

The biodiversity information clearing-house mechanism (CHM) as a global effort

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Abstract

The Internet-based clearing-house mechanism (CHM) of the Convention on Biological Diversity (CBD) is studied from the point of view of its information content, value for end-users and usability. The results show that, although the basic idea of the national CHM has been realised fairly well, the information provided by the national web sites is scarce and unprocessed. Especially the amount and processing of taxonomic, ecological and spatial information needs to be increased. In most participating countries of the CBD, construction of national clearing-houses has not reached a stage where accurate and integrant information would be provided for decision-makers. A distinct group of countries has taken an active role in the field of international biodiversity information issues. The results are also viewed from the point of view of disparity between ownership of the world's biodiversity resources and custody of biodiversity information. Suggestions for further development of the CHM are presented and its relation to other biodiversity information initiatives is discussed.

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1. Introduction

Efficient exchange of information has been recognised as one of the necessary preconditions for improvement of global biodiversity conservation. For this purpose, the clearing-house mechanism (CHM) of the Convention on Biological Diversity (CBD) was established (UNEP, 1995). The idea of the global CHM functioning as a platform for national clearing-houses was a considerable milestone in the history of biodiversity information sharing. Establishing of National Focal Points (NFP) by the parties of the convention has been underway since then.

The division between megadiversity countries (Sarukhan and Dirzo, 2001) as possessors of biodiversity resources and the OECD countries as biodiversity information holders is well recognised in several connections. Due to this disparity and since there are major expectations in utilitarian benefits of biodiversity both from the point of view of environmental conservation per se (Myers, 1996) and its commercial outcomes (Perrings, 1995; ten Kate and Laird, 2000), the issue of global biodiversity information is gaining increasing weight as a scientific and political matter.

This is expressed in the variety of manifold international biodiversity information projects and initiatives emerged during the last decade (OECD, 1999; Soberon, 1999; Bisby, 2000; Edwards et al., 2000).

Along with growing activity in this realm, the general framework in biodiversity information issues are experiencing a rapid shifting period with an increasing societal value (Olivieri et al., 1995; Tilman, 2000). The academic community as the major end user of biodiversity information is being challenged by representatives of business life as well as political decision-makers. During the first decade of the 21st century, this will have a deep overall impact on biodiversity information production. In the light of this development, it is surprising that the structure and contents of the national clearing-houses seem to be weakly attended and countries often choose their unique ways to proceed.

To see what kind of information the national CHM sites actually hold, we collected research material from their web sites. The aim of our work thus is to analyse the properties and outcomes of the CHM 10 years after the CBD was signed and, in the light of the results, search novel viewpoints for its further development. Operating in the fast evolving realm of information and communication technologies, the CHM has to adjust itself to any changes in these areas. Since the value of global biodiversity information systems for end-users is yet a nearly unstudied area in scientific

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literature, we approach the topic also from the users' viewpoint.

The main objectives of our study thus are to explore: (1) the core biodiversity information offered by the national clearing-houses, (2) the biodiversity information process operating behind them and (3) the capability of the CHM to serve users like scientists, conservation planners, representatives of economic sector (e.g. biotechnology industries), as well as agencies and donors with interests in information about national priorities on conservation and sustainable use of biological diversity. Usability of the CHM for persons with no professional experience on biodiversity issues is also studied.

2. Material and methods

This paper documents the state of the CHM as it was in July–August 2001. The work is based on data collected from the Internet web sites of the CBD (<http://www.biodiv.org/world/map.asp>) including operating national CHM web sites of the CBD parties (data set I). In addition, a usability test was made (data set II).

2.1. Data set I: properties of the national CHM web sites

A list of the countries filling the three criteria: (a) being a CBD party; (b) having a NFP; and (c) having national CHM web sites available was collected. The resulting 50 national CHM web sites were surveyed and the data collected. During the process of data collection, another 10 web sites had to be rejected either because they were not available at the time (Bolivia, China, Ecuador and Madagascar), because of language problems (Qatar), or because the pages showed only national administration web sites with no specific reference to the CHM (Denmark, Iceland, Luxembourg, Mongolia and Norway). Among the resulting 40 parties with operating CHM web sites there were nine megadiversity countries, 16 OECD countries (including Australia and Mexico that are also megadiversity countries), and 17 other countries.

Each web site was screened with respect to three themes of presence/absence-type parameters listed in Table 1. The parameters and themes were selected to indicate how the original objectives—co-operation, network development, information exchange (UNEP, 1999a), of the biodiversity CHM have been approached. Special attention was paid to the parameters indicating information exchange because of its crucial importance for the international CHM. These parameters were listed both according to the type of retrieval (index/search) and the available categories of information. Each observation documenting the presence of a property scored one point for the parameter and the national web site in question. The language-parameter scored one point when two or more languages were used on a web site.

To assess how the CHM serves expert users, four expert groups were identified including: (1) development agencies

Table 1
Thematic classification and description of the parameters used to indicate the properties of the operating national CHM web sites

Parameters	Properties or options
Theme 1: General properties of CHM	
Languages*	Language(s) used on the site
National report or strategy ^{a,b,c,*}	National biodiversity report or strategy available
National contact person*	Contact information of the national contact person available
National body in charge ^{a,c,*}	Contact information of the national body in charge available
Global CBD/CHM INFO	Information about global CBD/CHM available
Theme 2: Co-operation and networking	
Idea bank	Facility for suggesting new ideas by users
Environmental awareness	Environmental awareness—information available
Roster of experts ^{a,c,*}	Contact information of experts available
Feedback facility	Facility for feedback from users
Information manager	An information classification system available
News and events	Latest news and events—column available
International co-operation	Information about international co-operation available
National co-operation*	Information about national co-operation available
Theme 3: Information exchange	
Search and/or index-based information facilities:	
Ecosystem*	Ecosystem-based search/index
Taxonomic*	Taxonomically-based search/index
Spatial*	Spatially-based search/index
Organisations*	Organisations search/index
Persons*	Persons search/index
Administrative*	Administrative/judicial documents search/index
Bibliographic	Scientific bibliographic documents search/index
Thematical	Thematically-based search/index
Other	Other search/index
Free	Free search
General	General index
Categories of information available:	
Maps ^{b,c,d,*}	Maps/cartographic presentations
Contact information*	Contact information
Administrative documents ^{a,b,c,*}	Administrative/judicial documents
Administrative meta-data ^{a,*}	Administrative/judicial meta-data
Bibliographic documents ^{b,c,d}	Bibliographic documents
Bibliographic meta-data ^d	Bibliographic meta-data
Scientific primary data ^{c,d}	Scientific primary data
Scientific meta-data ^{b,d}	Scientific meta-data
Links	Links to other web sites
General	General biodiversity information
Other	Other information

The primary parameters reflecting the needs of the expert groups used in this study are indicated as footnotes. The parameters indicated with an asterisk were used in comparing the results with those of data set II.

^a Development sector.

^b Conservation planners.

^c Economic sector.

^d Scientific community.

and donors interested in information for national priorities on conservation and sustainable use of biological diversity; (2) conservation planners; (3) economic sector (such as biotechnology industries); and (4) scientists. A user profile listing the primary parameters of interest for each expert group was made, based on criteria distinguished in Table 1. From the raw data comprising 40 national CHMs (data set I), the scores of the parameters of interest for distinct user profiles were listed.

2.2. Data set II: usability of the national CHM web sites

To assess usability of the CHM sites, 12 first-year geography students were used as test persons. The students were accustomed Internet users but had no professional knowledge of biodiversity matters or previous experience of the CHM. To limit the working effort, eight national web sites (Cameroon, Chile, Congo, Namibia, Russia, Sweden, Switzerland and United Kingdom) out of the 40 used in data set I were selected as target sites. The test persons filled forms containing multiple statements concerning usability of the sites with reference to retrieving information about general properties, co-operation and networking and information exchange (see Table 1). The number of hits for each alternative was summed by country and compared with the results of corresponding parameters and countries in data set I (see Table 1).

3. Results

Parameters of the general properties of CHM (theme 1) gave relatively high overall scores (Fig. 1) and 15 countries

gained the maximum score of five points. In addition, there were only minor differences among the country groups. Nearly all web sites offered information about the global CBD and CHM, as well as contact information about the persons and organisations in charge of the matter at national level. Only slightly more than half of the sites used more than one language.

The theoretical maximum of eight points in biodiversity co-operation and networking (theme 2) was not reached by any of the web sites. For example, seven sites had a roster of experts, five had an environmental awareness-facility and only one served the users with a bank of ideas (Fig. 2).

In the information exchange (theme 3) parameters, index-based approach was used relatively often (Fig. 3). Administrative documents and information about organisations, as well as general information about biodiversity issues were the most popular categories available. Instead, information based on search facilities was offered only rarely (Fig. 4). Free search, not restricted to any particular information categories, was by far the most popular way to offer tools to explore the provided information. The scores for both index-based and search-based information were relatively poor. The theoretical maximum total score for one country was 31 points and closest to this value was Japan with its web site providing good examples of geographically referenced biodiversity information (Table 2).

The categories of information offered deal mainly with administrative issues as well as contact information of persons and organisations, or links to other web sites (Fig. 5). Also bibliographic and scientific metadata, i.e. lists on scientific publications or databases, is offered relatively often. Taxonomic and ecosystem information exists only rarely.

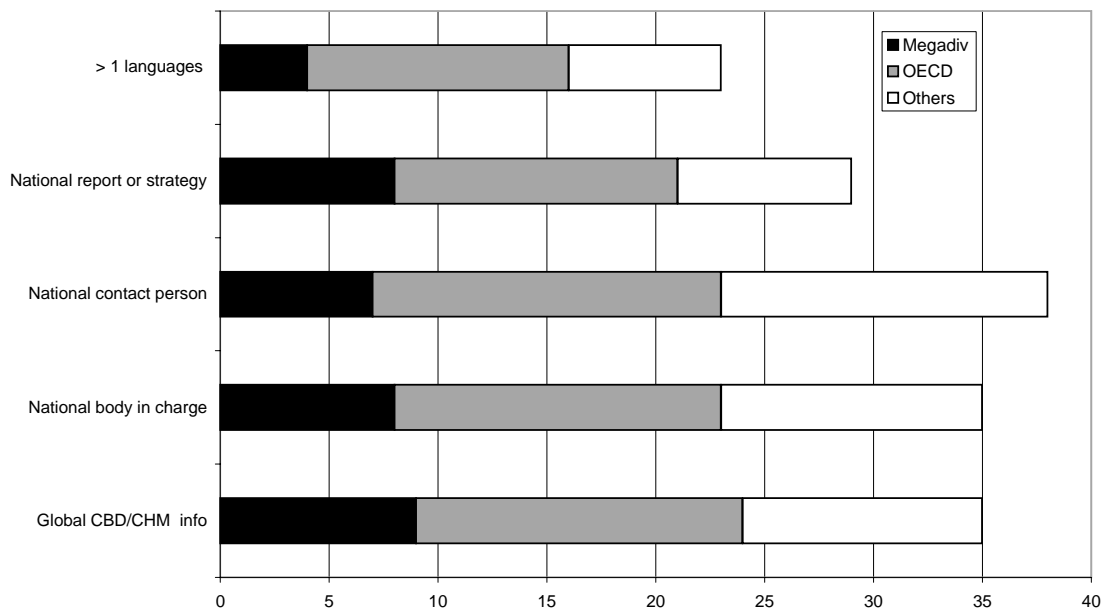


Fig. 1. Score of the parameters describing general properties (theme 1) of the national clearing houses. The bars indicate the number of the countries scoring a point with respect to the parameters in question.

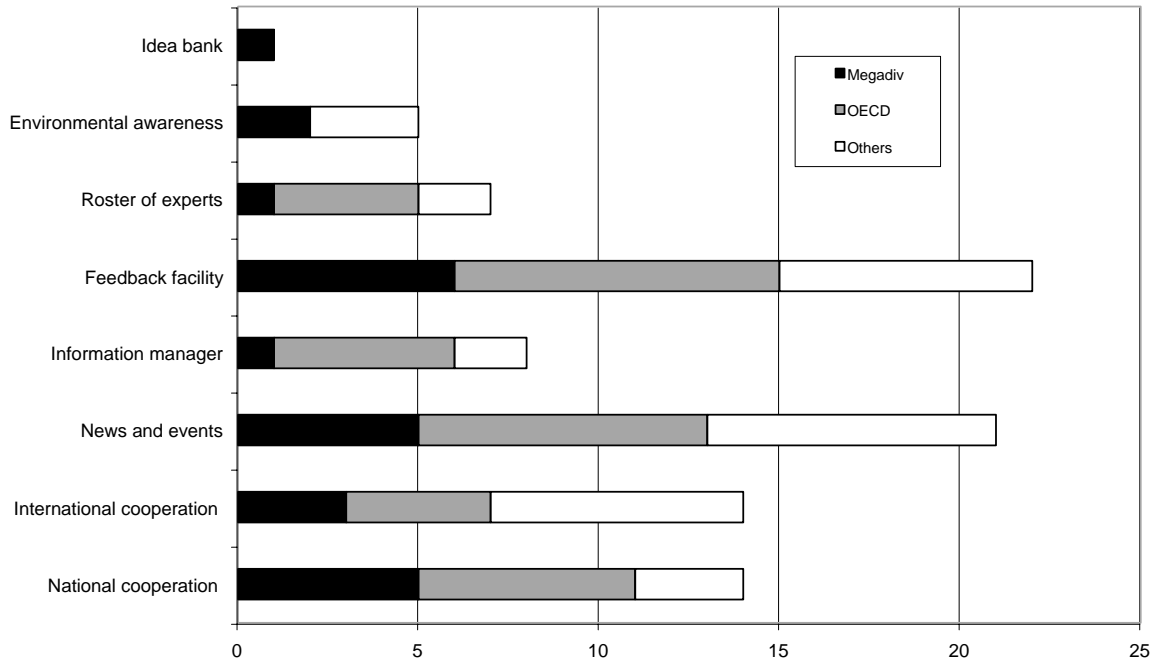


Fig. 2. Scores of the parameters describing co-operation and networking (theme 2) of the national clearing houses. The bars indicate the number of the countries scoring a point with respect to the parameters in question.

Further, synthetic information based on search facilities and/or including geospatial dimensions (maps) is rare.

Information contents of the CHM web sites from the point of view of expert users of biodiversity information varied according to expert groups (Table 3). The CHM offered best facilities for development sector and conservation planners, whereas there was less supply to meet the demands of economic sector and scientific community.

The results concerning usability of some national CHM web sites to non-professional users were compared with the results describing the web sites contents (Fig. 6). In some cases, easiness to find information is relatively consistent with what is offered on the sites, while in other cases good web sites architecture is not equalled by the information contents. In general, both usability and information contents show highest figures in the general (theme 1) parameters.

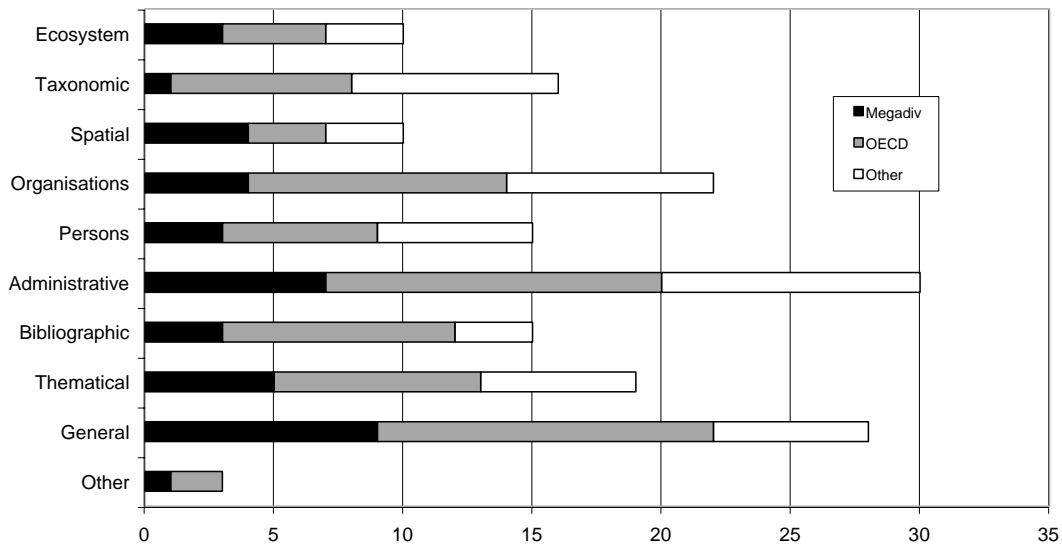


Fig. 3. Scores of the parameters describing index-based biodiversity information categories (theme 3) of the national clearing-houses. The bars indicate the number of the countries scoring a point with respect to the parameters in question.

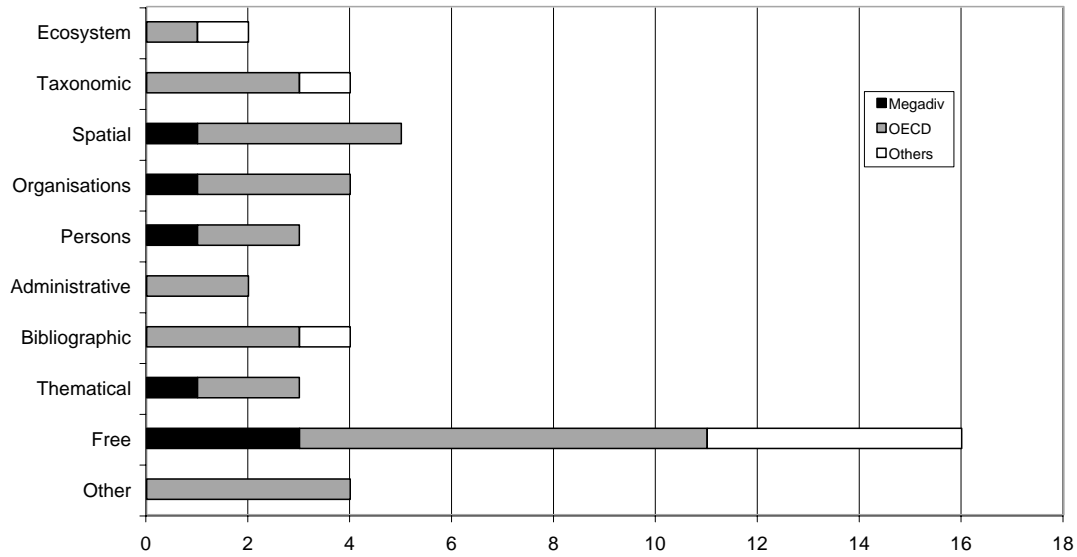


Fig. 4. Scores of the parameters describing search-based biodiversity information (theme 3) of the national clearing-houses. The bars indicate the number of the countries scoring a point with respect to the parameters in question.

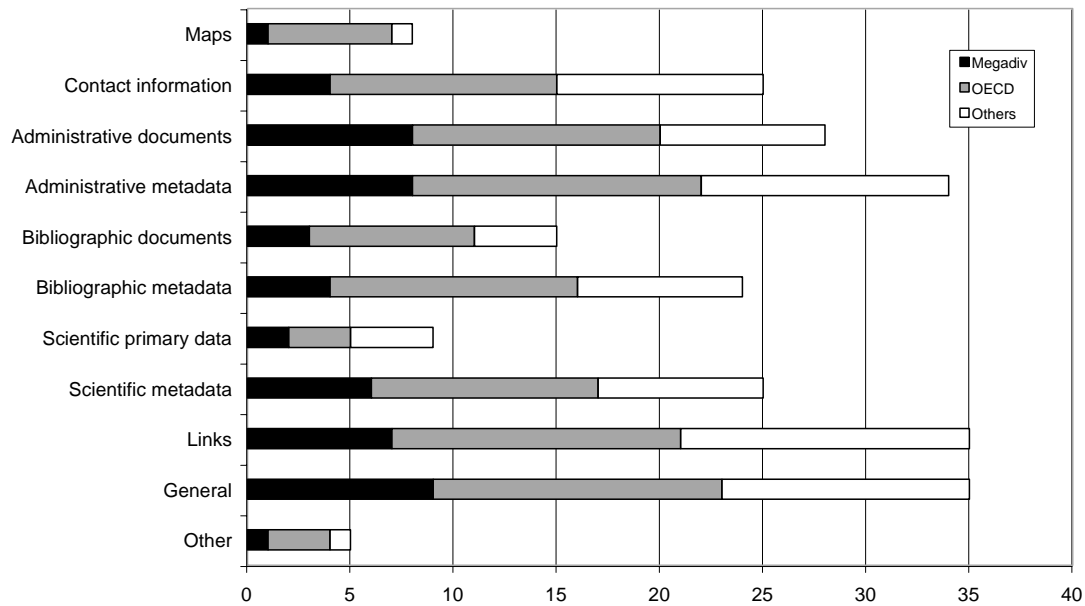


Fig. 5. Scores of the parameters describing biodiversity information categories (theme 3) of the national clearing-houses. The bars indicate the number of the countries scoring a point with respect to the parameters in question.

4. Discussion

4.1. The biodiversity information process

Decision-making uses knowledge that is produced out of data and information. Transforming data and information into knowledge in a clearing-house requires a background process carried out jointly by several co-operating parties. This stepwise process, universal for all information sharing systems with multiple sources of raw material, is often

divided into four equally important hierarchical levels comprising data, information, knowledge and wisdom (see e.g. Olivieri et al., 1995; Heywood, 1997; Stein, 1997). To serve decision-making efficiently, a biodiversity clearing-house must have a good command of the biodiversity information process, where all these levels operate interactively (Laihonen et al., 2003).

The overall results of the present study reveal that the CHM still operates at a relatively general and preliminary level. The involvement of the biodiversity information

Table 2
Scores of the parameters describing biodiversity information exchange properties (theme 3) of the CHM web sites

Country	Score of information exchange
Japan (o, g)	27
Germany (o, g)	19
Namibia	18
Mexico (m, o, g)	18
Austria (o, g)	16
Switzerland (o)	15
Chile	15
Canada (o, g)	15
Brazil (m)	15
Australia (m, o, g)	15
Poland (o)	14
Iran IR	14
The Netherlands (o, g)	13
Sweden (o, g)	13
Slovenia (g)	13
Belgium (o, g)	13
Mauritania	12
Malta	12
Finland (o, g)	12
Costa Rica (g)	12
Colombia (m)	11
United Kingdom (o, g)	10
Peru (m)	10
Venezuela (m)	9
Philippines (m)	9
Republic of Moldova	8
Republic of Korea (o)	8
Morocco	8
Gabon	8
Central African Republic	8
Italy (o)	7
Democratic Republic of the Congo (m)	7
Trinidad and Tobago	6
Malaysia (m)	6
Senegal	4
Russian Federation	3
Cote d'Ivoire	2
Spain (o, g)	0
El Salvador	0
Cameroon	0

In addition, the status of these countries with respect to biodiversity resources (m = megadiversity country), OECD (o = OECD member) and the GBIF (g = GBIF voting member) is presented.

process behind national clearing-houses was measured especially by the availability of multiple categories of search-based information. This procedure is justified by the fact that information has to be filtered, classified and labelled in several ways to be used in search engines. The results show clearly that information based on search facilities was offered only rarely indicating a low level of information processing by the NFPs. Also the high degree of index-based information retrieval facilities, especially when search-based alternatives were not available, indicated low involvement of the process.

A similar trend is apparent with respect to end-users. As the demands of the expert groups increased (in our exercise

from conservation planners to scientists), the capability of the CHM to meet the demands declined. A corresponding increase in demands occurs in the hierarchy of biodiversity decision-making comprising the successive levels of policy, strategic, tactical and operational decisions (see Smythe et al., 1996). At each level, the information content is expected to increase in amount and as well as in accuracy.

The challenging task of constructing a global information system needs to be understood as a process with multiple development stages. In this sense, the results of this study can also be seen to reflect the developmental degree of individual national clearing-houses. According to the results, the quality of services clearly decreases along the continuum of information depth, the poorest ranked countries eventually facing great pressures to improve their facilities. Further, the results of the usability test indicate that more attention should be paid to web site architecture and human-computer interaction. This is shown by the fact that although, for example, the Namibian and Chilean web sites have fairly good information content, it seems that the users do not find the information easily (Fig. 6). Even if serving non-professional users understandably does not come first when national web sites are being established, the CHM certainly is a major instrument in promoting environmental awareness as stated in the Article 13 of the CBD.

Maturity of ideas followed by preliminary administrative measures is necessary before deeper levels of biodiversity information exchange can be expected. Our study confirms that the idea of the global CHM has reached several important milestones facilitating further development of the system. Since the Rio Convention in 1992, most of the necessary work has been done to prepare the breakthrough of the idea. Yet, the operative work is still rather tentative, out of 181 CBD parties only 40 have operating national CHM web sites and, as shown in this study, their quality varies a lot. It will certainly take another decade from multiple international organisations and initiatives to establish a network with effective information sharing capabilities and true impact on biodiversity conservation. More information about species, habitats and ecosystems especially should be offered (Smythe et al., 1996).

4.2. Biodiversity information: parallel processes and policies

Since the Rio Convention in 1992, also another global initiative for biodiversity information sharing has been put forward. The Global Biodiversity Information Facility (GBIF), originally an OECD Megascience Forum initiative (OECD, 1999), aims to make biodiversity data globally available through modern information technology methods. It also encourages, co-ordinates and supports the development of world-wide capacity to access biodiversity data held in natural history museum collections, libraries and databanks. The work of GBIF includes co-operation with

Table 3
Scores of the parameters indicating supply of material offered by the CHM for biodiversity experts

Parameter	The number of national web sites with information about the parameter			
	Group 1 (development sector)	Group 2 (conservation planners)	Group 3 (economic sector)	Group 4 (scientific community)
National report or strategy ^{1,2,3}	29	29	29	–
National body in charge ^{1,3}	35	–	35	–
Roster of experts ^{1,3}	7	–	7	–
Maps ^{2,3,4}	–	8	8	8
Administrative documents ^{1,2,3}	28	28	28	–
Administrative metadata ¹	34	–	–	–
Bibliographic documents ^{2,3,4}	–	15	15	15
Bibliographic metadata ⁴	–	–	–	24
Scientific primary data ^{3,4}	–	–	9	9
Scientific metadata ^{2,4}	–	25	–	25
Sum	133	105	131	81
Theoretical maximum	200	200	280	200
Percentage	66.5	52.5	46.8	40.5

the international CHM and the Global Taxonomic Initiative of the CBDiversity, yet details of this co-operation are still ambiguous.

The emergence of several globally recognised programmes to enhance the exchange of biodiversity information indicates how important this subject actually is. Information about biodiversity has become an important form of biodiversity ownership. Concern for biodiversity benefit sharing by developing countries is understandable, since the bulk of the world's existing biodiversity resources are situated in these countries. Intellectual property rights including repatriation of biodiversity information about material collected from biodiversity-rich areas have also become a crucial topic at a general political level in the relations between the developing and industrialised world (Andersen et al., 2002; Janssen, 1999; Moody-Stuart, 2002). As all countries are both providers and recipients of genetic resources, comprehensive international legislation regulating biodiversity benefit sharing would have crucial value regarding the implementation of the CBD. Adopting the so-called Bonn Guidelines on access to genetic resources and benefit-sharing (UNEP, 2002a) was a major advance in this direction. Still, since the guidelines are voluntary, their true effects on biodiversity information exchange depends entirely on the political will of the CBD parties to work on the matter.

Economic interests related to biodiversity are important also for developing countries, who expect benefits from access to genetic resources as agreed in Article 15 of the CBD. Overall questions of intellectual property rights (IPR), including utilisation of existing biodiversity information for commercial purposes as well as data repatriation to countries of origin, have been another major area of interest throughout the entire CBD process (UNEP, 1999b, 2000a, 2001a,b). The problem has been recognised as one of the major risks threatening the CHM's development, as "information is a critical aspect of providing the necessary

parity of bargaining power for stakeholders in access and benefit sharing arrangements" (UNEP, 2000a) and as "developed countries and institutions may seek to use the CHM as a promotional and marketing tool" (UNEP, 1999c). Correspondingly, the GBIF regards respect of intellectual property rights as one of its crucial strategic points (OECD, 2003).

The role of megadiversity countries is especially important in the field of global biodiversity information exchange. At present, the degree of participation of those countries in both the CHM and the GBIF is insufficient. All but one of the 16 megadiversity countries participating in the CBD are also developing countries (UNDP, 2002). Further, these "developing megadiversity countries" have been relatively actively involved at least in the CHM, since among the 40 countries with functioning CHM web sites, 11 countries belong to this group (Laihonen et al., 2002). Still, among the 18 parties who have published at least four biodiversity reports requested by the CBD, there are only two developing megadiversity countries. Correspondingly, in our study only two developing megadiversity countries were among the 20 best scoring countries in biodiversity information exchange (Table 2). Likewise with GBIF, out of its 24 voting members in 2003, only five are megadiversity countries, three of which are developing countries (<http://www.gbif.org/>). Among the GBIF's 15 associate member countries, there are two megadiversity countries. One of the causes of the low involvement of the developing countries is financing, since the GBIF has membership fees for voting members.

A distinct group of countries has clearly taken an active role in the field of international biodiversity information issues (Table 2). Many of these countries have also succeeded in biodiversity reporting requested by the CBD (Laihonen et al., 2002). In some of these countries, development of the national CHM has been accompanied by acting as a voting member of the GBIF. Among those,

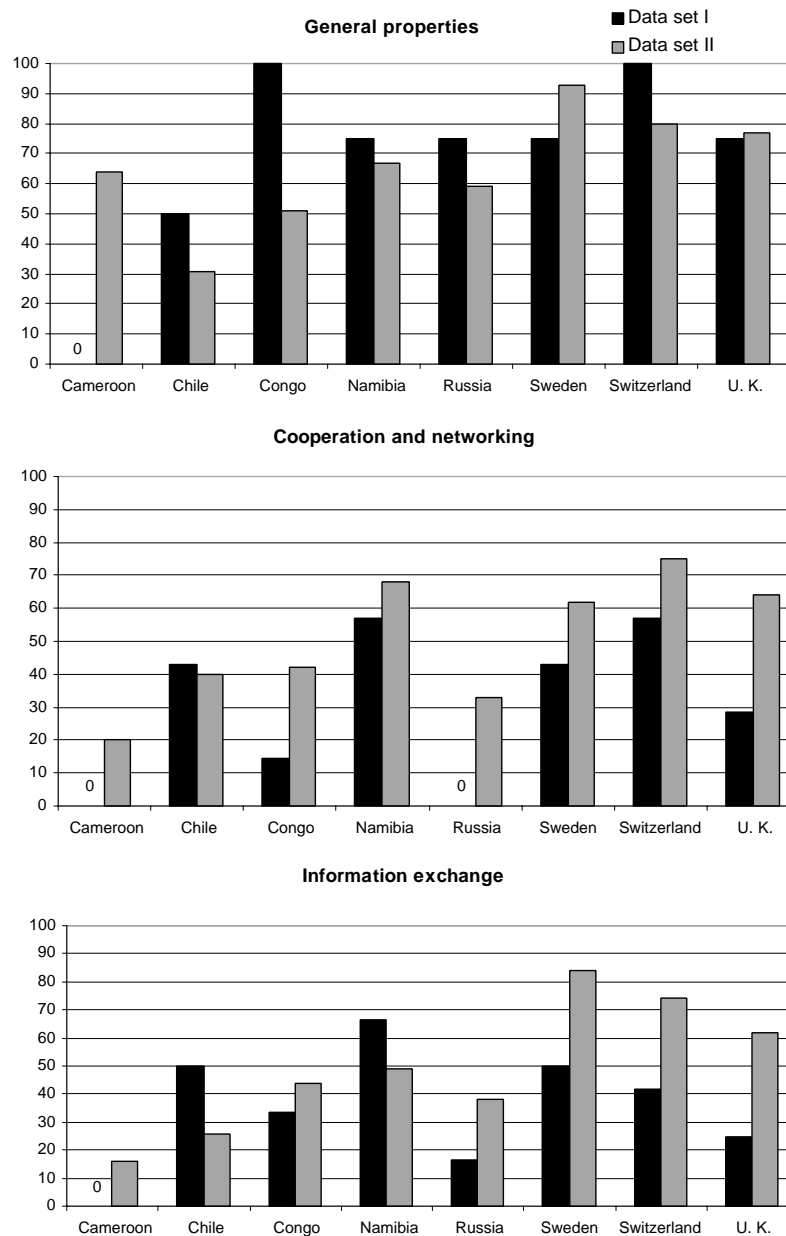


Fig. 6. Comparison of contents (data set I) and usability (data set II) on some national CHM web sites. The values are given as percentages of theoretical maximum scores.

Mexico and Australia are especially interesting from the point of view of implementation of the CBD through the CHM, since they are also megadiversity countries. Other countries of megadiversity have not been as successful in developing their biodiversity information infrastructures. This clearly demonstrates the gap between the megadiversity countries and the countries holding the major portion of the world's biodiversity information (see also Laihonen, 2003). The role of Austria, Belgium, Germany, The Netherlands and the United Kingdom as major biodiversity information holders is also important especially from the point of view of legacy data issues and repatriation of information.

4.3. The CHM and the Internet

The facilities and political will of developing countries and megadiversity countries to participate will in many respects be a critical issue for the future success of global biodiversity information initiatives. This has been taken into consideration in several ways, such as providing funding through GEF for capacity building, methodological development and transfer of technology through thematic programmes, as well as training (UNEP, 2000b, 2001a, 2002a). It has also been recognised that information providers would hold ownership of information distributed through the Internet (UNEP, 2001b; OECD, 2003).

Thus far we know only little about the generation of knowledge and wisdom through Internet-based biodiversity information clearing-houses, since all information systems in this field are young and relatively robust. From the point of view of constructing information systems, the sources of raw data for archiving are crucial (Tolvanen, 2003). Since biodiversity information clearing-houses can only rarely be based on commercially-produced and marketed raw data, connections to data custodians willing to participate in the CHM are essential. This requires significant amounts of work and is a necessary prerequisite for constructing an information system. Secondly, so-called grey data, i.e. data collected for multiple purposes apart from information clearing-houses, such as temporary research projects, can offer substantial resources. For these reasons, constructing biodiversity clearing-houses implies good connections with the persons and institutions gathering and holding the original data.

The Conference of the Parties (COP) of the CBD has given quite detailed instructions on the content and format of national clearing-houses (UNEP, 1995, 1996, 1998, 2000b). In addition, strategic documents have been prepared to guide the CBD parties in constructing the CHM through international, regional and subregional networking (UNEP, 1999a, 1999b, 1999c). Background papers (Olivieri et al., 1995; Busby, 1997; Juma, 1997) as well as papers focusing on distinct groups of organisms (e.g. Allkin, 1998) have been published concerning the capacity building phase of biodiversity information systems.

In spite of this, numerous practical problems are confronted in establishing national clearing-houses. Collation of primary data and initiation of co-operation among data holders can be difficult especially in countries with less developed data production infrastructure. Correspondingly, old structures of administration and management may prevent efficient use of multiple data bases in countries with longer traditions of data production. Even after co-operation has been initiated, significant amounts of resources are needed to put in use the methods and practices that would ensure efficient processing and rapid sharing of information. Lack of capacity is clearly a problem in several developing countries who nevertheless aim to establish CHMs (see also UNEP, 2002b).

In order to be usable in an Internet-based distribution system, data has to be processed systematically. Refining data into highly usable information is demanding. Types and categories of data are manifold, with varying capabilities and opportunities. The degree of participation and division of labour between multiple actors as well as administrative and geographical units is often unclear. Processing requires a significant amount of human work that cannot at present be replaced by automatic software tools. According to some experiences, e.g. the geocodability of bibliographic data and the facilities to interpret observational data are crucial from this point of view (Laihonen et al., 2003). This, again, is often highly dependent on availability of practical knowledge and orientation.

From the global point of view, the Internet in itself as a means of biodiversity information exchange is somewhat controversial. The least developed countries, who represent 10% of the world's population, comprise only 0.3% of the world's Internet users and, indeed, the gap between the LDCs and other countries is growing (Anonymous, 2002). Besides developing information technology infrastructure, favouring information exchange modalities other than the Internet would be one way of diminishing the effects of the Internet gap. In fact, inequality with respect to information has been recognised during the preparation of the CHM (UNEP, 1996) and at least one developed country, New Zealand, has chosen to run the national CHM with means other than the Internet. According to some views, instead of passing on information through passive mechanisms, the CHM should be focused on connecting people, since "the fundamental goal of the CHM goes beyond data exchange" (UNEP, 2002b).

In conclusion, three major tasks can be formulated for further development of the CHM: (1) general command of the biodiversity information process; (2) introduction of core biodiversity information, i.e. taxonomic and ecosystem information serving especially operational and tactical decision-making, in the process; and (3) development of means of information exchange to meet the demands of all countries including those with less developed ICT infrastructure. Moreover, there is an obvious need to refine the roles and currently unclear relations between the international CHM, GBIF and related initiatives of biodiversity information.

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