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Inter-American Biodiversity Information Network

Support to Building the Inter-American Biodiversity Information Network (IABIN)

Trust Fund #TF-030388

Summary Document

April 2005

NIPPON KOEI

In association with

UNEP WCMC

Support to Building the Inter-American Biodiversity Information Network

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SUMMARY DOCUMENT

March 2005

Support to Building IABIN (Inter-American Biodiversity Information Network) Project

Summary Document

Background

The World Bank has financed the current support work under the Japanese Consultants Trust Fund. The objective is to assist the World Bank in the completion of project preparation for the project Building IABIN (Inter-American Biodiversity Information Network), and for assistance in supervision of the project. The work undertaken covered three areas: background studies on key aspects of biodiversity informatics; direct assistance to the World Bank in project preparation; and assistance to the World Bank in project supervision. The present document presents a summary of the background studies.

The work has been carried out by Nippon Koei UK Co Ltd, in association with the UNEP World Conservation Monitoring Centre.

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CHAPTER 1 INTRODUCTION

1.1 Purpose of the document

This document provides a summary of the principal issues, themes, and recommendations from a series of 10 major reports of studies on a range of topics related to the building of the IABIN. These background studies comprise over 500 pages of detailed information, some of it specialised, providing guidance to technical and implementing participants.

The document is aimed at supporting an executive and strategic audience by providing an accessible overview (translated into languages relevant in the region). It further provides an entry point for more specialised audiences, by helping to identify which of the specialised reports should be selected to consult for reference study.

1.2 Objectives of the IABIN Support Project

The project "Support to Building the Inter-American Biodiversity Information Network" (the IABIN Support Project) - is to provide guidance and supporting information to the World Bank, to assist it in developing and managing the project "Building the Inter-American Biodiversity Information Network" (abbreviated as B-IABIN, as distinct from IABIN the network).

Support to the Bank is provided in three parts as follows:

(I) background studies on key aspects of biodiversity informatics

(II) provision of inputs to assist the Bank with project preparation

(III) provision of assistance to the Bank in project supervision.

The first of these is the most important, with the objective of providing the Bank with a better understanding of tools and trends in international informatics related to biodiversity, to enable the Bank to better execute its functions. In summary, the support project is assisting the Bank to manage and execute the project.

1.3 Objectives of IABIN

The following extract from the GEF Project Brief gives a good overview of the purpose of the GEF B-IABIN Project:

> *The project development objective is to:*
>
> *(i) develop an Internet-based, decentralized network to provide access to scientifically credible biodiversity information currently existing in individual institutions and agencies in the Americas.*

(ii) provide the tools necessary to draw knowledge from that wealth of resources, which in turn will support sound decision-making concerning the conservation and sustainable use of biodiversity (in doing so, this project will support implementation of Article 17 of the Convention on Biological Diversity (CBD) in promoting technical and scientific co-operation, and thus contribute directly to implementation of the CBD Clearing-House Mechanism (CHM)) as well as in other areas critical to development and poverty alleviation.

The project will implement IABIN at a regional level through:

- *Assessing the information needs of the biodiversity community, decision makers and stakeholders in the region;*
- *Concurring on a set of standards, protocols, tools, and methodologies that will enhance the ability to search, retrieve, and analyze information across networks (including georeferenced data, quantitative and qualitative data, information, and knowledge);*
- *Digitizing relevant data held in non-electronic forms, thereby increasing the amount of biodiversity information accessible through the network;*
- *Exchanging scientific expertise through collaborative projects and training and other efforts to build capacity in human and technological resources;*
- *Producing value-added information such as studies and analyses; and*
- *Supporting national CHM nodes to help provide the clearing-house functions mandated in the CBD and in subsequent Conference of the Parties (COP) decisions.*

The benefits are numerous. IABIN will:

- *Promote and facilitate access to the information necessary for ensuring conservation and sustainable use of biological diversity in all appropriate sectors including agriculture, tourism, and forestry;*
- *Improve regional co-operation for biodiversity management through sharing of knowledge and expertise;*
- *Provide the capacity to address critical issues — invasive species, migratory species, amphibian declines, and the spread of diseases, among others — at a regional level;*

- *Allow the identification of gaps in knowledge and new fields of interest and facilitate consensus-building on a research agenda to support biodiversity conservation; and*
- *Improve the quality of biodiversity projects (both at preparation and during supervision) in the portfolio of the Global Environment Facility (GEF), the World Bank, and other financiers*

1.4 Background Study Reports

Ten substantial reports were researched and compiled during the IABIN Support project. Nine of them are summarised in this report in individual sections in the following Chapter. One report, "Document 9", provides general generic guidance to the Bank on the incorporation of bio-informatics considerations in development projects, rather than specific guidance to building IABIN. It is therefore not included amongst the summarised reports. The following table indicates the basic structure of the report series.

Doc	Title	Pages	Scope of contents
1	**Overview Scoping Document: IABIN in the Context of Key International Programmes and Initiatives in Biodiversity Information Sharing**	**34**	Provides the context within which IABIN is being built. It defines the scope and extent of "biodiversity information", the intended role of IABIN, and an overview of the range of international information networks and processes currently sharing biodiversity information. It is a preliminary document to provide the background for the other deliverables of the IABIN Support Project, helping to define the "niche" that IABIN will occupy in the global context.

2	**Biodiversity Information for Decision Making – International Experiences** **Appendix 1:** Case Study: Experience in developing the ASEAN Regional Centre for Biodiversity Conservation; **Appendix 2:** Case Study: Experience in developing the regional EC Clearing House Mechanism; **Appendix 3:** Case Study: Experiences in the use of Internet-accessible information in the oil and gas industry; **Appendix 4:** Case Studies: Use of biodiversity information in the decision making process in Japan.	**70 + 112**	Examines the needs and evolving use of biodiversity information for decision- making and how experiences outside the LAC region can assist and inform the development of IABIN. Four major Appendices provide documentation of case studies of the of a regional centre, a regional clearing house mechanism, an industry sector, and national experiences outside the LAC region.
3	**Linking Biodiversity Information with Non-biological Networks**	**25**	Reviews the most relevant sources of non-biological information, e.g. socio-economic data, that is essential for answering questions concerning sustainable development and connections to human health and poverty alleviation. These include the national statistical and socio-economic databanks in the countries of the IABIN region, and global facilities in the UN system and international agencies. Covers effective methods of linking biological and non-biological data through use of GIS and other means.
4	**Recommended Standards and Practices for Sharing of GIS-based Information** **Appendix:** Supplementary case studies	**19 + 59**	Identifies the main issues involved in managing and sharing Geographical Information Systems (GIS) based information. Initially, a brief description of GIS is given, with some of the issues and implications highlighted and special reference given to data types and projections. This is then linked into an overview of Spatial Data Standards and their development, in terms of exchange, interoperability, and metadata standards. Appendix of supplementary case studies of the use of GIS in Japan
5	**Role and Use of Biodiversity Indicators at the Regional Level**	**43**	Reviews the role and use of indicators at the regional level in the context of both national interests and activities, and the broader international policy agendas. In doing so, the report draws on examples of various approaches employed around the world, particularly outside the Americas.

6	**National Strategies for Effective Biodiversity Information Management**	**46**	Describes worldwide examples of domestic strategies for making use of biodiversity information and associated information exchange systems. It is focused on selected case studies, and considers the regulatory, capacity building and institutional strengthening measures that may be used as guidance for the further development of IABIN.
7	**Taxonomic Authority Archives, Networks and Collections** Includes Annex of Key Specimen Collections relevant to the region	**71**	Provides a review of a number of taxonomic authority archives. Describes the scope and types of authority networks along with their role in biodiversity information management. In particular four comprehensive reference sources - GBIF, ITIS, Species 2000, and All Species - are reviewed with information on their structure, relationships, partnerships, and services. In addition, a number of specialised reference sources are reviewed, along with their relationship to the comprehensive reference sources.
8	**International Initiatives in Biodiversity Vocabularies and Thesauri**	**12**	Reviews a number of major thesauri and controlled vocabularies that are relevant to biodiversity information management, and highlights some of their strengths and weaknesses. Key aspects of thesauri and controlled vocabularies are also outlined.
9	**Recommendations on Bio-informatics Standards and Practices for Donor Financed Projects**		Generic recommendations for donor projects in general. **Not summarised in this document**
10	**a) Review of International Initiatives in Metadata Management** **b) Review of Experience in Developing Interoperable Systems for International Data Management and Sharing**	**29 + 28**	This pair of linked reports reviews existing international biodiversity metadata management initiatives relevant to IABIN, and the experiences of developing interoperable systems for data management and sharing in biodiversity at the international level. There is particular reference to Web-based services. The underlying technologies and standards are reviewed together with biodiversity related standards for information encoding and transfer.

The Documents have been researched and prepared by a number of authors who have expertise in a range of technical and scientific disciplines. They therefore reflect varying viewpoints and levels of detail. Some reports are at the strategic or policy level (Documents 1, 2 and 6), some relate to practical implementation approaches (Documents 3 and 5), to

scientific issues (Documents 7 and 8) and some to technical standards for information use and exchange (Documents 4 and 10), although there is considerable overlap. The suite of documents is meant for, and will be of interest to, various audiences. It is hoped that the above table, along with the Document summaries in the following Chapters will help to direct the reader to those volumes of specific interest that merit further reference.

Many of the reports have documented case studies and practical examples of approaches that have been successful internationally. The case studies occur within the bodies of the reports, in attached Annexes, or in separate Appendix volumes.

The following table provides an index to facilitate locating relevant case studies by topic.

Index to Case Studies		
Case Study Title	**Location**	**Topic**
Experience in Developing the ASEAN Regional Centre for Biodiversity Conservation	Document 2, Appendix 1	Use of Biodiversity Information for Decision Making
Experience in Developing the Regional EC Clearing House Mechanism	Document 2, Appendix 2	Use of Biodiversity Information for Decision Making
Experiences in the Use of Internet Accessible Information in the Oil and Gas Industry	Document 2, Appendix 3	Use of Biodiversity Information for Decision Making
The National Biodiversity Decision Making Process in Japan	Document 2, Appendix 4: p9	Use of Biodiversity Information for Decision Making
HGAP (Hokkaido Gap Analysis Programme)	Document 2, Appendix 4: p 6	Use of Biodiversity Information for Decision Making
Oil Spill Dispersion Modelling in the Sea of Japan	Document 2, Appendix 4: p 18	Use of Biodiversity Information for Decision Making
The Use of Spatial Information for Watershed Management Planning in the Philippines	Document 2, Appendix 4: p 22	Use of Biodiversity Information for Decision Making
The Use of Spatial and Biodiversity Information for Mangrove Management Planning in Myanmar	Document 2, Appendix 4: p 31	Use of Biodiversity Information for Decision Making
UNEP-WCMC Interactive Map Service	Document 4, Annex 4, p 7	GIS data exchange
GIS and mapping by the European Environment Agency	Document 4, Annex 5, p 15	GIS data exchange
JIBIS (Japan Integrated Biodiversity Information System)	Document 4 – Appendix of Supplementary Case Studies, Ch 1, p1	GIS data exchange

DNLIS (Digital National Land Information System of Japan)	Document 4 – Appendix of Supplementary case studies, Ch 1, p14	GIS data exchange
Inter-Ministerial Clearing House Gateway for Spatial Data (Japan)	Document 4 – Appendix of Supplementary case studies, Ch 1, p23	GIS data exchange
Tokyo BEIS (Tokyo Bay Environmental Information System)	Document 4 – Appendix of Supplementary case studies, Ch 1, p28	GIS data exchange
Clearing House for Water-Related Information (Japan)	Document 4 – Appendix of Supplementary case studies, Ch 1, p36	GIS data exchange
NOWPAP (North-western Pacific Regional Action Plan)	Document 4 – Appendix of Supplementary case studies, Ch 2, p39	GIS data exchange
PEMSEA (Partnership for Environmental Management in the Sea of East Asia)	Document 4 – Appendix of Supplementary case studies, Ch 2, p42	GIS data exchange
Review of Relevant Initiatives and Experiences: Europe Baltic States Asia and SouthEast Asia North America CSD Sustainable Forest Management OECD	Document 5, Ch 4, p11	Use of Biodiversity Indicators at the Regional Level
Examples of strategies and systems: Europe Australia Asia and Pacific	Document 6, Ch3, p11	National Strategies for Effective Biodiversity Information Management
Examples of capacity building and institutional strengthening: Europe Australia Asia and Pacific	Document 6, Ch4, p19	National Strategies for Effective Biodiversity Information Management

Examples of tools and best practice: CHM REMIB CGIAR-SINGER GBIF Species Analyst Knowledge Network for Biocomplexity GeographyNetwork UNEP.Net	Document 10b, Ch 4, p17	Developing Interoperable Systems

CHAPTER 2 REPORT SUMMARIES

2.1 Document 1 - Overview Scoping Document: IABIN in the Context of Key International Programmes and Initiatives in Biodiversity Information Sharing

2.1.1 Purpose

The purpose of this document is to provide the context within which IABIN is being built and will participate. It defines the scope and extent of "biodiversity information" and the intended role of IABIN, and gives an overview of the range of international information networks and processes currently sharing biodiversity information. It is therefore a preliminary overview document to provide the background for the other more specialised background reports of the IABIN Support Project, helping to define the "niche" that IABIN will occupy in the global context.

2.1.2 Themes and Findings

The term "biodiversity information" is difficult to define in a global context, for there is no consistent and accepted meaning. Various views as to the scope and meaning have evolved from different sectors of the environmental science community, and vary from being limited to taxonomy, through species-related data, to a broad ecological scope.

The stated objectives for IABIN indicate that the scope of "biodiversity information" extends beyond species-centric data, to include biodiversity management and ecosystems information – that would include protected areas, habitats, ecosystem condition and monitoring, conservation strategies and methodologies, population dynamics, actions towards conservation (conventions, regulations, action plans), and so on. The scope should therefore be taken to include biological information related to five categories (Taxonomic Information, Species Information, Protected Areas, Ecosystems and Responses), but to exclude pollution and resource extraction information. That is, IABIN will be a network for the exchange of **biodiversity** information (broadly defined) but not an Inter-American **Environmental** Information Network. This understanding forms the context in which we will be examining and recommending methods, standards and good practices.

Another key point extracted from the stated objectives of IABIN is the emphasis on providing access to scientifically credible biodiversity information **currently existing** in individual institutions and agencies in the Americas. We are therefore not concerned with networks and methods that serve to collect raw data, but rather, those that share or exchange information between custodial institutions.

A recent study of international information-sharing networks that provide support to European decision-makers identified some 289 information sources and networks related to biodiversity, and another 66 programmes or initiatives aimed at harmonisation and integration. These

exclude regional and sub-regional networks and sources. There is considerable evidence of overlap and lack of harmonisation amongst existing networks, and many claims made of networks being "definitive", "complete", "authoritative", "global", etc, are exaggerated, and reflect more the ultimate good intentions rather than the current reality. Further, in spite of the apparent proliferation of networks, significant information gaps exist as well. One particular area in which information is sparse and poorly co-ordinated is in the long term monitoring of ecosystems, and consequent indicators that would assist decision-makers to assess whether policies and actions are effective.

It is in this maelstrom of rapidly proliferating, overlapping and confusing biodiversity information networks that IABIN must find a useful niche that contributes non-redundantly to the whole, rather than adding confusion.

Document 1 contains profiles of 8 global and 5 regional programmes and network initiatives all of which provide elements that purport to support the stated objectives of IABIN – that is, to facilitate the exchange of biodiversity information between institutions with a target audience of "decision-makers". The global programmes include UNEP.Net, the CBD Clearing House Mechanism, UNEP-WCMC, the Millennium Ecosystem Assessment, GBIF, the Global Invasive Species Programme, BioNET and Birdlife International. These overlap in both geographic scope and subject content. For example, the first four all have a broad sweep of subject matter – covering all the main information categories, although with varying emphasis; there is clear overlap between the species-related data maintained by UNEP-WCMC and the more focused database of BirdLife International; and there is also overlap between the general GBIF and more specialised BioNET, particularly with regard to taxonomy capacity building. While these programmes co-operate and interlock in various ways, they cannot be said to be either rationalised or fully harmonised.

Regional programmes profiled are NatureServe, CANBIO-REMIB (Mexico), INBio (Costa Rica), CRIA (Brazil) and NABIN. These offer several examples of database structures for species information (such as that used by NatureServe and the ATTA system of INBio), and good examples of regional and sub-regional networks, and should be adopted to the extent possible.

2.1.3 Recommendations and Implications for Building IABIN

- One of the main purposes of the IABIN Support Project is to point towards an appropriate "niche" for IABIN. In defining this niche, IABIN should, as a matter of principle, seek to:
    - Avoid duplication of existing global and regional exchange networks
    - Avoid redundant development of database structures and tools
    - Emphasise adoption of existing standards and protocols
    - Emphasise linkage with, and augmentation of, existing networks and mechanisms.

- IABIN should seek to build on past successes and established national and sub-regional models, and seek further convergence and integration. An emphasis should be placed on using available technology while improving the coverage and appropriateness of information for decision-making, rather than on advancing technology tools.
- IABIN should consider how best to build on the current foundation through such methods as developing catalogues of useful technologies and compilation of case studies, in addition to data exchange facilitation. This will best be done by defining a small number of priority themes (as has been done in proposing Thematic Networks), rather than trying to advance on all fronts at once.
- Within thematic areas, needs should first be established – related to substantive issues and decisions that need to be addressed – followed by assessment of the principal obstacles to information exchange. Having identified the obstacles, whether technical, scientific or organisational, IABIN can then focus on solutions.
- The principal pitfall to avoid is to promote or facilitate information exchange for its own sake, rather than to address important regional issues.

2.2 Document 2 - Biodiversity Information for Decision Making – International Experiences

2.2.1 Purpose

The purpose of this document is to examine the needs and evolving use of biodiversity information for decision-making and how that experience (particularly as documented in case studies) can assist and inform the development of IABIN.

2.2.2 Themes and Findings

As a framework for discussion, a generic decision making process is outlined in a series of logical steps with 6 main elements: *issue awareness*, *issue assessment*, *policy option development*, *consideration of consequences of options*, *decision and policy implementation* and *monitoring of effectiveness*. An important aspect of this process is a feedback loop, to take results of "monitoring of effectiveness" back to further "policy option development". Each element requires supporting information and IABIN is placed in a key role to ensure that information flow and harmonisation enable the delivery of the appropriate information to the decision makers in a timely fashion.

The decision making process in matters regarding conservation of biodiversity is complex and involves agencies and institutions at all levels – global and regional, national, subnational and local. While support to all levels of decision making are implied in the B-IABIN documents, it is certain that the initial focus will be on the top two levels i.e. regional and global, and national, decision makers. As shown in Figure 1 below, information exchange and harmonisation between operational managers and scientific researchers will serve to supply

the information base to support the higher levels of decision making, and will logically operate through the proposed Thematic Networks, coordinated by IABIN.

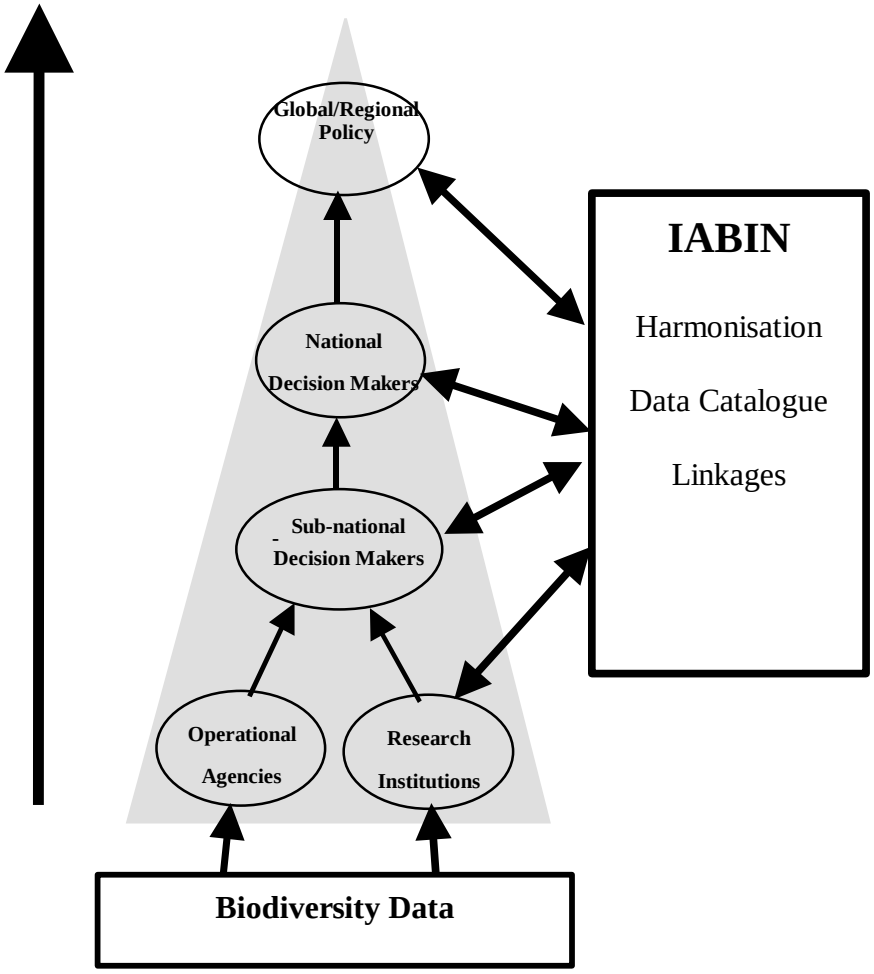

Figure 1: The role of IABIN in regional decision making

The databases that support the information management process are held by custodians in a wide range of national and sub-national institutions. It is the role of IABIN to support the **exchange** of information held in existing institutions (often at a relative low level of aggregation), and its **integration** into policy-ready information products and indicators.

The development of, and widening access to, the Internet over the last decade provides a major opportunity to advance in the sharing and dissemination of information. Recent years have seen a burgeoning of Internet-accessible biodiversity information sources and networks of varying degrees of specialisation, supported by governments, intergovernmental organisations, Convention Secretariats, and NGOs. Many of these contend to be "complete", "definitive" or "authoritative" and are aimed at supporting national and regional decision makers.

A recent study of international information-sharing networks that provide support to European decision-makers classified the 289 information sources and networks identified into the following 10 categories:

- Convention and Treaty Information Sources
- Information on Protected Sites
- Development projects and donor information
- Clearing-House Mechanisms & Integrated Exchange Networks
- Environmental Law Information
- Global and Regional Long Term Ecological Monitoring
- Taxonomic Reference Information
- Species Status Information
- Policy and Strategy Information
- European Nature Conservation Information.

The key sources in each category are reviewed, issues and concerns discussed and emerging standards and practices identified all with particular reference to the role IABIN could play in the region so as to integrate rather than duplicate, and avoid known pitfalls.

Relatively few studies have been conducted of how international information sources are used in decision making. World-wide lessons learned are collated from both national and regional experiences and selected relevant case studies are presented in four Appendices:

Appendix 1: *Case Study: Experience in developing the ASEAN Regional Centre for Biodiversity Conservation;*

Appendix 2: *Case Study: Experience in developing the regional EC Clearing House Mechanism;*

Appendix 3: *Case Study: Experiences in the use of Internet-accessible information in the oil and gas industry;*

Appendix 4: *Case Studies: Use of biodiversity information in the decision making process in Japan.*

Regional experiences are reviewed for Europe, including a review of the development of the EC Clearing House (Appendix 2), and for the South East Asia (Appendix 1). These show considerable contrast, with Europe using complex formal structures, conventions and legal instruments, whereas South East Asia has found that a looser more stakeholder driven approach more successful. The European approach is particularly strong on the implementation of methods to harmonise biodiversity data through "Topic Centres",

streamlined reporting mechanisms, and integrated networks such as EIONET, EUNIS and ReportNET.

Private sector experiences (Appendix 3) derived from the extractive industries show that biodiversity information is used by for:

- Strategic and operational planning (e.g. planning an exploration or exploitation programme);
- Choosing an industrial site (e.g. for a factory, or port);
- Environmental impact assessment (e.g. of major projects – dams, roads, etc).

Overall, the types of information required most frequently by decision-makers include:

- *Environmental law:* International conventions and treaties applicable in the region of interest and the way in which they affect the industry.
- *National laws controlling nature conservation and biodiversity:* National requirements for Environmental Impact Assessment (EIA).
- *Protected and restricted land use:* Internationally and nationally designated protected areas – their level of protection and limitation, and exact location (boundaries).
- *Protected species:* Status and distribution of protected species – including key habitat requirements, threats and migratory patterns.
- *Ecosystems:* Location of critical and important habitats (even if not officially protected or designated, such as mangroves, coral reefs, cloud forests, etc).

2.2.3 Recommendations and Implications for Building IABIN

The study concludes:

- A vast number of international networks and information sources are now available to assist decision-making related to biodiversity conservation. Many of these are accessible through the Internet, and this type of access is growing in developing, as well as developed countries. In spite of this progress in technology availability, many of the concerns identified 25 years ago still apply, particularly with regard to "appropriateness" for decision makers.
- Many networks overstate their scope, functionality and utility and this is an impediment for decision-makers in identifying appropriate sources.
- There are overlaps and duplications in the information content and scope of networks, but these are gradually being overcome through harmonisation initiatives, cooperative agreements and the evolution of *de facto* standards.

- Private sector decision makers often make use of third parties to assemble information from existing sources, indicating that current networks require specialized expertise, and do not have adequate tools for direct decision maker access.
- Public sector decision makers often focus narrowly on sources directly connected to their mandate, such as Convention Secretariat sites, and may not be aware and cannot easily find additional information.
- The most effective networks for decision making are those that are well supported by harmonisation programmes and tools – such as standardised ecosystem (spatial) frameworks, species synonym files, controlled vocabularies, efforts at specifying common core datasets, and the like.
- The most effective networks have a clear purpose and defined scope for classes of decisions and decision makers (rather than just to "exchange information"), and provide means of access and presentation suitable for national or regional level – such as by country.
- Few networks outside of Europe currently have performance measurement systems or have completed reviews of how the system is used.
- There is a lack of information available that is suitable for identifying long term trends or that can be used for indicators, and there is a need to make better connections between national reporting and indicator development.

Overarching Recommendations:

- IABIN should clearly define its scope and intended audience. Particularly it should identify the types of decisions and activities it intends to support and clearly define the **purpose** of information exchange.
- IABIN should work with its members to develop meaningful biodiversity indicators and provide means to more closely connect indicators and monitoring to reporting to Conventions.
- IABIN should adopt (or adapt) *de facto* technical standards for access and data exchange already in use by major international networks, and in this regard especially seek to be compatible with UNEP-WCMC, Millennium Ecosystem Assessment, BirdLife International, the WDPA, and GBIF.

Recommendations Deriving from Regional Experiences:

- The model for IABIN should be for a relatively closely controlled network directed at primary identified information needs for national decision makers, similar to Europe.
- IABIN should support the network with non-technical harmonisation initiatives and tools in a fashion similar to the European Topic Centres.

- IABIN should take cognisance of, and build on, the strengths of existing networks in the region, especially REMIB, INBio, NatureServe and CRIA.
- In order to build an effective and trusting relationship amongst partners in IABIN, the issue of data sharing should be approached with circumspection, and follow, for example, the IUCN-sponsored 'Global Biodiversity Commons' process.
- To be perceived as useful by its stakeholders, there is a strong need for stakeholder participation supported by detailed, trusted information based on objective analysis, preferably from a global perspective, formulated in a way that is relevant to American issues.
- IABIN should avoid being excessively formal and bureaucratic in its interactions.
- Networks should grow rather than be created by projects. It is more important for informed, inclusive dialogue to lead to a shared perception of genuine needs, which can then be met by the judicious application of technology, than for skills and technologies to be offered at the front end.
- It is recommended that IABIN uses common themes such as measuring progress towards the 2010 Target as a milestone for bringing together the IABIN countries and thus building the Inter-American knowledge network of the participating countries.
- It is recommended that IABIN maintains a clearly defined role regarding the CBD CHM and its national focal points in the Americas. This could include developing supporting mechanisms that help participating states with implementation of national CHMs.
- IABIN should put a strong focus on the development of a well balanced metadatabase and user needs for links to external biodiversity information sources. It should aim to provide at least the core services such as a catalogue or metadatabase in the most relevant languages of the American region (Spanish, English, Portuguese).

Recommendations Deriving from National Experiences:

- IABIN should review how to support specific national needs for implementation of Conventions, including assistance with information management regimes to develop indicators that are relevant both nationally and regionally.
- IABIN should assist countries to achieve increased harmonisation to enable useful interpretation in a policy context. This means not only developing tools for harmonisation of the information *per se*, but also for methods and means of information management and analysis.
- A central national repository for biodiversity related information, especially in GIS format, has been found to be effective (e.g. in Japan), especially in supporting national

and regional EIA. IABIN should encourage and support such centres and assist with data management tools and harmonisation standards.

- Various countries have found effective alternative ways to coordinate biodiversity information – for example, Japan uses a very formal approach with an high-level Inter-Ministerial Council, while the UK has no such body, and finds a more loosely arranged government/NGO coordination to be effective. IABIN should be prepared to interact with a wide range of national structures.
- IABIN should be a focal point for facilitating the provision of information to the public.
- IABIN should help articulate national policy driving forces and determine in what ways the network can address them specifically through improved regional information exchange, rather than through general measures.

Recommendations Deriving from Private Sector Experiences:

- The development of IABIN as a network specifically focussing on the Americas will, it is hoped, provide a more extensive and comprehensive regional information relevant to the extractive industries.
- The information requirements from the extractive industries are quite similar and include protected areas, international treaties and conventions, national environmental laws and regulations, and the location and typification of ecologically sensitive areas.
- IABIN should facilitate the availability of ecosystem and protected area information, in GIS format, suitable for downloading to overlay with industry sector information.
- IABIN should endeavour to be a coordinating resource for access to national environmental law and regulation.
- The catalogue or metadata function of IABIN is of importance to industry in order to locate data sets useful for environmental impact assessment and for case studies of habitat rehabilitation.
- Regarding all of the above information services, IABIN should concentrate on providing information not covered by global systems (e.g. national legislation and protected areas), and with continuously up-dated on-line availability rather than static resource packages on CD-ROM.

2.3 Document 3 - Linking Biodiversity Information with Non-biological Networks

2.3.1 Purpose

This Document reviews the lessons learned from what has been done elsewhere in linking biological information with socio-economic and other data, and recommends how IABIN can benefit from these experiences.

2.3.2 Themes and Findings

Linking biodiversity information with other key elements, such as socio-economic information, is essential for answering questions concerning sustainable development and connections to human health and poverty alleviation. Apart from national statistical and socio-economic databanks in the countries of the IABIN region, the most relevant sources of non-biological information for IABIN are:

- The Center for International Earth Science Information Network (CIESIN)
- FAO Statistics Division (FAOSTAT)
- UN Commission for Sustainable Development (UN-CSD)
- United Nations Statistical Division
- Organisation for Economic Cooperation and Development (OECD)
- GEO Data Portal
- The World Bank
- Global Observing Systems.

These principal non-biological networks and information services are relatively consistent in the way that information can be obtained. Essentially, they provide data "tables" (usually downloadable) in which aggregated statistics are presented against an administrative or political unit (usually country) and a time-period (often one year). Most commonly these are presented as a simple text file, or a Microsoft compatible table or spreadsheet that can be easily integrated into user databases, provided there is an appropriate link to the administrative unit.

Where graphic interfaces and mapped output are provided, these are usually simple and mainly consist of national or regional boundaries in common formats. Interactive geo-spatial processing is not generally provided. As far as can be determined, all significant non-biological information services are supported by relational database technology, and use common Web-based interface methods, but there is no consistent standard.

The two most active global programmes that are utilizing linked biological and non-biological data are the UNEP-led GEO process, and the Millennium Ecosystem Assessment (MA). Both have found that it is essential to categorise and summarise biological data using standardised ecosystem frameworks, so that it can be effectively linked to the socio-economic data based on administrative units. Once this standardisation of ecosystem information is obtained, the use of GIS functionality to link between the administrative and biological frameworks can be an important tool. There are two major barriers to such linkage: one due to the nature of "biodiversity data", and the other arising from the traditional incompatibility of the spatial frameworks used for socio-economic and biological information.

Intrinsic Issues with Biodiversity Information

Biodiversity information deals mainly with the observational and assessment aspects of conservation biology – a very descriptive science. The intrinsic nature of the information and the way it is customarily collected and presented make it difficult to integrate with other non-biological information due to some of the following characteristics:

- Biodiversity information is often both descriptive and subjective, rather than quantitative. Assessments of the state of ecosystems are often entirely narrative and contain un-standardised relative terms such as "declining" "improving", "healthy", "fragmented", with little or no quantitative information.
- There are few agreed standard ways to classify or typify habitats or ecosystems (or bio-geographic zones, or biomes, or vegetation cover, etc, etc). Where such classifications exist, they tend to be applicable only in a limited region.
- There is little long-term systematic monitoring of ecosystems – nor agreement on what to monitor – hence no baselines from which to measure change, or assess the impact of implemented actions.
- There is no agreed way to "value" biodiversity or to assess the "health" of an ecosystem or the state of its biodiversity, even in relative terms.

Because of these factors, biodiversity reports on ecosystems, protected areas, countries, districts, and species may contain huge amounts of information that is difficult to relate even to similar assessments of similar areas, and impossible to effectively link to non-biological information.

Some Solutions

- Agreed classification systems for habitats or "ecosystems" and associated global mapping of such a biodiversity spatial framework;
- Established "core datasets" for the major components of biodiversity information – protected areas, species status and distribution, state of ecosystems;

- Systematic long-term monitoring programmes with standardised measurement protocols;
- Agreement on indicators.

Some work is progressing on almost all these fronts and the European situation provides a good model (see Document 2).

Linking Spatial Frameworks

Non-biological information has traditionally been collected, organised and presented on an administrative framework – countries, provinces, census districts, etc. This is a logical and reasonable approach given that the decision-maker is likely to hold responsibility on the same geographic basis, and so the information "makes sense" in that framework.

Biodiversity, on the other hand, does not respect administrative borders, but rather natural boundaries such as watersheds, climate or other bio-geographic zones that cross national and sub-national borders. Information structures and indicators are relevant to these natural spatial units – as are the needed actions and responses. Linking the two spatial frameworks is the key to achieving an integrated picture for sustainable development decision-making. In fact, the use of "ecosystem" boundaries rather than administrative boundaries is a useful way to defuse defensiveness – the "problem" is no longer to be attributed to the person responsible for that county or country, but a problem in an ecosystem that "we" must solve.

Some solutions

One approach frequently used is to employ the administrative framework and attempt to squeeze biodiversity information into it. This is the approach taken (mainly) in the GEO process where the environmental variables are summarised by country and then aggregated into "regions" (mainly continents).

The best and obvious solution is the application of GIS technology. In fact, the earliest GIS systems (in the 1960s) were specifically developed to address just this issue – for instance to link soil and agricultural land quality to socio-economic data. It therefore continues to be surprising how infrequently this technique is used today. In the main, GIS is used as a means of producing maps to illustrate a narrative assessment, or for providing single coverage datasets, such as protected areas boundaries, or coral reef distribution. The case at hand requires use of the analytical capability of GIS to overlay the two spatial frameworks to produce a spatial base that can be aggregated in either way and hence expressed to both the biologist and the administrator in meaningful ways.

A prerequisite for such application of GIS technology is consistent ecosystem mapping across the region as mentioned above. This process is being done with the MA for the 10 defined ecosystems, in order to make the connections between ecosystems and human-well-being.

Of relevance to IABIN is a consistent multi-level "Ecological Regions of North America" map that has been prepared (but little used) in digital form by the CEC, and could be extended across the Americas region to provide the requisite biodiversity spatial framework for overlay on the administrative (socio-economic) framework.

2.3.3 Recommendations and Implications for Building IABIN

- Encourage and facilitate the preparation and wide availability of ecosystem mapping frameworks for the region, including a consistent ecosystem map of the Americas that extends the existing North American map, boundary mapping of the 10 MA Ecosystem categories, and other internationally recognised mapping frameworks.
- Assemble, standardise and make available a consistent GIS coverage of administrative boundaries within the Americas, at least to the first sub-national level, suitable for use to overlay with the ecosystem mapping. Such a coverage should be made compatible with the national and regional designations used by the principal non-biological networks, particularly the UN Statistical Division and the GEO process.
- Provide guidance and standards for using the analytical capability of GIS to integrate information from administrative and natural spatial frameworks.
- Facilitate the development of harmonisation tools for biodiversity information management, including agreed classification systems for habitats and ecosystems, core datasets for major biodiversity information categories, standardised species nomenclature, standardised vocabulary (multi-lingual), and so on, thus enabling consistent linkage with non-biological networks.
- Maintain links to the web sites of the key international and regional sources of non-biological data and maintain metadata, and provide guidance information on best uses of these sources.
- Work to define the indicators suitable to the region and the resulting needs for biodiversity and non-biological data in order to develop a systematic long-term monitoring system. This should be suitable for supporting the 2010 targets and MDGs, in structures that facilitate linkage with national and regional socio-economic data.
- Clearly define the roles and responsibilities of the Thematic Networks and their Coordinating Institutions in the development of indicators and the implementation of long-term monitoring programmes. These should provide consistent time-series using standardised IABIN ecosystem and administrative mapping units – and hence could be linked to non-biological data regionally and internationally.

2.4 Document 4 - Recommended Standards and Practices for Sharing of GIS-based Information

2.4.1 Purpose

This Document introduces the concepts of Geographical Information Systems (GIS), and provides guidance on the standards and practices that facilitate the exchange and compilation of spatial information amongst a network of institutions.

2.4.2 Themes and Findings

GIS is the name given to various computer systems used to collate, manage, analyse and present information with a geographical (locational) component. Such systems are potentially of great value in managing biodiversity information and there are increasing numbers of networks and international institutions making spatial information available

There is a need to both integrate biodiversity data of different types, from disparate sources, and (as discussed in Document 3) to link this information with other non-biological data. Spatial data standards provide the architecture for the integration of GIS data from multiple sources and in multiple data formats, along with providing the ability to more fully integrate spatial data with non-spatial data. The Open GIS Consortium (OGC) is a consortium of companies, government agencies and universities concerned with interoperability standards for geoprocessing.

Three areas of spatial data standards need to be considered.

GIS information exchange standards: These standards allow for the exchange of data between different organisations, so that the same information can be viewed with other data held on different software platforms and in different formats. Initially, this exchange was managed using specific extensions to GIS software packages but that does add a level of complexity. To overcome this, various standard interchange and open file formats have been developed that allow data to be viewable within multiple software systems without the need for data converters. Probably the most significant of these file formats is GML (Geography Markup Language), a specialised form of XML (Extensible Markup Language), developed as part of the OGC initiatives. GML has advantages in that it is a text-based standard and not reliant on any specific software. However, there can be problems when dealing with large datasets.

GIS information inter-operability standards: These standards allow for the integration of data held in an organisation, with other data held in a different organisation, which may or may not be working on the same GIS software platform. The data can be linked interactively through either the organisation's internal network or through the Internet. The development of web-based technologies has allowed for the evolution of Interactive Mapping Services (IMS), which give users the capability to view GIS data in an Internet browser environment. The OGC has been instrumental in the creation of standards to enable IMSs to interact with each

other and with multiple GIS packages. Currently there are standards for Web Map Services (WMS) and Web Feature Services (WFS), relating to IMS and Internet Data Services (IDS) respectively. Essentially, with IMS, processing and map creation are done at the server and the map image is delivered to the user; with IDS, the server delivers the data needed to create the map, and the map is produced at the user workstation.

Spatial metadata standards: For data to be used effectively, it is important that a user be provided with as much information as possible about the data themselves. "Metadata" provides the user with information about the data values, their structure, the systems on which they are managed, etc, and thus allow the data holdings to be explored, interrogated and incorporated within other networks. Standards for metadata have developed in line with the advances in technology and data formats. A wide range of metadata standards now exists covering different data types and user needs. ISO have developed standard ISO 19115 that has combined aspects of several other metadata standards to create a universal standard for the storage and distribution of metadata.

In an ideal world, GIS data would be entirely interoperable, meaning that the information would remain in the possession of the original owners and incorporated into other organisations through Web applications. If data is being physically exchanged, there is always the possibility that the end-user is working with an outdated copy of the dataset and this becomes more likely in cases when a dataset is updated frequently.

To integrate GIS data stored in different formats in different locations across the web, access must be provided through an Internet map or data server. To be fully interoperable between software systems, this server needs to provide information that complies with the OGC standards for WMS or WFS. A service that complies with WMS or WFS standards can be viewed in many software packages such as ArcIMS, but also can be imported into different applications running on different software such as the OGC compliant map viewer used in the FGDC data clearinghouse.

2.4.3 Recommendations and Implications for Building IABIN

- When deciding on the standards and practices to adopt for sharing GIS-based information, the primary consideration is the needs and capabilities of the contributors and end-users. If the technologies and standards employed do not allow easy integration or assist them in their programme of work, then their use is of little value.
- Special consideration also needs to be given to the development of policies for the management and distribution of information provided by partners and third parties. Data distribution policies need to be developed to allow these providers to include their data in the network, whilst maintaining ownership and control over how the data is distributed and used within other systems. This will also have an effect on the type of system that is employed to store and manage the data within the network.

- Data may be incorporated into IABIN either by compiling the information in some kind of central repository or by linking to information held in the different organisations. There are advantages and disadvantages to each with regard to accuracy, infrastructure within the collaborating centres, and the currency of data provided. It is recommended that the IABIN system is constructed in such a way that it is possible to include data held both locally and remotely, thus allowing as many organisations as possible to collaborate.
- For a variety of reasons, information exchange is often the most viable and convenient option for the sharing of data. It is best to distribute data in a number of formats such as "shape" files or DXF (AutoCAD Digital Exchange Format), although to be truly open GML is the best route to take.
- Wherever possible it is recommended that an open access data policy should be employed in relation to all data outputs from IABIN. However, where information is provided with restrictions, this needs to be adhered to and access restrictions put in place. To encourage partners to provide data to the system, a comprehensive security policy needs to be employed.

2.5 Document 5 - Role and Use of Biodiversity Indicators at the Regional Level

2.5.1 Purpose

This Document reviews the role and use of indicators at the regional level in the context of both national interests and activities (mainly outside of the Americas), and the broader international policy agendas. It provides insight into a range of approaches to indicator development of potential application and benefit to IABIN and the Latin America and Caribbean region.

2.5.2 Themes and Findings

The development of indicators is one of the crucial areas in conservation and sustainable development where science and policy meet. The major function of environmental indicators is to support assessment of the effectiveness of environmental policies and management practices by making relevant information available to decision-makers and managers in an intelligible form. The challenges in developing indicators are (1) to identify the key questions that affect policy and management, and (2) to confine development to measures that are feasible.

Good indicators are:

- *scientifically valid*, i.e. they relate appropriately to what they are meant to represent;
- *based on easily available data*;
- *responsive to change*;
- *easily understandable*;

- *relevant to focal issues and users' needs*;
- *subject to target or threshold setting*.

Starting with the Earth Summit in 1992, a number of initiatives have contributed to the need for, and increasing acceptance of, biodiversity indictors. These include the UN Millennium Development Goals, the Convention on Biological Diversity, the 2010 Target and the Global Plant Conservation Strategy and Targets.

Specifically within the Americas, a number of international efforts that have developed at regional scales will require biodiversity indicators to help track progress in their implementation. These include the Regional Biodiversity Strategy of the Andean Pact countries, the regional processes to promote sustainable forest management, the Lepaterique Process in Central America and the Tarapoto Process of the Amazonian countries. Also in Central America, regional processes to develop environmental policy and resources such as the Comisión Centroamericana de Ambiente y Desarrollo (CCAD) and the Consejo Centroamericano de Bosques y Areas Protegidas (CCAB/AP) are potential users of regional scale indicators.

A number of frameworks for establishing suites of indicators have been proposed and used. The most widely used indicator framework is the "pressure-state-response" (PSR) framework, which was developed by the Organisation for Economic Co-operation and Development on the basis of the Canadian "stress-response" model. The PSR framework is built on the idea that human activities (such as clearance of forest for agriculture) exert pressures on the environment, which can induce changes in the state of the environment (for example, the extent of forest cover). Society may then respond to changes in pressures or state with policies and programmes intended to prevent, reduce or mitigate pressures and thereby reduce environmental damage. Indicators provide tools for elucidating PSR relationships, both at the reporting stage and during policy analysis.

The PSR framework has been widely applied to indicator development. For example, it is explicitly recognised by the CBD; the Commission for Sustainable Development (CSD) has used a variant of this approach, in which the term "driving force" is used instead of "pressure" to accommodate social, economic and institutional indicators; the European Environment Agency further expanded the PSR scheme to include drivers and impacts, forming the "DPSIR" framework.

The Global Environment Facility (GEF) has also attempted to develop a framework for indicators that would help evaluate the impact of its biodiversity programmes. This framework takes explicit account of the three objectives of the CBD and the three levels of biological diversity to identify the kinds of questions that should be addressed by indicators of its programmatic impact.

Some regional experiences are reviewed in detail in the Document and include Europe (through the EEA), the Baltic States (a combined State of Environment Report), South East Asia (through the ASEAN Regional Centre for Biodiversity Conservation), the CSD and the OECD. Of these, the EEA approach is most mature. The EEA is the principal source of regional scale environmental data in Europe. Its current biodiversity indicators focus principally on grasslands and combine data from national reporting processes with remote sensing overviews, data from NGOs and some regional scale assessments. The EEA plans to adopt further indicators based on trends in populations of species associated with each of the major habitat types in Europe. Recently, the EEA has begun working on the Pan-European Biological and Landscape Diversity Strategy, with UNEP-WCMC and others, to develop indicators for assessing progress in achieving the 2010 target.

The experience of the various regional initiatives and the recent CBD COP decision on indicators have identified the highest priorities and most feasible areas for indicator development to be those 'state' indicators that supply information on trends in the extent and protection of ecosystems and habitats, and in the abundance and distribution of species.

One such species-based approach is the Living Planet Index. It was originally conceived as a rough indicator of biodiversity change that would help address the question, "how fast is nature disappearing?" through effective and quantitative use of the imperfect data that are available. The wider application of species population trend indices like the LPI is a promising avenue for national and regional monitoring of biodiversity trends and potentially one of the most useful ways of monitoring progress toward meeting the 2010 biodiversity target, at national, regional or global level. They have been applied at national scales in a number of developed countries and a few developing ones, and will form the basis or regional scale indicators in Europe. The advantages of such indices include:

- The ease with which they can be understood by, and communicated to, a non-scientific audience.
- Their transparency: listing the species populations included in them makes any biases clearly visible.
- Their flexibility: in addition to representing the state of the species in the index, they can serve as proxies for the healthy functioning of the ecosystems and can therefore be used as biodiversity indices in a broader sense.
- Their suitability at different scales.

Other approaches include the Natural Capital Index, baselines and indicators of spatial extent of habitats. Spatial mapping may also be relevant for pressure indicators

2.5.3 Recommendations and Implications for Building IABIN

Developing meaningful indicators at regional scales requires a more complex approach than simply aggregating national indicators, and IABIN should develop its data management strategies accordingly. IABIN and its member institutions can and should play a crucial role in ensuring that the necessary information is readily accessible and understandable. In some cases this will involve identifying a need and generating indicators directly. In other cases it will be a matter of ensuring that appropriate data for use in indicators are clearly identified and well documented, so that other agencies can make use of them.

Given the history of ecosystem mapping in the region and the degree to which species trend data are dispersed and frequently inaccessible, it is likely that map-based indicators will be the first to be fully operational at the regional scale. IABIN can and should facilitate this by:

- making mapped data on ecosystems accessible;
- ensuring that adequate documentation is available to enable users to evaluate the appropriateness of comparing or combining different data sets;
- providing guidance or lexicons to elucidate the relationships between different ecosystem and land cover classification systems.

The potential for developing species trend indicators in the Americas is high and will increase as the participants in IABIN mobilise more relevant data resources. This objective should be pursued by:

- making species population trend data easily accessible and providing guidance on their use;
- providing linked documentation on species distributions, ecological requirements and habitat associations;
- enhancing access to data included in grey literature;
- improving outreach to amateur and academic networks as a mechanism for identifying and documenting unpublished data;
- making use of institutional memories to assess and document data quality;
- (potentially) providing access to on-line index calculation, allowing users to choose focal ecosystems and select species for inclusion.

IABIN can facilitate the development and use of indicators of pressure on biodiversity by:

- recognising the importance of data from outside the biodiversity and conservation sector;
- identifying important pressures on ecosystems and species at local, national, regional scales;

- establishing collaboration with relevant organisations that may hold data on such pressures;
- where possible, providing well-documented links to relevant data on these pressures, which are likely to be held outside the IABIN network.

In the area of response indicators, IABIN potentially has a key role to play in:

- facilitating access to data on protected areas and ecosystem and species distributions;
- mobilising information on the assessments of management effectiveness that are taking place under a number of different initiatives and providing access to their results as they become available;
- identifying and facilitating links to other data, including:
    - data on certified ecosystem management within the region;
    - information on ecosystem restoration activities;
    - data on investments by donors (bi-lateral, multilateral and NGOs) and the private sector in conserving, managing and restoring biodiversity.

Above all, it is vital for IABIN to consider how information in the network can be used in developing biodiversity-related indicators, and to ensure that users are clearly and transparently directed to data that are important for the focal areas for indicators. A clear structure showing how different kinds of data relate to these focal areas and to key policy questions will be critical. Clear and comprehensible documentation of data and the relationships among them are also vital.

It will be important for IABIN to take account of (and participate in) regular review programmes to assess the value of existing indicators in supporting decision-making, and to adjust indicator development and implementation programmes accordingly.

2.6 Document 6 - National Strategies for Effective Biodiversity Information Management

2.6.1 Purpose

This Document describes worldwide examples of strategies for information management and associated information exchange systems that enable use of biodiversity information for national benefit. It is focused on selected case studies, and considers the regulatory, capacity building and institutional strengthening measures which may be used as guidance for the further development of IABIN.

2.6.2 Themes and Findings

Several types of international initiatives relevant to the establishment of national strategies for biodiversity information management are described. These include capacity building to enable countries to develop sound information management strategies and information exchange systems (the UNEP GEF BDM Project); definition of guidelines and actions leading

to implementation of information management (as components within NBSAPs); and programmes of scientific and technical co-operation, and information exchange, which constitute the basis of operational CHMs.

Case studies of strategies and systems are given from European countries (Norway, Spain and Italy), Australia, and Asia (India and Thailand). They have all been through a process of self-assessment of capacities and needs as regards information management; have developed their NBSAPs with reference to information exchange issues; have established biodiversity CHMs; and have provisions for the continued training and capacity building of technical staff.

Countries in Europe have adopted similar approaches to information management, although their respective CHMs may look different. The benefits from adoption of a common policy framework, such as the Aahrus Convention concerning free and facilitated access to information for everyone, can be seen in the relative weight of links that consider this and other regional and international conventions and treaties in their CHMs.

Australia's approach is focused on increasing the availability and accessibility of biodiversity data and information. It promotes the use of CHMs to disseminate information prepared by the provincial governments, local councils, research and educational centres, industries, NGOs and individuals. The cases of India and Thailand show where efforts are made for connecting stakeholders using two different approaches: one, through a network of technical centres and a structure of nodes providing technical advice (India); and the other, through establishing a strong central node with capacity to respond to identified user needs (Thailand).

Concerning assistance and co-operation efforts, the EU countries have concentrated on helping other countries to establish their CHMs (e.g. the Partnering Role of the Belgium NFP). Their approach is focused more on technological rather than institutional aspects, and this includes the definition of adequate legislation on access to information at the regional and national scale.

Australia's approach promotes the development of self-sufficiency in assessing and understanding key biodiversity issues at the local level, also comprising the maintenance and inter-generational transfer of traditional knowledge by indigenous peoples. The situation of India and Thailand is different, in that they are still dependent on external assistance. The emphasis is on the development of capacity to respond to specific demands, through the establishment of nodes or similar mechanisms.

Around 30 different initiatives promoting effective information management have been developed and implemented at global level. A small group of them has been analysed in this document with the view to providing some practical guidance for the further development of the IABIN network, based on enhanced co-operation at regional level. They are relevant as examples of partnership and co-operation, leading to the constitution of thematic information

networks, the bridging of major information gaps, and the building of local capacity in areas of information management.

2.6.3 Recommendations and Implications for Building IABIN

The Document highlights the issues that are important when planning for effective strategies of biodiversity information management at national and regional scale. They have all been considered by countries selected as case studies, and include the following:

- *Sound policy framework*: Having a policy framework, which provides for a free and facilitated access to biodiversity information is an essential stage within effective national strategies. Promoting a harmonised approach to knowledge management across the LAC region is desirable, and would greatly contribute to the flow of data and information between countries, as it is already happening in the EU as a result of the application of the Aahrus Convention.
- *Clear definition of roles and responsibilities*: Effective strategies are those with a good definition of the institutional roles and responsibilities in terms of the generation, storage, processing and dissemination of biodiversity information and associated environmental data. Case studies show that sound information management also depends on institutional stability.
- *Identification of capacity building and institutional strengthening needs*: Effective national strategies depend on the existence of strong agencies and institutions, and staff with the capacity to facilitate access to information by all users, especially those that need it to make informed policy decisions.
- *Opportunities for regional collaboration and integration*: Benefits from a common regional approach to information management are clear, although the process of policy harmonisation may take a long time to proceed. This process might be facilitated by identifying opportunities for a gradual regional collaboration and integration, e.g. through the implementation of pilot initiatives of the sort proposed by IABIN under the TN's scheme.
- *Dissemination of joint successful initiatives*: Examples of joint successful initiatives involving institutions and expertise from two or more countries should be disseminated as widely as possible. These can consist of actions or activities relating to any aspect within the information management cycle – from data gathering and processing, to the delivery of user-driven information products, and so its conclusions may serve to demonstrate that collaboration and integration is ultimately feasible.

IABIN can make a substantial contribution to the development of sound national strategies, and their integration at regional level. This could be achieved through the following activities:

- *Multi-national institutional survey and ERI*: IABIN co-ordinating agencies can conduct a regional survey of institutions related to their TNs of the sort proposed under the BDM Project scheme. The Network can then keep an electronic catalogue of profiles of these institutions, including specific information on available capacities, specialities and expertise.
- *Facilitated access to NBSAPs*: IABIN can facilitate access to all NBSAPs that have been elaborated throughout the region. This is key to promotion of a harmonised regional approach to strategic biodiversity planning. Again, this action may be concentrated on the TNs, and so the chapters or sections within NBSAPs that are relevant to these themes may be extracted or connected through the Internet.
- *Incorporating the IABIN concept into available toolkits*: Annex 3 includes a Comparative Evaluation of Toolkits for Development of CBD Clearing-House Mechanisms.
- *Promotion of capacity building and institutional strengthening*: This is an essential need all across the LAC region. IABIN should generate a suite of capacity-building and institutional strengthening opportunities, which may include the sort of mechanisms reviewed in this document. A number of institutions throughout the Americas are in an excellent position to provide training-on-request (on aspects of both planning and implementation), thus potentially reducing travel and other costs. The development of tools such as Australia's Self-Assessment Checklist and the Benchmarking Biodiversity Conservation Framework can be promoted at regional level.
- *Enhanced community participation*: IABIN should explore mechanisms for enhanced community participation in biodiversity decision-making by using electronic means. This may involve promoting the development of a common regional approach to free and facilitated access to information (similar to the Aarhuis Convention). A regional revision of instruments (policies, laws, etc.) that exist at national level might be sufficient as a first stage.

2.7 Document 7 - Taxonomic Authority Archives, Networks and Collections

2.7.1 Purpose

This Document provides a review of selected taxonomic authority archives (TAA). It describes selected taxonomic databases and electronic reference sources, the scope and structure of each, and examines the relationships between these reference sources. Problems encountered by TAAs are described, and tools and mechanisms that have been used to overcome these problems are presented. It is therefore a document that will provide guidance to IABIN on how best to compile and present taxonomic and other related information.

2.7.2 Themes and Findings

The species name is key to the management and dissemination of biodiversity information. Before a species can be linked to any kind of information such as distribution, population size, trends, etc., that species must first be described and classified by taxonomists. Hence, despite all the debate and uncertainty, taxonomic information is essential to manage information on species, an important component of biodiversity. The taxonomic status of any organism has implications on factors such as threats, endemism, etc., for that species. Conservation efforts are often species-orientated but, without a sound taxonomic basis, appropriate species-focused conservation actions are difficult to determine.

Users of taxonomic information and TAAs include scientists and governments who use it in support of, *inter alia*, the formulation of policy, biodiversity indicators, and commitments to Multi-lateral Environmental Agreements (MEAs).

Most TAAs have been established by governments, inter-governmental organisations and agreements, and institutions or, as is often the case, by partnerships between these groups. Because there are so many other types of information that could be included, there are important differences between a database that is fundamentally intended as a taxonomic resource and one whose main aim is to provide other information. TAAs obtain their information from a range of reference sources and in many different ways. Some databases use only primary reference material, often in conjunction with expert comments, and all information is compiled by the institute 'housing' the database (e.g. ITIS). However, other taxonomic authorities are essentially networks that combine information provided by a range of other databases and institutions or from secondary reference material (e.g. GBIF), and may be centralised or decentralised. Taxonomic networks operate at three main levels – national (e.g. UK National Biodiversity Network), regional (e.g. EUNIS), and international (e.g. GBIF).

Many TAAs are specialised and deal only with specific taxonomic groups, which may be on a global, regional or national scale (e.g. the global FishBase and Index Kewensis). Some (e.g. GBIF, Species 2000) aim to eventually include all taxonomic groups. Species 2000 estimate that the existing global species databases may presently account for some 40% of the total known species.

Four comprehensive reference sources, GBIF, ITIS, Species 2000, and All Species are reviewed in detail.

- *The Global Biodiversity Information Facility (GBIF).* Established in 2001, its mission is to make the world's primary data on biodiversity freely and universally available via the Internet. It provides digital access to information on taxonomic hierarchies with links to further information where available. A number of areas of emphasis have been identified by GBIF, namely: data access and interoperability; digitisation of natural

history collections; electronic cataloguing of names of known organisms; and outreach and capacity building. According to their website "*In the near term, GBIF will provide a global metadata registry of the available biodiversity data with open interfaces. Anyone can then use it to construct thematic portals and specialised search facilities. Building on the contents of this registry, GBIF will provide its own central portal that enables simultaneous queries against biodiversity databases held by distributed, worldwide sources."* Of particular note is the GBIF programme ECAT (Electronic Catalogue of Names of Known Organisms) which is working towards an electronic catalogue of the names of known organisms. It aims to provide content infrastructure to enable searches across multiple information domains, to make seed-money awards to speed progress of Catalogue development, and to develop the Taxonomic Name Service function of GBIF information architecture.

- *The Integrated Taxonomic Information System (ITIS)* aims to provide authoritative taxonomic information on plants, animals, fungi, and microbes of North America and the world. Although originally established with a North American focus, ITIS has since expanded and includes information on species from around the globe. The goal is to create an easily accessible database with reliable information on species names and their hierarchical classification. ITIS includes documented taxonomic information on flora and fauna from both aquatic and terrestrial habitats. Currently coverage for some taxa is global, and for others it is as yet confined to North America, and there are many gaps in ITIS in the coverage of South American taxa. Each of the ITIS countries (US, Canada and Mexico) has a separate portal in which data can be queried. In addition, the ITIS data can be queried through the GBIF portal. Although the same data are used for all of these, different tools are available through each. For example, for some taxonomic groups, the Mexican portal provides different taxonomies that have been used for a given species, a tool that might be useful to IABIN.

- *Species 2000* is a "federation" of database organisations working closely with users, taxonomists and sponsoring agencies. Species 2000 aims to provide an index of all known species in the world through an array of participant global species databases covering each of the major groups of organisms. Each such database will cover all known species in the group, using a consistent taxonomic system.

- *The All Species Foundation* was established to catalogue every living species on earth. This inventory would need to enlist the support and cooperation of scientific organizations around the world. All Species is intended to be a temporary endeavour which will cease to exist in 25 years when its mission to compile a list of all species is completed. Information in All Species is sourced from both comprehensive and specialist TAAs around the world. At the moment, the activities of All Species as a TAA appear to have been surpassed by the activities of the other major initiatives, and

it may be of limited use to IABIN. Funding constraints have led to a scaling down of its activities.

Relationships between these TAAs are complex. ITIS and Species 2000 together produce the Catalogue of Life, a uniform and validated index to the world's known species collated by taxonomists throughout the world. It is available on a CD and can also be downloaded from the web. ITIS and Species 2000 signed a Memorandum of Understanding in November 2003 to further enhance collaboration.

GBIF has recently signed a three-year Memorandum of Cooperation with the Catalogue of Life Partnership. The Memorandum provides a basis for mutual co-operation and a framework for GBIF to access the Catalogue of Life and to use it in its services. The synonymic species checklists provided by the Catalogue of Life partnership will be made available to GBIF, and it is anticipated that they will play a key role in the name-service and indexing functions of the GBIF portal. The role of GBIF differs from that of the Catalogue of Life partners. While ITIS and Species 2000 will provide a checklist of species of the world, GBIF will be a portal both to that information as well as to large amounts of other information based on species collections from museums and herbaria throughout the world. GBIF will contain not just the Catalogue of Life species names but also names that have long since gone out of use, that have been misused, misspelled etc and location and other information linked to each such specimen.

The initial focus of GBIF appears to be on museum specimens, which should provide new sources of information and will complement work already undertaken by ITIS and Species 2000.

In addition to the four comprehensive systems, a number of more specialised taxonomic authority archives exist, including Fishbase, MammalBase, GloBIS (butterflies), Index Kewenis (seed-bearing plants), ILDIS (legumes), CABI (chiefly fungi), CGIAR SINGER (germplasm), UNEP-WCMC Species Database (species protected by MEAs), IUCN Red List (taxa that are facing a higher risk of global extinction), Zoological Record (citations to scientific literature on animals) and EUNIS (European Species of Conservation Concern). Relationships between them are uneven and there are gaps and overlaps, although many have formal or informal cooperative understandings with the comprehensive TAAs.

Data ownership is an issue of concern to many specialised reference sources. Considerable time, effort and money are required to compile taxonomic information, hence, institutions and individuals can be reluctant to make data freely available and accessible so that others can ‘reap the rewards’ of their labour. Where data collection is specifically funded through governments or foundations, public access to the resulting data is often a condition of funding, so these issues may be of lesser concern. In addition, many scientific journals now insist as a condition of publication that the data used in the paper should be made freely available

(usually over the Internet). However, where data are gathered in a voluntary capacity, as part of the core activities of an institution, or in any commercial context, problems with data ownership are likely to persist.

To address this concern, many of the comprehensive reference sources have data "user agreements" whereby the user must fully acknowledge the source database. Formal contracts can be useful to protect both partners to ensure proper acknowledgement and recognition of the data source, and in the case of disagreement. However, not all databases have formal contracts

2.7.3 Recommendations and Implications for Building IABIN

GBIF is emerging as a leading global player in the field of comprehensive reference material with strong support from the ITIS and Species 2000 partnership, the Catalogue of Life Partnership. The emphasis of All Species appears to have shifted away from the niches occupied by the other three.

Several of the specialised reference sources reviewed in this report, are the leading electronic sources of global information for particular taxonomic groups. The quality of information provided by such specialised reference sources often determines the quality of the information held by the comprehensive reference sources. Many of the specialised TAAs have already established partnerships with the comprehensive reference TAAs outlined above. These partnerships and the resulting provision of data are important factors in the taxonomic coverage and success of the comprehensive TAAs. The IUCN Red List and UNEP-WCMC species database provide important information on subsets of species that may be useful to IABIN.

A consistent taxonomic approach is essential for the reliable interpretation and use of data. The main mechanisms used by specialist databases to deal with taxonomic problems are their collaborations with experts and organisations from around the world. Access to authoritative reference sources, expert review and expert input to decision making appear to be the most important factors in determining the taxonomies used, the application of synonyms in the databases, and the elimination of problems and inconsistencies.

Although the incorporation of taxonomic information into IABIN could be achieved by forming partnerships and bringing together information from the specialist TAAs, this would seem to be needless duplication of the work of the comprehensive TAAs which already have established partnerships and compiled the relevant information. For many taxa, the coverage of ITIS has a North American focus, and it will probably take some time before coverage of taxa across the Americas will be more complete. However, clearly the American focus is of particular relevance to IABIN. In addition, the checklist of species produced by the Catalogue of Life could prove to be a very useful tool for IABIN depending on its requirements. However, GBIF includes information from ITIS and many other sources in its archive, and

also includes a range of other information including that from museum and herbarium collections.

Upon inclusion of all species names in a comprehensive TAA, many types of information can then be attached to the species names. It is suggested that a complete distribution, legislation and global threat status may be useful types of information to include on species of the Americas due to the species specific nature and range of end users of such information. However, it must be noted that the distribution information in many of the comprehensive databases is not complete and at times is misleading. Regional and national organisations in the Americas may be able to assist in improving the quality of such information. Where national biodiversity archives have been or are currently being developed, e.g. that of Colombia, the information compiled can fill geographic gaps for particular taxa in the Americas, and can be used to include information on national status. However, there are also likely to be many taxonomic groups for which little information has been collected across the entire region.

The overall recommendation is that IABIN maximises the benefits available to the network through the utilisation of all existing and available data and tools, rather than to duplicate work that has already been undertaken by other agencies. Financial and other resources will be most efficiently and usefully employed by identifying gaps in existing data and technologies, and focusing on these gaps. Full use of available expertise from national, regional and international sources will be key.

More specific recommendations follow.

- Species lists with taxonomic hierarchy, accepted names, synonyms and common names will be the cornerstone of the taxonomic information held by IABIN. Such lists have already been developed for some taxa of the Americas. It is recommended that IABIN make maximum use of those lists that are already available, both through international reference sources such as the Catalogue of Life Partnership and GBIF (and its Electronic Catalogue of Names of Known Organisms Programme (ECAT)), and through existing regional and national bodies. To this end, it is recommended that IABIN should liaise closely with the Catalogue of Life Partnership through which comprehensive species lists for some taxa are already available. In particular, the regional and scientific expertise of the ITIS partner CONABIO will be important.
- It is suggested that IABIN include all species names that are considered to be accepted names by different authorities so that relevant information can be retrieved from other databases or networks. However, it is suggested that IABIN uses technologies that are being developed by GBIF and others to display different taxonomic classifications and nomenclature, or adopts one standard taxonomic classification, so that relevant information can be consistently attached to the correct taxon name. Links between

accepted names and their synonyms should be provided, again so that relevant information can be accessed. Discussions with ITIS, Species 2000, GBIF and regional data providers should provide some advice as to the various taxonomic classifications widely used.

- It is recommended that IABIN liaise closely with GBIF and its ECAT Programme on the most appropriate technologies to use. GBIF are developing technical standards and technologies to assist in the retrieval of information from various sources, and developing an overall architectural framework for data exchange. IABIN should avoid investing significant resources in developing their own tools that would duplicate GBIF's work. IABIN might find it useful to consult with other networks (such as the UK NBN) that receive data from sources that do not have technical capacity or expertise.
- It is important that IABIN should receive support from within the region. To this end, national and regional organisations should perceive IABIN as a partnership that is assisted by the aforementioned TAAs, but that is not directed by them. It is recommended that IABIN should identify appropriate taxonomic organisations at a national and regional level, and develop partnerships with them from the outset.
- Regional gaps in datasets are inevitable. It is suggested that IABIN should prioritise areas for new research along particular themes or in areas that will have a maximum number of uses and end users e.g. invasive species, species of particular ecosystems, bioprospecting, etc. Such themes should also provide practical examples of the political, economic and social benefits of taxonomic and related information, such as that provided by IABIN. Such thematic projects are more likely to attract external funding than stand-alone taxonomic projects. Seed money available through the GBIF Programme ECAT may be of particular interest to IABIN.
- The input and review of relevant experts and organisations is a fundamental aspect of the management of taxonomic databases. Many TAAs have established specific groups that liaise with the wider scientific community to deal with taxonomic problems. It is recommended that a taxonomic advisory group within IABIN should be established to liaise with the TAAs and to deal with issues such as taxonomic and other standards, synonyms, etc.
- It is also recommended that IABIN should develop formal agreements with its TAA partners to ensure that full acknowledgement is given to the source. This will help address the discomfort that many organisations experience when supplying their data in its entirety to be used by others.

2.8 Document 8 - International Initiatives in Biodiversity Vocabularies and Thesauri

2.8.1 Purpose

This Document reviews the most relevant international vocabularies and thesauri that may be usefully adapted to further IABIN information exchange processes.

2.8.2 Themes and Findings

A controlled vocabulary is a restricted list of words (or short phrases) that can be used when trying to describe or search for an item. This can be extended to include relationships between terms that are synonyms, or even to include narrower and broader terms.

A thesaurus is a collection of terms along with their relationships usually organised in a hierarchy of concepts and narrower/broader terms.

Thesauri and controlled vocabulary lists can primarily be used to assist IABIN in two key areas of knowledge management - information cataloguing and information discovery.

Six environmental vocabularies and thesauri of relevance to IABIN are reviewed in this report.

CBD Controlled Vocabulary: The CBD Controlled Vocabulary was developed with the intention of providing the CBD Secretariat with a list of terms that could be used as descriptors, i.e. metadata, for web pages on the Convention's web site including the Clearing-House Mechanism (CHM). The list is also recommended for use by CHM National Focal Points to describe the contents of their national CHM web sites. It is intended to facilitate the searching, locating and retrieval of information by linking similar documents and resources with a unique term. It would also standardize descriptions of web sites, and so assist in efforts to make information interoperable within the CHM network, and with other websites related to the CBD. The CBD Controlled Vocabulary is regularly updated with new terms as needed.

UNEP EnVoc: EnVoc is a multilingual thesaurus with a controlled and structured vocabulary for use in indexing, storing and retrieval of environmental information. The latest edition contains categorised and alphabetical lists of subjects, together with a KWIC (KeyWords in Context) list. This thesaurus is available in the six official United Nations languages. EnVoc supercedes the former INFOTERRA Thesaurus of Environmental Terms. Available for purchase as a printed document, this thesaurus has also been accessible for on-line querying although at the time of writing, the service was frequently unavailable.

FAO AgroVoc: The AgroVoc thesaurus is designed to cover the terminology of all subject fields of agriculture, forestry, fisheries, food and related domains, in order to catalogue documents. AgroVoc is currently at version 4 and is available for on-line browsing. It supports seven languages: Arabic, Chinese, Czech, English, French, Spanish and Portuguese.

GEMET 2001: The GEneral Multilingual Environmental Thesaurus (GEMET) was developed by the European Environment Agency (EEA), with the co-operation of international experts,

to serve the needs of environmental information systems. Analysis and evaluation work led to a core terminology of 5,400 generalised environmental terms and their definitions. This vocabulary ensures validated indexing, cataloguing and retrieval within environmental information services as well as harmonised translations in the multilingual European network. GEMET 2001 is provided as a polyhierarchically structured thesaurus and is now available in 19 languages. It provides a complete numerical equivalence (all descriptors have an equivalent) with the included languages. The semantic equivalence (correct correspondence of meaning between languages) has been separately ensured.

CIESIN (Center for International Earth Science Information Network) Indexing Vocabulary: The CIESIN Indexing Vocabulary was developed to index data resources and datasets related to the human interactions in global change. The Vocabulary comprises two elements: CIESIN Indexing Terms and CIESIN Location Indexing Terms. The former is a controlled thesaurus of socio-economic and environmental terms arranged in nine Science Data Domains with all of the terms organised in a hierarchical relationship (of broader to narrower terms). The Location Indexing Terms is a controlled vocabulary developed to represent the geographical, geopolitical, and spatial coverage of socio-economic and environmental data resources. At the time of writing, these had been last revised in 2002 but the Indexing Terms have not been revised since 1997. The database is available for on-line interrogation.

NBII/CSA Biocomplexity Thesaurus: The Biocomplexity Thesaurus was developed in 2002-3 through a partnership between the US National Biodiversity Information Infrastructure (NBII) project and CSA, a leading bibliographic database provider. The thesaurus was developed through the merger and reconciliation of five thesauri – the CSA Aquatic Sciences and Fisheries Thesaurus, the CSA Life Sciences Thesaurus, the CSA Pollution Thesaurus, the CSA Sociological Thesaurus and the CERES/NBII Thesaurus. The thesaurus is overseen by the NBII Thesaurus Working Group, which considers its expansion and addition/modification of terms. The thesaurus holds its terms with relationships including Subject Categories (SC). It can be accessed on-line, and only provides results in English on the website.

2.8.3 Recommendations and Implications for Building IABIN

IABIN should review their needs for thesauri in the light of the developments being undertaken within the broader biodiversity/environment community, to ensure that they are collaborating in such a way that all parties benefit from the shared experiences.

The work undertaken in Europe, particularly within the European Commission and its associated agencies, (e.g. GEMET) is of particular relevance as it has already advanced in terminology in English, Spanish and Portuguese, which could be adapted to use in the IABIN region.

Attention is also brought to the recent initiative of UNEP in convening a meeting of major participants in the field of multi-lingual thesauri in Geneva in April 2004. For the first time,

this brought together the major providers of environmental terminologies with the aim of discussing the status of their terminologies, how they are applying new technologies, and how these resources can be "integrated" using new technologies. The meeting examined many of the overlapping thesaurus initiatives underway, and discussed opportunities to bring them together using the available web-based collaborative technologies as a coherent mechanism for developing a global multi-lingual system. Representatives from many of the major thesaurus initiatives participated.

There was general agreement on the need for consolidation and collaboration on the development of thesauri and controlled vocabularies, and an over-arching organistion was proposed to take this forward. Further annual meetings are planned to allow all parties to be appraised of recent developments and to foster collaborative efforts. It is recommended that IABIN monitors this process (and participates as appropriate) to look at the synergies between different thesauri and the opportunities for IABIN to draw upon the subsequent multi-lingual developments.

2.9 Document 10a and b - Review of International Initiatives in Metadata Management and Interoperable Systems

2.9.1 Purpose

This Document is in two parts. The first part (Document 10a - Review of International Initiatives in Metadata Management) reviews existing international biodiversity metadata management initiatives and the second (Document 10b - Review of Experience in Developing Interoperable Systems for International Data Management and Sharing) summarises developments of interoperable systems for data management and sharing. The material provides a base of experience and a view of current trends relevant to the requirements of the B-IABIN project, and therefore provides support to decisions on adoption and implementation of standards and good practices in data management and information sharing in IABIN.

2.9.2 Themes and Findings

There are several different levels of metadata to be considered. The material in Document 10a is primarily concerned with the higher level(s) i.e. metadata intended for "discovery" (describing an information resource) and for "semantics" (concerning the meaning of keywords for example).

Several metadata standards of relevance to IABIN exist. The Dublin Core (DC or DCMI) is intended for use in describing any type of electronic information resource and is relatively simple, consisting of only 15 elements. The US Federal Geographic Data Committee (FGDC) is responsible for developing a metadata standard for spatial data and US Federal Agencies are required to use this in documenting geospatial data holdings. This, with others, is being used by the ISO in their development of spatial metadata standards. It was also used by a

Biological Data Working Group of the FGDC to define a Biological Data Profile (BDP). This includes additional elements to fully describe biological data but also, since biodiversity data may not always be spatial, removes the mandatory requirement for geospatial elements where applicable. The Knowledge Network for Biocomplexity has developed a set of tools to "discover, access, interpret, integrate and analyse complex ecological data from a distributed set of field stations, laboratories, research sites and individual researchers". One component is a metadata standard – Ecological Metadata Language (EML) – that encompasses the elements of the standards mentioned above.

All the standards mentioned are in use in existing organisations and networks. The differences in metadata elements are an impediment to the ability to search through all potential sources of biodiversity information in an integrated fashion. However, there are common terms used and these equivalences can be used to provide a level of interoperability (referred to as metadata cross-walking). In practice, it can mean using a "lowest common denominator" to some extent, since there can only be a partial overlap between a standard with many metadata elements and one with relatively few. The Dublin Core is designed specifically to be composed of a minimum set of essential terms.

Controlled vocabularies are an important component of metadata systems and multi-lingual vocabularies provide a simple means to cross language barriers. There are a number of existing vocabularies of potential use to IABIN and these are described in some detail in Document 8.

Two specific initiatives in the use of metadata with biodiversity information are reviewed – the Clearing House Mechanism of the CBD, and GBIF. The former is well-established and includes the development of a multi-lingual thesaurus. The latter is a relatively new initiative and central to the approach being taken is the "Web Services" framework described below.

Attention is drawn to a 1999 review of existing metadata initiatives in the IABIN region, carried out under the leadership of Vincent Abreu (report available at http://www.iabin-us.org/documents/proj_reports/metadata_fnl.pdf). The metadata elements proposed to be used by IABIN are very sensible and provide an appropriate compromise between usability and excessive levels of interoperability. It is not clear at the time of writing Document 10 which of the recommendations in the report have been adopted throughout IABIN and which are still seen as future goals. There was clearly an extensive range of activities already underway in the region and, given this is an area in which new initiatives are likely, it is suggested that a second review be undertaken. This would update the 1999 findings and could ascertain the progress made in adopting recommendations already made.

Another IABIN report, IABIN Portal Architecture (McClarty, 2003), includes recommendations on the IABIN Catalogue System and proposes the following with regard to metadata standards:

- The DCMI element set is used for bibliographic resources;
- The FGDC standard, together with the Biologic Data Profile, is used for "Datasets"; and
- An indexing system is used for cataloguing web resources, i.e. HTML pages of appropriate sites.

Although there is general agreement, the following points are made:

- It is likely that qualifications to the basic DCMI element set will be required to tailor it to the specific purposes of IABIN. Further, the DCMI can, with qualification, be used to describe non-bibliographic resources, such as datasets, at a resource discovery level.
- Since IABIN is an international initiative, it may be more appropriate to refer to the broadly equivalent ISO standard instead of the FGDC (which is a national standard).
- It is not clear what a user will do with discovered resources once they have located them. The use to which they are put, whether by human or machine processing, may dictate metadata requirements i.e. whether DCMI or a more comprehensive metadata profile such as developed by ISO.

To make metadata a successful data sharing and information discovery tool, its compilation and management must be part of the institutional data management culture. Establishing metadata is not a trivial task, either in terms of understanding it role, its utility, the tools used to manage it, or in its compilation. There is often little recognition of the effort required and it becomes an under-resourced area.

Document 10b is concerned with the steps following the discovery level of metadata, i.e. the management and sharing of data and information through development of systems that are truly interoperable.

It is important to note that the design and management of the individual data systems that form nodes of any network are crucial. For instance, data modelling uses formal methods to determine data structures and ensure efficient storage and retrieval. The general adoption of the relational model and standardisation on Structured Query Language (SQL) resulted in a degree of interoperability between systems. Current database design may make use of object-oriented (rather than relational) techniques. Whatever methods are used, these initial steps are vital to preserve valuable data for future use. As stated in Documents 4 and 10a, the inclusion of metadata is also needed as part of the data management process.

Standards are essential to allow the transfer of data and information from multiple sources to be used in an integrated fashion. Given that IABIN is focussing on Internet-based delivery of biodiversity data, there are two types of standards of relevance to interoperability:

i) technology standards for Web Services, and

ii) biodiversity standards for information coding and transfer.

With reference to the technology standards, the following generic standards and protocols are described and references to sources of more detailed technical material are given.

- JDBC and ODBC – both enable access to heterogeneous database systems
- XML – a simple meta-language becoming an essential tool in encoding information recommended by W3C
- Web Services (WS) – based on XML and SOAP, a framework for distributed information networks

It is noted that the WS architecture and supporting technologies have endorsed by major hardware and software vendors and are being taken up by commercial software developers, standards organisations and biodiversity information networks. However, they are still very new and there are obstacles to overcome to realise their full potential.

Four standards, developed specifically to aid biodiversity information management and exchange are also described and references given.

- The Darwin Core – developed as part of the Species Analyst
- Access to Biological Collections Data (ABCD) – from a joint working group of TDWG and CODATA
- Distributed Generic Information Retrieval (DiGIR)
- Xanthoria – a metadata query system associated with EML.

There are many organisations concerned with the establishment of these types of standards. Four of those considered most relevant are described briefly in the Document: the World Wide Web Consortium (W3C) is concerned with common protocols to ensure an interoperable WWW; the International Organization for Standardisation (ISO) and the Open GIS Consortium (OGC) have both been mentioned in Document 4 in connection with geospatial metadata standards; and the Taxonomic Database Working Group (TDWG) defines standards for taxonomic databases (Document 7).

There are many examples of information systems that aim to foster biodiversity information sharing through interoperability. The Document describes several of those judged relevant to IABIN. In some cases, these initiatives are based on "traditional" information sharing and techniques, some are based on specific custom-built software, and still others are based on the newer evolving Web Services technologies.

2.9.3 Recommendations and Implications for Building IABIN

This Document covers a diverse, and in parts somewhat esoteric, range of information systems tools for information sharing and database interoperability. Perhaps the greatest challenge is

not in adopting the technologies, but in understanding how they can best be utilised in the biodiversity context. The full potential of any new technologies for biodiversity can only be realised through a sound analysis of information requirements and careful design of services to address these requirements. IABIN should promote the use of appropriate technologies to provide the required services and avoid the temptation of technology for the sake of technology.

The successful development of interoperable systems for data sharing requires that the organisations that are the data providers have well-established data management infrastructures. These should include recognition of the need for, and the place of, activities such as data modelling, database design, and compilation of metadata in the data management cycle. IABIN should encourage members to ensure that this is so. IABIN should also establish clear and compatible policies on such things as data ownership, security and access.

The 2003 report on IABIN Portal Architecture referred to above, includes recommendations on technological tools and mechanisms for database interoperability and sharing. In general these are supported in the following but with some qualifications and additions.

- IABIN should use open standards and open systems to aid in interoperability. (Particular note is made of a recommendation in the 2003 report to use the Mercury system but it is understood that Mercury is a proprietary system, which mitigates against its adoption.)
- Software developed in IABIN should be shared freely.
- IABIN should more clearly state what the role of its catalogue services are. The catalogue services will assist in locating information resources, but what happens next and how does this metadata layer interface with the Web Services architecture? In particular IABIN should look at the on-line support that can be provided to the partner organisations in terms of how to best deploy many of these tools and methods.
- The IABIN catalogue service should be based on a discovery metadata profile that is appropriate, and has good supporting tools and training materials.
- Consideration should be given to the use of EML as a metadata framework and its associated tools. EML is a newer technology offering a rich and extensible metadata paradigm. Furthermore, EML offers a tight linkage between data and metadata and offers a range of support tools.
- As stated in the 2003 report, IABIN should work closely with the GBIF initiative. IABIN should also work closely with other initiatives that include not only taxonomic information but also information on species, protected areas, ecosystems and responses.

- As well as utilising current and emerging information systems standards, IABIN should also consider appropriate Web Services that can be provided in addition to cross database searching.

CHAPTER 3 SUMMARY CONCLUSIONS

This Summary derives from the nine major Documents and accompanying Appendices that contained background information on international initiatives and experiences, numerous case studies relevant to IABIN, and a wide range of recommendations (over 80 it would seem) pointing to how this information and experience could be applied to successfully build the network over the coming year.

Two overarching messages dominate:

- Build on existing strengths – adopt, adapt and implement technical standards, reference authority archives, methods and approaches that have been successful elsewhere.
- Focus on supporting regional needs for decision-making – that is, provide information exchange capacity directed at solving identified problems.

The suite of background documents and their contained recommendations build on these messages – what are the existing strengths, which can best be adapted for IABIN, and how?

There are three major themes extracted from the recommendations:

- *Strategies and policies* for effective institutional arrangements for information exchange,
- *Reference archives and harmonisation tools* that facilitate information sharing, and
- *Technical standards* for information exchange and interoperability.

An attempt is made in the following to summarise the recommendations under these headings but this must, of course, be a great over-simplification. Readers are directed to the originating documents for the details and supporting discussion.

Strategies and policies

- IABIN should focus on issues of mutual concern in the region (where it is feasible to make a difference) and first identify the information needs, assets and gaps, and subsequently identify the technical information exchange requirements That is, let the needs dictate the technology and approaches.
- Adopt the best parts of the European model and other successful regional networks:
    - Identify and link national centres of excellence on an institutional basis (like EIONET)
    - Identify regional “topic centres” to address harmonisation and data content standardisation issues on selected key issue areas

  - Separate the concept of data/information exchange (like EUNIS and ReportNet) from institutional networking (people and expertise, like EIONET).

- Support and facilitate national clearing houses, linked to the CBD clearing house mechanism.
- Adopt proven indicator frameworks that support reporting to MEAs, and the GEO process and that can monitor progress towards international targets (such as MDGs and the 2010 target). Base the indicators, where possible, on natural ecosystems rather than national comparative frameworks.
- Roles, responsibilities and benefits of countries and institutions participating in IABIN should be clearly identified and operations should be transparent.
- A full open access data policy should be adopted as much as possible, involving and considering the needs of all stakeholders. However, access controls and technical security to ensure the integrity of data must be implemented. IABIN should be a facilitator of information exchange, not a data repository, and should enter into formal agreements with national institutional data custodians.

Reference Archives and Harmonisation Tools

- With GBIF as a focus, IABIN should work with key international taxonomic reference archives, particularly the Catalogue of Life coalition, and facilitate the contributions of taxonomic reference knowledge from key institutions in the region. IABIN should seek to make the relevant broad and specialized taxonomic reference archives freely accessible through the network.
- The GEMET thesaurus and the UNEP EnVoc should be considered as a base for adopting a standard multilingual vocabulary for IABIN (such as for keywording IABIN documents). IABIN and key institutions in the region should participate as much as possible in the recent coordination work begun by UNEP to seek possible mergers of major thesauri.
- IABIN should foster the development of a regional ecosystem classification system consistent across the Americas, and maintain GIS based mapping of ecoregions to facilitate information presentation, analysis and indicator development.

Technical Standards

Technical standards (IT-related) for information exchange and interoperability continue to undergo rapid development. Any recommendations in this regard must be understood in that context. The current state of development and implementation of a number of technical standards are discussed in detail in the various Documents (particularly Documents 4 and 10). Top level considerations are:

- Carefully identify and document user needs for information exchange and interoperability services and related applications, before choosing and implementing a technical standard.
- Always emphasize agreed "open" standards and systems (such as Dublin Core, OGS) vs. proprietary solutions.
- Technical exchange and interoperability standards must be accompanied by semantic standards for the data content in order to make integrated data meaningful. Thus there must be linkage with reference archives and implementation of controlled vocabularies.
- Effective technical standards must be accompanied by policies on data ownership, access and protection, and particularly with regard to metadata, work practices and attitudes that recognise the value of the extra effort needed for metadata compilation.