) or L(low), while mandatory fields will receive an asterix (*). Whether or not a parameter be observed highly depends on the availability of financing, observers and considerations related to the variety of observations made in the previous chapters. All suggestions on prioritization are merely indicative.

7.1. DATA SET ON LEGAL STATUS AND MANAGEMENT OBJECTIVES

The World Database on Protected Areas (WDPA) provides the most comprehensive dataset on protected areas worldwide and is managed by UNEP-WCMC in partnership with the IUCN World Commission on Protected Areas (WCPA) and the World Database on Protected Areas Consortium (WDPA). The WDPA is a fully relational database containing information on the status, environment and management of individual protected areas. All countries in the American Hemisphere collaborate in the WDPA and for harmonization purposes it is essential that databases be designed to be fully compatible with the WDPA. For that region, the document lists the fields required for the WDPA as mandatory. Fields names in the WDPA are listed as such.

The legal status and management objectives provide the user the basic information about

- land-use restrictions and allowed use
- key characteristics
- location;
- size;
- management agency;
- legal text regarding its creation.

Using the field names and characteristics of the WCPA consistently in a national protected areas biological and management database

Individual protected area code*[5]

An individual protected area code is extremely convenient for database management. We propose a code consisting of the following structure in capital letters and digits:

- 3 letters for the ISO3 country as listed by the International Organization for Standardization ISO
- A unique 3 letter code by country for each protected area

Field name: SITE_CODE; Field size: 6 letters[6]

Official name of the protected area*

Field name: AREANAME; Field size: 120 letters

ISO3 Country Code

Field name: ISO3; Field name: 3 letters

Country

Official name of the country

Field name: COUNTRY; Field size: 75 letters

Central Lat

Field name: LAT; Field size: 19 characters

Central Lon

Field name: LON; Field size: 19 characters

Designation*

Designation to the official national management category (e.g. national park, nature reserve, etc.)

Field name: DESIGNATE; 100 letters

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[5]This is a proposal to change the coding of the protected areas in a way that the countries themselves can manage the coding. This allows them to assign a new code themselves without having to consult the UNEP-WCMC.

[6]There is a distinction between characters, letters and digits. Characters can be letters or numbers. Letters are roman alphabet text. Digits are Arabic numbers.

Reasons for designation

Field name: ?; ? letters

Primary management objectives*

List up to 2 primary management objectives
Field name: ?; ? letters

World Heritage designation*

Field name: ?; Check box

Ramsar designation*

Field name: ?; Check box

MAB designation

Field name: ?; Check box

IUCN Category

Field name: IUCNCAT; 8 letters

Protective mandate

national
midlevel (State, Province, Department)
municipality
private
other
Pull down in the context of a national database. Information important in the context of a national database. 1 digit, H

Status*[7]

Current status of site, e.g. Designated, proposed, etc. H, but not always known or agreed on.
Field name: STATUS; 80 letters

Polygon data

Field name: POL; Y/N option. Y means polygon data available. N means no polygon available for the area.

Date of creation*

Field name: EST_DATE; YYYYMMDD

Coordinates and boundaries

The complete set of coordinates and/or boundaries defined in the legal document.
This can be quite lengthy at times. This information should be acquired literally from the legal document. This information is important for national use so that users may plot their own spacial information.
250 character field. H

Total area*

Total area in ha of both land and water.
Field name: AREA_HA; 15 digits[8]

Marine portion*

Total marine area in ha from mean high water mark if applicable.
Field name: ?; 15 digits

No take*

Qualitative indication of area that is no-take (i.e. extraction of all resources is prohibited.)
all
part
none
Pull down menu. Field name: ?;1 digit

Administration*

?

Management authority*[9]

[7]It is questionable if this should be part of the WDPA. An area is not a protected area until it has been declared so legally. If it has been declared legally, "DESIGNATE" has already answered that question.

[8]I propose this to be digits, so that the numbers can be added for what ever purpose necessary.

[9]It is not quite clear what kind of info is required for this field. This is how I interpreted it.

This is the officially mandated authority. This authority may have contracted the management to another institution.
Field name: MANAGEMENT; 50 character field

Notes
Any observations can be made here.
Field name: NOTES; 254 character field.

Official announcement*
Government publication (e.g. "Gazete, Diario, etc.) announcing the designation
Field name: SOURCE; 50 character field.

Management plan*[10]
Check box

Entry year validity management plan*
4 digits
By providing the date of the approval of a management plan, one knows whether or not it exists and how current it is.

Last year validity management plan*
4 digits

Top two threats*
Field name: ?; ? letters

Top two management activities
Field name: ?; ? letters

Required budget in local currency*[11]
Field name: ?; 10 digits

[10]The field for management plan is superfluous with the existence of the fields for start and end dates.
[11]For international use this amount needs to be converted to US$

Available budget in local currency*[12]
Field name: ?; 10 digits

Number of temporary staff*
Field name: ?; 3 digits

Marine*
Field name: MARINE; Y/N option. Y means the area has a marine element. N means there is no marine element in the area.

Part of larger marine management plan*
Check box. If marked the area is part of a larger spatial marine resource management plan.

7.2. AREA HIGHLIGHTS

Public knowledge about the use of the protected areas is paramount for their conservation. In order to "market" protected areas to the public, it is very important to provide information on the highlights in the each area. Particularly visitation is one of the broadest public use of protected areas, as it provides (1) enjoyment to many visitors; (2) income to local communities and it functions as an important magnet for foreign visitors, which benefits the entire tourism sector of a country as well as the national economy. Prospective visitors to protected areas and tourists visiting another country would like to be able to access general information on the protected areas of the country of their interest. Important highlights of interests include outstanding geological phenomena, spectacular scenery, types of surface waters (waterfalls, lakes, rivers, desert pools, etc.), cultural heritage, special ecosystems and species of special concern. Further, the visitor would like to know general information about access and services. In part, that information should be descriptive, but it would also be extremely useful to the data users if it could be

[12]For international use this amount needs to be converted to US$

sorted. So this document proposes a structure of the fields that can foresee in both needs.

Maximum elevation in m above sea level

The maximum and minimum elevation levels and their difference provide the informed user with ideas of the terrain (flat, mountainous), climate (elevation deviations from the predominant lowland climate) and the related ecology.

4 digits field

Minimum elevation in m above sea level

4 digits field

Most outstanding land formations

These need to be check box options for each characteristic.

Mountains
Hills
Plateau
Upland
Valley
Coastal plain
Flood plain
Dunes
Peat
Lava
Other

Outstanding water bodies

These need to be check box options for each characteristic.

Coastal see
Estuary
Coastal lagoon
Lowland river
River
Conspicuous waterfall
Carstic river
Carstic ponds and/or creeks
Isolated desert creeks or ponds
Lake
Crater lake
Alkaline waters
Other

Outstanding ecological formations

These need to be check box options for each characteristic.

Evergreen broadleaved forest
Deciduous broadleaved forest
Needleleaved forest
Mixed forest
Savannah
Shrubland
Prairie grassland
Semi desert vegetation
Scarce desert vegetation to vegetation free desert
Treeless tundra formation
Bog or peat formation
Marsh (treeless)
Swamp (wooded)
Saline marsh[13] (treeless)
Saline swamp (primarily mangrove)
Coraline formations
Seegrass or marine algae bed
tidal flat
beach

Categories of species of Special concern*

These need to be check box options for each characteristic.

Very conspicuous species (macaws, flamingos, vicuñas, etc.)
Endemic species
Large predators (bears, cats and wolves)
Bird concentrations
Bird breeding colonies
Marine turtle colonies
Marine mammal concentrations
Endangered species

[13]The distinction between marsh (treeless) and swamp (wet or inundated areas with trees) is little known to non-english speakers and needs to be specified.

List species of special concern*

254 letters

Cultural heritage

These need to be check box options for each characteristic.

Ethnic groups

Scenic villages

Sacred sites

Monumental buildings

Traditional customs related to the area

Archaeological sites

Area description

This field allows a brief descriptive elaboration of the highlights.

1000 letter field

7.3. SERVICES DATA SET

PUBLIC SERVICES

Open to public from month X
(2 digit field)

until month Y
(2 digit field)

Opening hours from X
(4 digit time field)
until Y:
(4 digit time field)

Visitor center
Check box

Capacity public campgrounds in number of camp sites
4 digits field

Number of public entries to the area
2 digits field

Km of roads open to the public
3 digits field

Km of trails open to the public
3 digits field

Public guiding services
Check box

Transportation within the protected area
Check box

Estimated admission fee in local currency
3 digit field

Street and number administrative building or visitor center*
70 character field

City*
70 character field

General telephone number* of area administration
12 digit field (including country code)

Public email address of area management*
50 digit field

Website of the protected areas agency or area*
150 characters field

Website of the protected area*
150 characters field

PRIVATE AND NON-AREA MANAGED SERVICES

Private guiding services
Check box

Transportation within the protected area
Check box

Capacity hotels in nr. of beds within a radius of 25km
4 digits field

Capacity privately operated campgrounds in number of camp sites
4 digits field

Scheduled transportation to and from the area
Check box

Services description
A services description may include many different kinds of information, like contact data of ser-

vice providers like hotels, nearest airports and bus and train stations, air, train and bus services providers, interpretation programs, etc. etc. The services description should have a 1000 character field.

7.4. DATA SET FOR THE AREA ADMINISTRATION

A number of additional data would be desirable for planning maintenance routines and budgeting:

Mandated authority for biodiversity protection

These can be at the national level, mid level (state, Province, department or territory) and local level. This can be through a pull down menu. Thus far, it does not seem that the community level is a frequent option, but at the mid-level it makes sense to register the authorities. In Canada, the USA and Brazil, a considerable number of protected areas have been instituted and/or are owned at the mid-level. The registration of mandated authorities with their contact data would be desirable.
Pull down menu. 1 digit.

Number of inhabitants

Number of habitants living within the borders of the protected area: 6 digits field

Privately owned land

Estimated ha of privately owned land: 7 digits field

Costs management plan in local currency

20 digits

Year appointment protected area committee

4 digits
If this is filled out, it means that there is a committee

Length periphery in km

4 digits

Percentage demarcated

3 digits

Demarcation costs per km in local currency

20 digits

INFRASTRUCTURE

Building type, infrastructure and major inventory

50 characters
A database would need to allow for plural entries. Units may include ranger stations, visitor centres, exposition, entry gates, toilets, roads, parking lots, trails, etc. Objects may be coded for distinction.

Name or unit code

50 characters
It is suggested that each building in each protected area receives a code.

Built in year

4 digits

Construction costs in local currency

20 digits

Local currency

3 characters

Annual Percentage write off

2 digits

Annual Percentage maintenance

2 digits

Year major maintenance / renovation

4 digits
This indicates when the next major maintenance is due. This is every 100 / annual maintenance percentage. (e.g. Maintenance 5% means every 20 years)

Year routine maintenance / painting

4 digits
This indicates when the next routine maintenance (particularly painting and routine repairs) is due. Usually every 3 years.

EQUIPMENT AND GOODS

Type of equipment

50 characters

This can be vehicles, outboard motors, boats, motorcycles, computer workstations combined with the peripherals, library, complete server installation, etc. To avoid entering large numbers of items, it is recommendable to categorize items with an individual item value of less that $2,500. This may include all the "office furniture" in which the entire non-electronic office inventory can be included. Field and electronic equipment like desktops and laptops, GPS, cell phones, binoculars, etc. can be combined into one entry. Another item might be the total value of the books in the library.

Unit code
8 characters

Purchased in year
4 digits
For combined categories an average age needs to be estimated.

Price in local currency
10 digits

Annual Percentage write of
2 digits

SPECIAL MATERIALS

Type of material
50 characters
Only apply to important materials, particularly fuel for vehicles, heating fuel, etc.

Unit price in local currency
4 digits

Total annual use
10 digits

Unit
10 characters
gallon, liter, kg, etc. This can be a pull-down menu

STAFF

Type of staff
50 characters

Position level
2 digits

Monthly base salary
10 digits

Number of months payable per year
2 digits

Percentage over base salary of monthly social benefits not paid by employee
2 digits

Contract until year
4 digits
0 = permanent

Paid by
50 characters
This can be the protected areas agency, but also a protected areas fund or an NGO or project.

Service contracts

Type service contract
100 characters
This can be rent for buildings, water bills, internet, rental of airplane or other equipment, consultancies, etc.

Annual costs
10 digits

7.5. DATA SETS ON NATURAL RESOURCES OF PROTECTED AREAS

7.5.1. Tracking data

Tracking data register time and place the data were observed or collected and they provide them with a unique code. Tracking data are a fundamental prerequisite for field field data; without this information, the collected data cannot be related to a location and moment in time and consequently, they lose much of their value for purposes of mapping, baseline characterization, monitoring and statistical analysis.

The Site code is designed to make the data of a given site and given time unique. By giving the first 6 fields for the date, than 4 letters for the location, followed by 2 digits for the sequence, it may provide an almost unrestricted number of entries for every date of the year.

Furthermore the tracking data provide information about place (latitude, longitude or UTM), date and time. Under trees one usually cannot get a GPS reading, or one may not carry a GPS. In such case one can't fill out the coordinates. In such case, one enters the central coordinates of the protected area or of a known sector within the area and makes a note in the observations. One may estimate his/her position from trail markers[14] or a known nearby position.

If you need to design a new data table to fit your specific needs, you would need to link such table to a tracking table, so that you can relate your information to other data.

Site Code*:

Tracking items include an observer-defined site code, which is a unique identifier based on the date defined by the two last digits of the **year, the month and the day**, followed by a **four-letter** code chosen for the site and **two digits** for sequential observation on the observation date: yy-mm-dd-aaaa-nn**.**

Observer*:

3-character code to define the observer. This field is compulsory, since it facilitates the information user to track the data to the observer.

Organization Code:

An 8-character code for the organization responsible for the collection of the data entry. Staff members, volunteers, students or individual observers under contract by an organization can enter that organization here. M

State/Department/Province:

Fill out the State/Department/Province.

Information by State/Department/Province and be very useful for analysis and reporting at the state level. This can be designed at a pull down menu in a database graphical interface. M

Municipality/township/county:

Fill out the township/county/municipality or equivalent.

Interpretation and reporting by municipality probably is a less frequently needed event. L

Country*:

Two-digit code for country consisting as defined by the International Organization for Standardization, ISO. Annex # lists the codes for the countries of the American Hemisphere. This coding is necessary for database management when combining data of several countries.

LT:

[14] It is recommended that area managers have cement or metal position markers placed at regular intervals along the trails with a code and a known geographical position.

Local Time. Usually only needed for data that vary in the course of the day, like fauna observations, weather and water data and human activities. M for mobile organisms or continuously changing conditions; L for sessile organisms and fixed conditions.

Latitude (W) and Longitude (N)*:

Register the latitude and longitude in degrees (D) [15], minutes (M) and seconds. Only the W position starts out with the global hemispheric quadrant of the site (NE = 1, NW = 2, SE = 4, SW = 3). It is necessary to start out with a zero (0) after the quadrant, when the degree value is less than three digits.

UTM zone, UTM X and UTM Y:

Alternatively one may want to register UTM zone, UTM X and UTM Y. This is recommendable as experience has shown that people with preference for UTM data may go at great length to "force" the system to accept their UTM coordinates.

Protected Area:

Name of the protected area. Enter the official code for the official protected area mentioned for the protected area data: 2 letters for the country code, 1 digit for the IUCN category and 3 letters for the protected area. It is recommended that a list be made with the protected areas and their codes be made for the protected areas of the Americas. This field is not necessary but very convenient. H

Geographic range:

Name of geographic range, like Cordillera de Nombre de Dios (eg. Register one word in uppercase: NOMBREDEDIOS). Maximum 55 characters. It is recommended that a list be made with the names of geographical ranges of the Americas.

Dimensions of the plot or relevé in <u>Length & Width & Orientation</u>, or in <u>Radius:</u>

For ecosystem characterization, circular plots are defined by their radius. As a standard for observations for the Ecosystems map of Central America, circular plots have been used with a radius of 25 m. However, for the shores of aquatic ecosystems and locations with gradients, circular plots are often not practical. Extended shore lines (up to 1000 m) may be required to characterize the ecosystem. For ecosystem characterization, this information is H.

Attention: Some observers like to chose an elongated rectangular plot perpendicular to a gradient to include the different elements of the gradually changing ecological conditions. This way they capture several ecosystems in one characterization. As such practice would combine several ecosystems into one dataset, the practice of selecting plots perpendicular to the gradient should be avoided, and instead plots should be chosen parallel to the gradient, including only one ecological condition at the time. Several plots would be needed to characterize a gradient.

Rectangular plots are registered by their length, width and orientation in degrees from true north. All plots are defined by their geometric center.

Point observations may be registered as a circular plot with a 0 (zero) radius.

Topographic map nr.:

Allows entry of the topographic map number if known. Convenient for the user, but not strictly necessary. L.

[15] For instructions on how to obtain this reading, please read the manual of your GPS unit.

Directions:

Directions for finding the plot are to be provided by the observer. Also allows notes about methodology used if needed. 255 characters. Convenient for the user but not strictly necessary. M

7.5.2. Ecosystem data

An ecosystem map presents sharply defined polygons with authoritative labels. However, any classification system is arbitrary in the sense that it introduces artificial separations in only gradually changing landscapes by subdividing modifiers in subdivisions agreed by convention and which can often not be located in the field with precision. Polygons reflect all the biases of its authors, as well as all the imperfections and errors inherent to any map and to any classification system (Muchoney et al. 1998, Touber et al. 1989). To compensate for such imperfections, sound field data need to be collected, representing consistent sampling and stored in a logically organised database. The mapping project for Central America made a mayor effort to decide which field information to collect. It started out with the "STEP" design of the University of Boston (Muchoney et al. 1998) and tested it extensively with the participating scientists in the field each being among the most experienced scientists in his/her country of residence. Renowned external scientists were consulted (i.a. Professor R.A.A. Oldeman, Ph.D., University of Wageningen; Professor A. M. Cleef, Ph.D., University of Amsterdam and Wageningen; Dr. H. van Gils, ITC, Enschede and M. Kappelle, PhD, University of Utrecht).

HUMAN INFLUENCE

Perturbation

Because the effects of human disturbance are so important to biological conservation and understanding land use and cover change processes, it is important to estimate the degree of human intervention a site has been subject to. Distinct perturbation classes are suggested for terrestrial and aquatic ecosystems, as defined in the following paragraphs. In seasonally flooded areas, the differentiation between a land ecosystem and an aquatic ecosystem may be arbitrary depending on the season. Choose one or the other, depending on whether – in your judgement - aquatic or terrestrial conditions prevail. M.

Originally three degrees[16] of intervention were distinguished. It was found however that it was difficult to distinguish three levels from satellite images. Therefore only 2 classes of disturbance have been mapped for the Central American Ecosystems Map, in which disturbance classes 2 and 3 as presented in the following paragraphs have been combined. It is however still considered useful to distinguish 3 disturbance classes for site analysis, as it provides very detailed and specific information on a specific site. It is recommended to continue combining disturbance classes 2 and 3 in a mapping disturbance class 2 for mapping purposes, while distinguishing 3 for site analysis. When aquatic formation is indicated, the system is aquatic. 1 digit, M.

[16] The class " natural" is not part of these three degrees.

Perturbation land ecosystem:

The following classes are recognized:

0)	Natural	No traces human intervention apparent for at least several decades.
1)	Disturbance class 1:	Woody structure largely intact; Herbaceous layer lightly grazed and/or cropped, possibly occasionally burnt; Savannas seasonally burnt with grazing practically absent or absent;
2)	Disturbance class 2:	Woody structure largely intact with occasionally logged trees Herbaceous layer moderately grazed and/or cropped, possibly occasionally burnt; Savannas seasonally burnt with moderate grazing;
3)	Disturbance class 3:	Woody structure distinctly logged and forest structure severely thinned but maintaining forest characteristics, grazing moderate or absent, possibly burnt; Savannas seasonally burnt and intensively grazed;
4)	Agricultural systems	
5)	Urban environment	
6)	Other	

In many cases the magnitude of human intervention is evident, while in others it is less conspicuous. The classification is bound to be subjective, but it still gives an indication of the degree of human influence. E.g. much of the coastal plains of the Mosquitia area and the coastal plains of Belize are burnt every few years or annually. This results in various degrees of suppression of forest growth. However, with no grazing present, the vegetation has a strong natural appearance. In such case class 1 could be suggested, while in areas with moderate grazing, class 2 seems more appropriate. Many spontaneously seeded Caribbean Pine stands in Belize, and the Mosquitia are managed as production forests through thinning and selective logging. Still these forests maintain well-developed shrub and vegetation covers and maintain distinct natural characteristics. Under such conditions class 3 would be appropriate as opposed to the alternative of forest plantation.

Forest plantations, agroforestry, permanent intensive pastures, as well as all industrial plantations and production crop systems all would fall under agricultural systems.

Perturbation aquatic ecosystem:

As in terrestrial ecosystems, there are three classes of disturbance for site analysis:

0

1

2

0.	Natural	
1.	Modified natural class 1:	Natural aquatic formation surrounded by moderately intensive agricultural practices; shores largely in tact; no eutrofication; uninterrupted connection with the sea. Small-scale fisheries.
2.	Modified natural class 2:	Natural aquatic formation surrounded by intensive agricultural systems, moderately eutroficated and /or with moderately grazed shore communities; altered water bodies (dredged coastal canals along Atlantic coast of Costa

	Rica) in swampy environments with natural aquatic shore communities and moderate to good water quality.
3. Modified natural class 3:	Severely eutrophicated (green, non-transparent) surface water with largely reclaimed shores (urban construction; agricultural use) or man-made water systems with important natural characteristics like stabile shore communities, good water quality (Panama Canal).
4. Man-made water system	
5. Aquaculture	
6. Other	

Usually, water reservoirs fall under the category of man-made water systems, as their water tables severely fluctuate in short periods of time, which does not allow for the development of stable shore communities. Pollution generated eutrophic ecosystems must always be labelled under perturbation 2 or 3.

Perturbation cause:

In the case of disturbance, try to assess the main cause of intervention. If necessary, elaborate in the Description of physical elements field. Don't fill out for undisturbed ecosystem.

1. fire
2. wind
3. insects
4. disease
5. logging
6. grazing
7. drought
8. flooding
9. recreation pressure
10. pollution
11. other

PHYSICAL DATA

Land formation:

A choice of 10 major categories can be listed:

1. mountain
2. hill
3. footridge/slope
4. plateau
5. upland
6. piedmont plain
7. valley
8. coastal plain
9. periodically inundated plain
10. dune
11. lava flow
12. other

If a significantly different category applies, enter other and specify in the Description of physical elements field. 2 digits M

Position on slope:

Relative position of a plot in hilly terrain. Don't fill out in the case of plains or flat upland plateaus. If in a valley, fill out "base". 1 digit, L

1. top
2. upper slope
3. mid slope
4. lower slope
5. base

Elevation Source:

The source of the elevation can be indicated as either: 1) altimeter, 2) map or 3) GPS. 1 digit, L

Elevation:

Elevation is defined as the average elevation of the site polygon in meters above sea level, based on topographic maps, global positioning system (GPS) and altimeter readings for field plots. 4 digits, M

Slope Angle:

Slope angle is the inclination of the slope in degrees determined by estimation, hand level or tape measurement. For flat areas; fill out "0". 2 digits, L

Orientation:

Slope orientation or aspect is the direction of the slope of the site, recorded in degree units from north based on compass or GPS readings. The range is therefore 0-360, however the value of 399 is used for strongly variable slopes. Don't fill out if slope angle is 0. 3 digits, L

Soil geology:

For general ecosystem mapping only superficial soil data are collected. No soil drillings are to be performed or descriptions of soil profiles required. Soil data are only registered on the basis of surface examination of exposed mineral soil. Profound soil records can be registered in the SOIL form. Five choices of geological origin are given. If origin is not known, don't fill out the db-field. 1 digit, L

1. igneous
2. plutonic
3. metamorphic
4. sedimentary
5. non- consolidated
6. other

Soil type:

Five choices of soil types are given. If soil type is not known, don't fill out the dbfield. 1 digit, L

1. clay
2. lime
3. sand
4. clayey-sandy
5. clayey-limy
6. organic soil
7. peat
8. other

Saline soil

Terrestrial ecosystems may have saline conditions. This is often indicated by mangrove[17] or other salt-tolerant plants. check box, L

Soil color:

Seven choices of soil colors are suggested. 1 digit, L

1. white
2. grey
3. brown
4. black
5. ochre
6. red
7. other

[17] Occasionally mangrove may grow under apparent fresh water conditions. In such specific cases, make sure to mark "fresh water" under the "water characteristics".

Moisture regime soil:

The moisture regime of the site is intended to be used to describe the prevailing and seasonal water balance of plots. It **does not refer to the soil condition at the moment** as that is a condition that varies constantly. Take into consideration prevailing climatic conditions, drainage, absorption capacity of the soil, etc. to make your assessment. **Assess the moisture characteristics for both the wet and the dry season in the relevant columns of your form.**

1 digit, L

Desiccated:	Extremely dry conditions resulting from desert to semi-desert climatic circumstances.
Dry:	Seasonally dry conditions. Usually reflected by vegetation as deciduous phenology
Moist:	Moisture apparent throughout most of the year due to abundant rainfall under good drainage conditions; or good water conservation during dry periods, due to moderate to poor drainage.
Wet:	Site is extremely humid throughout most of the year due to abundant rainfall and/or moderate to poor drainage.
Saturated:	Poorly drained soils that are saturated during a good part of the wet or rainy season.

Drainage:

This field allows for further characterization of the moisture regime by defining drainage and inundation levels and also aspects of human interference. This is one of the greatest modifiers in terrestrial ecology. 1 digit, H

1. well drained:	Sloping (hilly to mountainous) terrain that facilitates continuously rapid surface drainage; if in flat terrain, soils are extremely porous.
2. moderately drained:	Very mildly undulating terrain with regular to mildly porous structure which during the wet prevents waterlogging most of the time; no significant periodical flooding.
3. poorly drained:	Flat terrain with dense soil structure which leads to waterlogging during the wet season but no significant flooding.
4. periodically inundated:	Terrain covered by water for more than 50% of the surface. It includes, riverine and marine flood plains and tidal zones.
5. permanently inundated:	Terrain covered by water for more than 50% of the surface most of the time. It may include, marshes and swamps and tidal zones. For tidal zones use 400 in duration of inundation.
6. Irrigated:	Irrigated system.
7. Impounded:	Water locked in by man-made conditions, like rice fields, water trapped behind a road, shrimp farms, etc.

Aquatic formation:

Eleven classes of aquatic systems have been chosen. If a different system is required, fill out "other", and specify in "Comments regarding physical elements". 2 digits, M

1. marine system
2. estuary
3. river
4. coastal lake
5. coastal canal
6. inland lake
7. volcanic lake
8. karstic lake
9. reservoir
10. dredged system
11. swamp / marsh
12. other

Water characteristics

The characteristics refer to some ecologically important differentiating physical categories:

1. fresh
2. brackish
3. saline
4. volcanic dissolvents or alkaline
5. thermal
6. other

Further details can be specified in the aquatic data monitoring form, but that is not required for general ecosystem mapping purposes. The first 3 options are the most important modifiers in aquatic ecosystems: 1 digit, H

Composition of the water bottom:

The following classes of water bottom are listed.

1. soft sediments
2. sand
3. rock debris
4. bedrock
5. coral
6. other

These modifiers often are difficult to establish. 1 digit, M

Depth source:

Refers to the information source, 1 digit, L

1. map,
2. estimate
3. instrumental measurement.

Depth:

Maximum depth of plot in meters. In Description of physical elements more details can be given about maximum depths of water body. These data are time consuming to take and in shallow waters, highly variable. 3 digits, L

Submerged shore slope:

Estimate the submerged shore slope angle in degrees. 2 digits, L

Flow velocity:

Estimate the flow velocity in kilometers per hour. This can be measured by throwing a leaf in the current and estimate the distance traveled during one minute to calculate velocity. For visibly but very slow flowing currents, fill out 01 if estimate cannot be more precise. For stagnant waters one must fill out 0, which is very different from a blanc entry. 2 digits, L

Duration of inundation:

Estimate the duration of inundation in days per year during a typical year. In the case of tidal inundations, which are a form of periodical inundation, use 400, which will be interpreted as daily tidal inundation. Duration of tidal flooding period of the site itself may be added in description. Be aware that the flooding period of each location varies greatly depending on the elevation and tidal characteristics of an estuary. 2 digits, L

Inundation season:

Indicate the inundation season in months during a typical year. 4 digits with separator (mm / mm), L

Estimated normal fluctuations:

Estimate fluctuations in the water table expressed in meters during a typical year. This may need further elaboration in the "Description of physical elements". 2 digits, L

WEATHER DATA

Weather data are usually only relevant for fauna surveys. There is no need to register these for botanical surveys.

Temperature:

This usually is just a rough estimate, and obviously, temperatures will greatly vary in the course of the day. If important, you may provide details in the observations dbfield. degrees C, +/- 2 digits, L

Relative humidity:

In percentage. This information usually is not available, as it requires a hygrometer. 3 digits, L

Wind:

1. No wind
2. light breeze
3. windy
4. strong wind
5. very strong wind
6. gale

1 digit, L

Precipitation:

1. dry
2. light drizzling rain
3. prolonged drizzling rain
4. occasional showers
5. prolonged shower(s)
6. very heavy showers
7. Immediately after rain

1 digit, L

Type of precipitation:

1. Rain
2. hail
3. snow
4. freezing rain and sleet

1 digit, L

Sky:

1. Clear
2. hazy
3. scattered clouds
4. partially clouded
5. overcast with clouds higher than 300 m
6. overcast with clouds lower than 300 m
7. light fog
8. heavy fog

1 digit, L

Visibility:

Register visibility in meters. If good no entry. Visibility may be restricted by atmospheric conditions or by vegetation. For the latter condition please make a note. In either case the user will know how far the observer could see. If this is combined with the registration of fog or rain, the user will know that the observer was also limited by atmospheric conditions.

4 digits, L

Phase of the moon:

1. First Quarter
2. full moon
3. last quarter
4. new moon

Can also be interpreted from the observation date. 1 digit, L

Description of physical elements:

This 255 letters field allows for any description.

7.5.3. Data on the vegetation

The biotic data to be collected for ecosystem mapping are primarily based on the characteristics of the parts of the vegetation that grow into the air or the atmospheric part of the biosphere, and which will be referred to as "atmospheric" vegetation elements. For aquatic ecosystems without "atmospheric" vegetation, other considerations can be taken into account – depending on the level of detail: floating and submerged vegetations, specific life forms (corals), geology and geography.

"ATMOSPHERIC" VEGETATION ELEMENTS

ALL STRATA

While recognizing that specific layers or strata are often a very arbitrary characteristic in a vegetation (Oldeman, 1990) and in many cases statistically absent, it is still helpful to analyze the vegetation by several distinctions of heights. Consistent with the UNESCO classification system and its derivatives, a database can distinguish three strata: Tree Stratum (> 5m); the Shrub Stratum (between 1 and 5 m, default in database) and the Ground Stratum (<1,5 m) (Mueller-Dombois, 1973). The term "Ground" Stratum has been used instead of "Herbaceous" stratum as in this stratum also the ground cover of non-living elements is registered. Please note that the ground stratum is height defined and may include woody plants as well as non-vascular plants, while the shrub stratum may include tall (> 1,5 m) herbaceous elements. The separations are arbitrary, and the surveyor may sometimes wish to deviate from the defaults, reason for which the heights of each stratum may be specified. No height filled out for Shrub or Ground stratum means standard heights.

Ecosystem classification system

This information is important in the context of ecosystem classification. 1 digit H
FAO-UNEP LCCS
UNESCO
USNVC
Braun-Blanquet
Other

Ecosystem class:

The final word on this will be elaborated in the Ecosystems thematic network.

Distribution

This field refers to the distribution patterns within the vegetation at large (not within a sampled plot) of a polygon. **Random uniform** means that the dominant life forms are distributed at random, but their distribution is rather even, and from a distance – as seen from the air, the vegetation has a uniform appearance. In natural vegetations the most commonly found distribution will be random uniform for vegetations with a finer texture. **Random clumped** refers to very coarse texture vegetations, such as savannas with clusters of closed woodlets. **Ordered distribution** refers to plantations in which the trees are planted a specific pattern. **Ordered clumped** are typical for commercial plantations with various fields each with identical age classes and/or species. **Linear distribution** will typically be associated with ecotones, like shores, beaches and gallery forests. Linear does not refer to the linear rows in a plantation, which instead would be ordered uniform. 1 digit, L

1. random uniform
2. ordered uniform
3. random clumped
4. ordered clumped
5. linear

Texture:

The differentiation of development of the vegetation within the landscape is important for determining the nature of disturbance, the ecosystem dynamics and stratum/canopy geometry in its horizontal composition. The texture defines the structure of the vegetation in its horizontal dimension as it is seen from above. The texture may have various degrees of spatial variation or maze, which can particularly be observed on slopes, from elevations, from the air, aerial photographs or images. This variety may not always be visible at the site. The degree of variety varies from homogenous to very coarse. 1 digit, L

1.	homogeneous	Vegetation with closely stuck trees, shrubs of herbs that gives an impression of a homogeneous vegetation blanket. (e.g. steppe, meadow, same age-class of single-species forest);
2.	fine	Closed tree or shrub cover with distinct variation in heights and dimensions of crowns, but without abundance of openings (chablis). Usually well developed tropical ombrophilous forest;
3.	medium	Broken tree or shrub canopy with distinct openings in the dominant cover or clumps of distinct species of up to 3 times the height of the tallest life form; Visible on aerial photographs;
4.	coarse	Broken tree or shrub canopy with distinct openings in the dominant cover or clumps of distinct species of clearly more than 3 times the height of the tallest life form but less than 100 m; Visible on Landsat images as a coarse grain.
5.	very coarse	Tree or shrub cover with varying structure of more than 100 meters and distinguishable on Landsat images as fine patterns within polygons. Usually mosaics of open forest or shrubland with meadows, swamps or savannas.

Indicator life forms:

Some life forms may indicate certain ecological conditions. As absence of such indicators may have indicator value as well, there absence can be an option as well. No value means no data. 3 digits, L

Some arboreal life forms may have indicator value: Abundance of **arboreal palms** is often indicative of poor drainage. **Tree ferns** are more common in tropical forests at higher elevations and their presence may indicate the distinction between low land and (sub-) montane tropical ecosystems. **Acaule** (truncless; may occur in Shrub and Herbaceous strata) **palms** may indicate disturbance. The following life forms are recorded in percentage:

- Absent
- Arboreal Palms
- Acaule Palms
- Tree Ferns

Some life forms are usually dependent on trees or shrubs, but not always. The coverage of such tree- or shrub-supported plants is often hard to assess; therefore their presence is registered in the abundance classes: (0) absent, (1) rare, (2) common, (3) abundant. 1 digit, L. Tree-bound epiphytes may be split in three categories, each indicating different ecological conditions: drapery, sessile and climbing associations. Many **Vines** and **sessile epiphytes** are heliophylous and their abundance may indicate disturbances from both anthropogenic (felling or burning) and natural (hurricane) origin. Tree- or shrub-supported life forms:

- Vines
- Drapery Epiphytes
- Sessile Epiphytes
- Climbing epiphytes

Ecosystem dynamics

The dynamics of the community is recorded in classes of increasing dynamics. It is often difficult to make a good estimate of the real age of an ecosystem and possibly it makes more sense to register its dynamics. Particularly the difference between Pristine (never deforested) and Ancient or Mature (deforested in a distant past but since then recovered to a new climax forest) is difficult to assess in Maya territory, as well as in hurricane prone and fire swept territories of the Caribbean lowlands. In assessing the dynamics, there is no judgement whether disturbance is of natural or human origin. Between brackets, indications of period of regeneration since last incident of destruction. Destruction may occur as a constant factor, such as seasonal burning, inundation, flushfloods, etc. Under such circumstances the dynamics are "stable" meaning that the ecosystem will stay very much the same, but the ecosystem dynamics are high resulting in a status quo under those conditions.

1. pristine	Never disturbed climax vegetation;
2. mature	Disturbed in (pre) historic past but regenerated to climax conditions (> 200 years; e.g. documented former Maya territory);
3. old secondary growth	Disturbed in historic times but recovered to seemingly more mature ecosystems (40 – 200 years; forests in the Appalachian Mountains in the USA and Canada);
4. recent secondary growth	Full grown pioneer trees with low species diversity (typically 10 - 40 years; e.g. many Caribbean Pine stands);
5. dynamic	Recovering ecosystem after severe disturbance. Abundant growth of young pioneer trees and bushes. (typically 5 - 20 years; e.g. many shrub dominated savannas; burn sites in Yellowstone NP);
6. very dynamic	Ecosystem subject to severe changes. Growth of pioneer species mostly in herbaceous or shrub phase. (typically < 5 years; e.g. many riverine sand banks covered with bushes).

The degree of dynamism is a key ecological characteristic with great impact on species composition and species richness. The higher the level of dynamism, the lower the number of species capable of surviving under those conditions. Usually higher dynamisms is reflected in lower vegetation cover density. Ecosystem dynamism usually is not mapped as such, but it may be intrinsically represented in certain other modifiers. A specific modifier that is based on dynamism is a characterization of (anthropogenic) disturbance or perturbation. High ecosystem dynamism should not be confused with ecosystem stability. Natural dynamism may be a very consistent factor in an ecosystem, such as the continuously changing water table in the tidal zone. Ecosystems under a consistent regimen of dynamism may be considered stable in the context of nature conservation purposes. 1 digit, L

Description of biotic elements:

Description of the biotic elements applies to all strata. It is included at the bottom of the form as an aid to understanding the ecosystem. It allows the observer to register any complementary information to the standardized biotic parameters.

TREE STRATUM

Height:

The tree height is important for describing ecosystem structure and physiognomy, which are related to biomass, productivity and microclimate and influence parameters such as surface roughness. The tree stratum (> than 5 meters) is recorded in meters and defined by the tallest trees. 2 digits, M

Densiometer:

Indicate the use of densiometer:

0 no
1 convex, provided by the project
2 concave

For the use of the densiometer, please follow the instruction that comes with the equipment. Preferably make four readings and average. 1 digit, L

Canopy Cover:

The cover by the tree stratum is defined by the canopy cover, expressed in percentage. If no tree stratum present, fill out 0 and continue to shrub stratum. 3 digits, M

Basal area cover:

This parameter is used by foresters to calculate the amount of harvestable wood, which in turn can be used to estimate biomass. The basal area cover of the tree stratum is based on the basal area factor (BAF). The **registration is counted in trees** rounded off to the higher full number. Mention method in "Comments regarding the vegetation". 2 digits, M

Leaf morphology:

This characteristic can be made available to be recorded for all three strata. This refers to the predominant leaf type of the trees, the shrub and of the predominant life form in the herbaceous stratum. Graminoid vegetation comprises grasses, sedges; forbs include rushes and pteridophytes (ferns).

Mixed refers to mixed broadleaf/needleleaf. Significant mixed compositions of other classes may be mentioned in the dbfield "Comments on the vegetation". Orthophyllous and sclerophyllous refer to respectively soft and hard (leathery) leaves. Often the distinction is hard to make and may change with the age of the leaves. The hardness of the leaf may be an indication of the moisture regime during the driest part of the year, but only so in combination with other factors, as some trees in tropical rainforests may carry sclerophyllous leaves where fully exposed to the sun.

1. None
2. Broadleaved orthophyllous (normal)
3. Broadleaved sclerophyllous
4. Needleleaved
5. Palmate
6. Cactus/Thorn
7. Bamboo
8. Graminoid
9. Forb
10. Mixed broadleaved / needleleaved

Canopy leaf phenology:

Leaf phenology registers whether the woody species in the tree stratum drop all or a portion of their leaves periodically and therefore must regrow all or a portion of its photosynthetic mechanism from year to year. Defoliation does not necessarily happen simultaneously, and while some trees are still shedding their leaves, others may have already started to grow new leaves. Determination of defoliation preferably is based on a combined assessment of site surveys and low-level aerial observation (reconnaissance flights and/or aerial photographs). Often the leaf phenology may not be assessed in the field and the consultation of other sources may be required. 2 digits, L

SHRUB STRATUM

Most of the parameters for the shrub stratum are of the same nature as in the Tree stratum. Height is set at default in database as this stratum is defined by its higher limitations of 5 m and lower limitations of 1.5 m. However, in some cases there may be a reason to define the stratum with a different height. The shrub stratum may be composed of shrubs and tall herbs (> 1,5 m). Therefore the overall cover of the stratum is recorded as "plant" stratum including both. In a separate field the herbaceous component is recorded. If no shrub stratum is present, fill out 0 in plant stratum and continue to ground stratum.

Herbal Periodicity:

For the shrub stratum, this characteristic can be recorded for the tall (>1.5 m) herbaceous species of the Shrub Stratum. 1 digit, L. Herbal periodicity[18] is recorded as:

1. without periodicity, such as is the case for bare rock and soil
2. ephemeral (1-4 month life span terophytes)
3. annual
4. cryptophytic
5. perennial (or phanerophytes)

GROUND STRATUM

An estimate of the ground cover fractions of plant and substrate cover (all plant life forms),

1. Dwarf shrub cover (shrubs smaller than 1m)
2. Non-vascular cover
3. Fallen wood
4. Organic matter
5. rock
6. Mineral soil
7. water
8. snow

Ground cover is to be recorded in percentages. 3 digits each, L. The standard maximum height is 1.5 meter, but sometimes deviations may need to be recorded (e.g. very tall grasslands may be higher than 3m).

Leaf morphology:

List the leaf morphology of the dominant life form

Phenology dwarf shrub vegetation:

As phenology refers to life forms that seasonally shed their leafs, only dwarf shrubs - if present – can qualify. Only list phenology if dwarf shrubs (< 1.5 m) are present.

Herbal Periodicity:

Herbal periodicity informs us about seasonal stress (availability of water, winter). Seasonal wilting of the herbs of an evergreen forest is an important indicator of the "seasonal evergreen tropical forest". Annuals (or therophytes) must produce both root and above-ground vegetation from seed annually, while perennials can store energy above and/or below the ground. Periodicity is defined as

- without periodicity, such as for bare rock and soil
- ephemeral (1-4 month life span, therophytes)
- annual
- cryptophytic
- perennial (or phanerophytes)

This characteristic is tracked for the dominant herbaceous species only. 1 digit, L.

[18] For further detail see Ground Stratum.

AQUATIC STRATUM

Floating vegetation:

Floating vegetation comprises the vegetation fraction that covers the water surface while being supported by the buoyancy of the water. It may be attached to the water bottom by their stems, but in such case the leaves should not penetrate into the air. Leaves penetrating into the air carrying their own weight (as is often the case with water lilies during periods of low water) should be considered to form the herbaceous stratum. Floating plants that penetrate somewhat into the atmosphere, but that are fully supported by buoyancy, like water hyacinth are considered floating vegetation.

Submerged Vegetation:

Submerged vegetation constitutes the vegetation fraction that does not reach the water surfaces. This may often be difficult to assess without subaquatic observation.

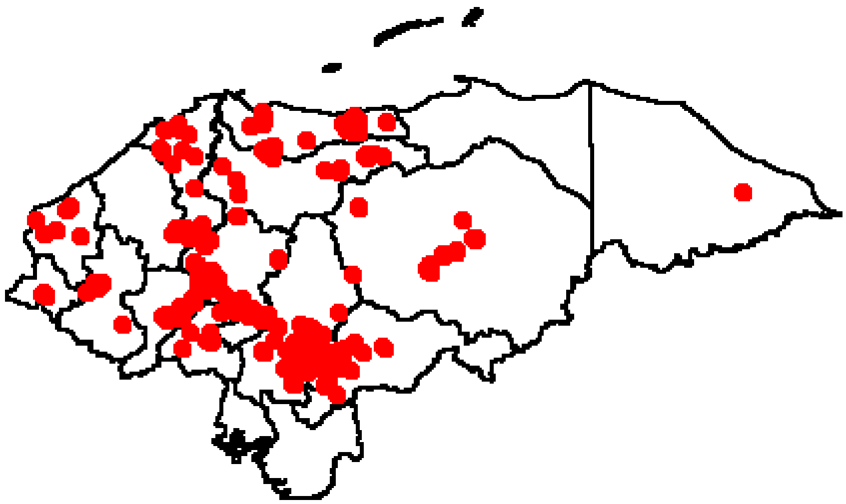
7.6. DATA ON ORGANISMS

7.6.1. The role of species of special concern

Commonly advocated as a selection criterion for protected areas are endemic species. **In general, using endemic species as indicators for ecosystems, other taxa or management effectiveness is somewhat dubious**. Small countries like Central America will proportionately have far less endemic species than large countries like Brazil. Even if endemism is used in the sense of restricted-distribution species with a maximum distribution range of less than 5,000,000 ha – about the size of Costa Rica - (Stattersfield 1998, BirdLife International, http://www.birdlife.net/ 2003), their indicator values would be extremely coarse, e.g. Honduras, which has about 60 qualifying ecosystems, has no more than a handful of areas with restricted-distribution species of birds and mammals combined (House et al. 2002). The largest protected areas of the country have no known higher endemic species and would not be selected using this criterion. The high arctic has no endemic species at all, while limited distribution species are extremely rare in the entire boreal region (K. de Korte, pers. com.). This can be no argument to neglect polar and sub-polar ecosystems in protected areas systems. In general, typically large ecosystems would rarely qualify as their species usually are characterised by wide distribution.

House et al. (2002) show convincingly that the known distribution of endemic plant species in Honduras is concentrated around the capital city of Tegucigalpa, which is home to the two largest botanical research institutions in the country as well as areas along main access roads. Obviously lopsided sampling leads to distorted information on endemic species. **In the tropics the mere fact that a species has only been found on a few occasions and/or in a restricted area often puts it in the category of rare and/or endemic for the simple reason that sampling still is very incomplete**; particularly for small organisms there is too little information to make such categorization (H. van der Werff, pers. com.).

Figure 1: Map of plant species endemic to Honduras



The bias of the data set on endemic plant species in Honduras observed by House et al. (2002) are by no means limited to plants. They "show from less detailed data sets that a similar situation applies to fauna species and from our collective experiences we have many indications that justify us to suspect that similar situations apply to all countries of the world, including developed countries". In the Netherlands high concentrations of vagrant birds occur around the homes of the country's most renowned birdwatchers. Further, geographical sampling biases are not restricted to endemic species, but apply to all species assemblies that are not collected through specific random sampling site selection or systematic grit inventories. **This corroborates our previous conclusion that only data from ecosystem maps are sufficiently impartial to serve as the primary criteria for biodiversity representation analyses**.

This does not mean that information on the distribution of individual species should be neglected in area identification. On the contrary, House et al. 2002, show how species information complements ecosystem information acquired from ecosystem mapping. Moreover, many stakeholders highly value endemic species, and often with a little extra effort, many can be saved from extinction.

Despite the obvious sampling problems associated with endemic species, it is possible to learn from the distribution of restricted-distribution-species. Geographical isolation is considered one of the primary requisites for species development. In Honduras, 6 ecosystems together contain 60% of all of the reported endemic plant species in that country, yet they only represent 12% of the total area of natural ecosystems. Those ecosystems all have in common that they are relatively small and geographically isolated, being either montane or being restricted to isolated dry valleys in a rain shadow. The natural fragmentation of these ecosystems is possibly one of the reasons for the high numbers of species with restricted distributions.

Also in the montane environment of the Andes, endemism and restricted distribution is much more common than anywhere else. Among higher plants, restricted distribution and endemism is about 15 times higher in the Andes than in the Amazonian lowlands (H. van der Werff, pers. com), while species densities are usually higher.

In aquatic and wetland ecosystems restricted-distribution species are usually rare or absent. This is due to (1) their very effective connectivity in aquatic environments, and (2) their relatively high dynamics, which require mobility and flexibility of their species to survive[19]. Typically large ecosystems (see Chapter #. "Terrestrial Ecosystems) are also likely to have few endemic or limited distribution species. For example, Pitman et al. (1999) studied the distribution of trees in the Department of Madre de Dios in Peru, where they did not find any endemic tree species; this is an area with extremely high species diversity, where most species occur in very low densities. Thus the absence of endemic species, provides no indication about the degree of biodiversity and should not be used for proxy ecosystem evaluation or weighting.

Some species need areas for only a very limited time; in such cases protective measures and/or use restrictions may only be necessary during the season of intensive use. This may apply to breeding colonies of birds and locations where birds congregate during migration, etc. Examples of other taxa with migrant populations or gregarious behavior include most Pinnidea (Seals, Sea Lions and Walrus), Cetacea (Whales, Dolphis and Porpoises), all Chelonidae (Marine Turtles), some butterfly species – e.g. the Monarch butterfly, *Danaus plexippus*, (Bohdanow 2002) - and some ungulates, such as the Caribou, *Rangifer tarandus,* in the Neoarctic.

[19]Worldwide a number of aquatic species have 'beaten" the odds and survived climatic change in extremely isolated desert habitats (Chen, 2002), that were deprived of all connectivity.

The challenge is to determine which SSP should be monitored, how and with which frequency. This document cannot go into those details, and suggest to further elaborate a potential list of macrofauna SSP for the Americas in a separate document.

A practical problem in using species for distribution analysis is that many data that have been collected belong to individual scientists or institutions, many of which don't have a policy of openly and broadly sharing their scientific data; as a result, such data – although collected – are not available to other researchers or conservation institutions. This is regrettable; more so, because public funding derived from tax revenues ultimately has financed most of the collection of those data. **Bi- and multi-lateral financing as well as governmental institutions should adopt a policy to always include a clause in all financing contracts that the beneficiary shall deliver all data resulting from that financing to the financing institution to be made available for public use.**

7.6.2. All life forms

Taxonomic Group (TG):

This dbfield allows a quick entry into different taxonomic groups:

1. Green Plants
2. Fungi
3. Lichens
4. Bacteria
5. Mammals
6. Birds
7. Amphibians
8. Reptiles
9. Arthropods
10. Corals

11. Mollusks
12. Sponges
13. Others

2 digits, L

Family, Genus, Species, Genus, Local name:

In order to ensure consistent spelling, it is suggested to build a mechanism that helps the user find the species through a graphic interphase with pull-down menus. This requires that one enters the species systematically, passing through the 4 levels of taxonomical organization provided in the system, starting with the Taxonomic Group. Normally, a selection will already show up after typing 3 or 4 letters in the pull-down menu and then you click your selection.

In the case that the required taxonomic level does not yet exist, one may enter it by typing it in. For a new species, this requires that one passes through all 4 taxonomical levels.

For botanical plots, it is recommended that you primarily focus on the species that seem to be predominant in that particular ecosystem.

Invasive species:

Check box marker. M

Certainty:

1. ID confirmed
2. ID not confirmed
3. subspecies uncertain
4. species uncertain
5. genus uncertain
6. family uncertain

For species of special concern, this information usually is rather important. 1 digit, M for SSC.

Local name:

If known give common or local name. 70 letters, L

Size:

Adult size in meters.

1 digit dot 2 digits, L

Water position (Wp):

1. free floating
2. rooted floating
3. submerged
4. covering bottom
5. burrowed in the bottom

1 digit, L

Institution of Herbarium or collection:

Name the institution that guards the sample in its herbarium of collection.

50 characters M

Collection sample code (code):

Register code as it is registered in aforementioned institution, including bird ring number.

50 characters M

Vitality (Vit):

1. healthy
2. sick
3. dying
4. dead

1 character, L

7.6.3. Primarily plants

Shape:

Describe the shape of the adult sessile life forms: e.g. one-stemmed or multiple stemmed tree, umbrella shaped tree, spherical bush, cone shaped moss cushion, etc. (55 letters) Also consult Raunkiear and Dansereau. This field can also describe shapes of sessile marine life forms.

Flower (Fl), Fruit (Fr), Seedling (Sdl) and Seed (Sd):

Create these entries with a check box. Not entered is undetermined, L

Stratum (Str):

Mark presence for each of the 3 vegetation strata with a check box, L

COVAB:

Cover-abundance is a combined estimate which marks the abundance of individual plants, when their cover is less than 5%, while the percentage is marked from 5% and up (Please consult Tropenbos[20]):

R rare (equivalent to r in Braun-Blanquet)

O occasional

F frequent

A abundant

cover > 5% register percentage

3 characters, L

[20] This is a world wide continuous Tropical Forest research program financed by the Netherlands Ministry for Development Cooperation.

7.6.4. Primarily animals

Biosphere:

Describes in which part of the biosphere the organism has been observed. The observation may be in several parts of the biosphere. Create the following options with a check box:

- On the land
- underwater
- in the soil
- air bound

Only in very special conditions is this information useful, L.

Pupa (Pp); larva (Lv); Egg :

Create these entries with a check box. Not entered is undetermined L

Substrate:

This may be a species, a life form or a non-living substrate. 50 characters, L

Observation:

Mark the type of observation:

1. sight
2. hearing
3. track
4. excrement
5. netting
6. shooting
7. trapping
8. ring
9. other

1 digit, L

Flight:

Elevation of flight above the surface of the earth in meters.

4 digits, L

Total number (Nr tot):

Total number of individuals of animals.

8 digits, M

Number of males (Nr m):

Number of males.

8 digits, L

Number of females (Nr f):

Number of females.

8 digits, L

Number of Juveniles (Nr juv):

Number of juveniles.

8 digits, L

Number of reproduction individuals

These are the accumulated reproducing individuals. This may be relevant in case of endangered species. 8 digits, L

Distance:

Observation distance in meters

4 digits, L

Shy:

1. Degree of shyness:
2. very shy
3. shy
4. a little shy
5. ignores you
6. tame

This is a very subjective assessment and often not possible to assess. Very shy is when the animal takes off immediately when it notices you; shy is when it takes off but it will stop within viewing distance, a little shy is when it increases the distance from you when you come too close, but it does not really disappear. It ignores you when you stand still, but when you move in too close, it may still step or fly a few meters to keep some distance; tame is when you can almost or actually touch it, or if it tries to obtain food from you.

This information may be indicative of hunting pressure and disturbance. 1 digit, L

W:

Weight in kg.

4 digits, dot, 2 digits, L

7.7. WATER DATA

The water data form allows for the recording of data in direct relationship with biodiversity information. The database can provide a considerable selection of common parameters, but it can be expanded to suite specific needs. In general all water data are Low in priority, unless a specific water quality problem emerges.

Flow velocity:

Estimate flow velocity in km per hour. This can be measured by throwing a leaf in the current and estimate the distance travelled during one minute to calculate velocity. For visibly but very slow flowing currents, fill out 01 if estimate cannot be more precise. For stagnant waters one must fill out 0, which is very different from no data.

Transparency:

Transparency of the water phase is in meters. Observation from above the water is with the use of a white transparency measurement disk or estimate; from scuba diving observations by estimate.

pH:
5 digits

Conductivity;

Suspended matter:

Organic matter:

Bacteria:

Na:
mg/l 10 digits

K:
mg/l 10 digits

Ca:
mg/l 10 digits

Mg:
mg/l 10 digits

Cl;
mg/l 10 digits

HCO3:
mg/l 10 digits

NKJ:

NH4:
mg/l 10 digits

P-Total:

PO4:
mg/l 10 digits

SO4:
mg/l 10 digits

NO2:
mg/l 10 digits

NO3:
mg/l 10 digits

BOD5:

COD:

Mineral oil:
ppm/l 10 digits

AS:
mg/l 10 digits

CU:
mg/l 10 digits

Mn:
mg/l 10 digits

Ni:
mg/l 10 digits

Pb:

mg/l 10 digits

Fe:
mg/l 10 digits

Cr:
mg/l 10 digits

Cd:
mg/l 10 digits

Co:
mg/l 10 digits

Hg:
mg/l 10 digits

Ur:
mg/l 10 digits

PCB:
ppm/l 10 digits

PAC:
ppm/l 10 digits

DDT:
ppm/l 10 digits

Dieldrin:
ppm/l 10 digits

Lindane:
ppm/l 10 digits

Observations:
General notes, observation, methodology. 250 characters

7.8. SOIL DATA

The Soil Data Form has been based on the Methodology originally developed by the FAO (FAO, 1977, Guidelines for soil profile description) and enriched by a committee of 42 experts on natural resources management to produce the Tropenbos 4. Technical Series (1989) on Guidelines for a common methodology on Inventory and Evaluation of Tropical Forest Land. The methodology has been incorporated – using the same terminology - to allow for full integration of detailed soil profile data with other ecosystem data. In general, taking soil profiles is very time consuming and the information gives rather little information on the ecosystems. The collection of these data is low priority.

In order to provide full detail of a soil profile, you must describe each horizon separately. The db-fields Phreatic Water and Rock formation need to be entered only once and may be entered with the first horizon.

The Soil Data Form has a broad selection of parameters, but you may add more db-fields to suit your specific needs.

Phreatic water:
Phreatic water level in meters from surface.

Rock formation:
Depth of solid rock formation in meters from the surface.

Horizon:
Horizon class and/or number
3 characters

Depth top:
Upper level of the horizon in m.
1 digit, dot, 2 digits

Depthlow:
Lower level of horison in m.
1 digit, dot, 2 digits

Color:
Color in Munsell scale.
3 character code

EC:
Electric Conductivity in 1:2.5 soil/water suspension.

pH:
pH in 1:2.5 soil/water suspension.

Texture:
(1) Sand, (2) loamy sand, (3) loam, (4) silt loam, (5) silt, (6) sandy clay loam, (7) clay loam, (8) silty clay loam, (9) sandy clay, (10) silty clay, (11) clay, (12) other.
2 digits

Character:
(1) Mushy, (2) mucky, (3) greasy, (4) gritty, (5) leafy, (6) mossy, (7) peaty, (8) other.

Structure:
(1) Structureless, (2) granular, (3) non-compact layered, (4) compact layered, (5) loosely fibery, (6) fibery, (7) other.
1 digit

Stickiness when wet:
Stickiness when wet: (1) Non sticky, (2) slightly sticky, (3) sticky, (4) very sticky.
1 digit

Consistency dry:
Consistency when dry: (1) Loose, (2) brittle, (3) slightly hard, (4) hard, (5) very hard.
1 digit

Consistency moist:

When moist: (1) Loose, (2) very soft, (3) soft, (4) springy or elastic, (5) firm, (6) tenacious, (7) very firm, (8) extremely firm.

1 digit

Consistency wet:

When wet: (1) Non plastic, (2) slightly plastic, (3) plastic, (4) very plastic, (5) smeary, (6) slightly fluid, (7) fluid

1 digit

Gravel:

Gravelliness (0) (0.2-7.5 cm): (1) 2-15%; (2) 16-50%; (3) 51-90%; (4) >91%.

1 digit

Stones:

Stoniness (7.5-25 cm): (1) 2-15%; (2) 16-50%; (3) 51-90%; (4) >91%.

1 digit

Rock:

Rockiness (>25 cm): (1) 2-15%; (2) 16-50%; (3) 51-90%; (4) >91%.

1 digit

Pores abundance:

Pores abundance: number per dm^2.

2 digits

Pores size:

Predominant size in mm.

2 digits

Pores volume:

Pores volume in %.

2 digits

Mottles characteristics:

Calcareous, (2) Argillaceous, (3) Gypsiferous, (4) Siliceous, (5) Ferruginous, (6) Manganiferous, (7) Saline, (8) other.

1 digit

Mottles abundance:

Mottles abundance in % of profile area.

2 digits

Mottles size:

Predominant mottles size in mm.

3 digits

Mottles color:

Mottles color in Munsell scale.

Root size:

Root size: predominant diameter size in mm.

2 digits

Root abundance:

Root abundance: number per dm2.

3 digits

Root orientation:

(1) Random, (2) along oblique planes, (3) horizontal, (4) vertical.

1 digit

Mycelia:

Presence of mycelia: Y / N.

Fauna activity:

Apparent fauna activity: (1) mites-type, (2) enchytroid-type, (3) arthropoid-type, (4) worm-type, (5) other. Note: you may enter details in the “data on organisms.

1 digit

Fauna abundance:

Abundance of faunal activity: (1) none, (2) little, (3) common, (4) abundant.

1 digit

Organic matter:

Organic matter in percentage according to the Walkley and Black method (if different specify in Observations), Page et al., 1982.

3 digits

Calcareous:

(1) Non calcareous, (2) slightly calcareous, (3) calcareous, (4) strongly calcareous. This is determined with exposure to 10% HCL solution. Reaction: none, slight, strong, violent respectively.

1 digit

P:

Available P.

N Kjeldahl:

Available N using the Kjeldahl method.

Ca:

Observations:

General notes, observation, methodology. 250 Characters

7.9. HUMAN ACTIVITIES

Forms VI and VII have been developed to systematize and store field observations by park rangers and forest officers of protected areas. They function under the premise that rangers make contact with individuals they meet on their rounds[21].

We have prepared two sets of field forms. One set provides four sheets integrated into one file: (VIa) Persons on the Trail, (VIb) Harvest Data, (VIc) Data on Offences and (VII) monitored species. These pages fit on one page each and may be printed in any combination to suit your needs.

There is a separate field form file for recording only the indicator species in combination with the tracking data and the weather data. If you use that, in the database you will first have to fill out the tracking data and the weather in form VI and then change to form VII for entering the species.

[21]In the past administrators used the term patrols, but nowadays the role of rangers is much more oriented towards service to the public; therefore we use the term Ranger Round, which reflects the modern philosophy of the functions of field staff.

7.9.1. Additional tracking data

LT in:

Time of starting the round or transect observation at Local Time

LT out:

Time of finishing the round.

It is recommended that protected areas are divided up in coded management and monitoring sectors with a standardized central position. In GIS systems, the sector should be polygonized.

Sector code

2 characters

Sector central longitude:

Standard format

Sector central latitude:

Standard format

7.9.2. People on the trail

Number of people on the Trail[22], GROUP 1-6:

Records the number of people on the trail encountered during the ranger round. One form allows for the registration of up to 6 groups. If more groups are encountered, please enter a second form, using the consecutive number for the tracking data. If there is a continuous stream of encounters, you may like to avoid registration and just count the total number recorded that day. Management staff and visiting researchers encountered en route are not counted.

Group 1-6 X:

Longitude of previous

Group 1-6 Y:

Latitude of previous

Origin 1-6:

Origin of the persons. This may be the country for foreigners and the community or city for residents. This is not a compulsory field! Don't stop people to find out their origin. Only fill it out if you have talked with them for other reasons.

LT 1-6

Approximate time of encounter in LT

Visitors:

Total number of non-local visitors encountered during the service round. This field is to assess the recreational visitation density of the Protected Area sector.

Persons:

Total number of persons encountered, both local residents and visitors. Staff and visiting researches are not counted.

Observations on Persons on the Trail:

A 255 letters field for any observations on Persons on the Trail.

[22] We use passersby, as the people encountered on the trail may be local inhabitants, resource users, visitors, etc.

7.9.3. Harvesting data

As the database has been designed for both strictly protected areas, buffer zones, and multiple use areas, the database allows for the collection of data of harvested products. The harvesting may be legal or illegal; in the latter case, it may be appropriate to also enter information in the component on offences.

Harvesting type:

For observed forms of harvesting of natural (non-agricultural) products, mark for woody products “deforestation by burning, felling or other”, for other activities mark activities like hunting, collection of firewood, mushrooms, fishing, etc. The db-field has been kept very broad to allow any kind of harvesting activity.

Harvesting date:

Date of harvesting site if known or may be estimated for recent deforestation. The date may differ from the service round.

Extracted products:

Trees, firewood, wild animals, fish, mushrooms, plants, other.

Number of units extracted:

Number of units of the previous field.

M3 extracted:

Estimate volume of extracted (fire)wood

Ha deforested:

Surface of deforested site in hectares.

Habitat:

Type of effected habitat in UNESCO code or other in use by the administration of the area.

Land-use:

This applies particularly for buffer zones and multiple use areas. Mark the land-use of effected area, like agriculture, coffee, cattle raising, forestry, ecotourism, etc. Various uses are allowed. For strictly protected areas mark wildlife conservation wildlife conservation, etc.

Authorization code:

Code for permission for harvesting, cutting trees, fishing or hunting license, if any.

Action:

Mention what kind of action was taken, if any.

Observation on deforestation:

A 255 letters field for mentioning any observation on the deforestation, including recommendations for action.

7.9.4. Infraction

Offences usually do not take place at a major scale in areas with a continuously present field staff. Nevertheless it is important to properly register the cases to see to what extend irregularities take place. In consultation with the area administrator, determine which types of offence must be registered and how. The paper offence form collects more information that the database. Any information of personal nature is left out to avoid that personal information becomes public. **Under no circumstances should the names of individuals show up in the database.**

infraction

Type of offence:

Describe the type of offence.

Offence X:

Longitude of offence.

Offence Y:

Latitude of offence.

Action taken:

Mention what kind of action was taken, if any.

Observation offence:

A 255 letters field for mentioning any observation on the offence, including recommendations for action.

7.10. DATA ON THE OBSERVER AND DATA COLLECTING INSTITUTION

7.10.1. Observer data

Observer code:

3 letter code. M. This field is for the convenience of the observer to avoid the need for entering his/her full name for each observation. When integrating data from different sources, database managers will have to convert these codes to the source name.

Name:

50 letter field. H

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7.10.2. Data Collecting Institution

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