KPMG

GBIF 3rd Year Review

February 2005

GBIF

Global Biodiversity

The GBIF 3rd-Year Review
Report from the Review Committee

28 February 2005

Preface

The Review Committee and the Review Team present this report convinced that the Global Biodiversity Information Facility (GBIF) is "the right initiative at the right time with the right goals." At the same time, as is predictable for any new, ambitious, and complex program, there are several areas that warrant attention. We have learned a great deal about the way that this unique international enterprise is developing, the ways it currently is perceived, and what its future promises. We have done extensive investigation and analysis, and we present a lengthy series of recommendations and their rationales. We have tried to make our review, done early in GBIF's 'life', as useful as we could, although GBIF's youth means that we have not yet been able to fully ascertain how some aspects might be better implemented. GBIF's development and growth make it a "moving target", in the best sense.

We appreciate the cooperation of everyone associated with GBIF, especially the members of the Secretariat, in answering our questions and providing other information, and in being adroit in their responsiveness, even adjusting some operations during the review process!

We trust that our recommendations will be received in the spirit that we intend them—that of thoughtful and constructive suggestions.

The Review Committee

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The Review Team

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Executive Summary

I. Introduction

There are few more pressing endeavors in science or society than understanding the nature and scope of our planet's biosphere. Despite the importance of the world's plants and animals—and microorganisms—in our common destiny, we know surprisingly little about all the beings with which we share our existence. Only about 1.75 million out of an estimated 10 million or more species have been identified and the information on less than 10% of all the collected specimens has been digitized. Much of the information that has been compiled resides in museums and other research institutions that are willing to share it, but have lacked the means to do so in a well organized and globally accessible manner. Improved access to those information resources will help make us better stewards of our environment and can ultimately yield substantial social and economic benefits.

In view of this imperative, the purpose of the Global Biodiversity Information Facility (GBIF), which was launched in March 2001, is to promote and implement the compilation, standardization, digitization, and global dissemination of the world's primary biodiversity data. This work is to be done in close cooperation with established programs and organizations that compile, maintain, and use biological information resources. The countries and organizations that formally participate in GBIF are collaborating on the development of a distributed, online information system that will enable users to access and use increasing volumes of biodiversity data freely and openly on a global basis. In early 2004, GBIF launched its portal, gbif.net, which quickly began to provide integrated access to millions of these distributed biodiversity data records.

According to GBIF's Memorandum of Understanding (MoU), an independent review of GBIF's operations, financial mechanisms, legal basis, governance structure, and links to other organizations was to be conducted in GBIF's 3rd year of existence to determine if any changes are needed. The lessons learned are to be used to evaluate the effectiveness of the governance structure and to recommend any necessary changes. This

Executive Summary—and the full report—respond to GBIF's formal review requirement.

The review was conducted by a committee of six independent scientific experts appointed by the international Committee on Data for Science and Technology (CODATA). The Review Committee was supported in its work by a Review Team of three professional consultants. The review was performed between April 2004 and February 2005, using a combination of empirical and qualitative analytical approaches, which are described in some detail in the first chapter of the report.

Despite the fact that GBIF was established less than three years ago, our fundamental conclusion is that GBIF constitutes an essential step forward in global systematics, and in related biodiversity and ecological research and applications. In our view, if it did not exist, it would need to be created.

The remainder of this Executive Summary presents a condensed version of our principal conclusions and recommendations. Because the full report is over 200 pages, these extracts are highly selective and of course are not able to convey the full meaning or the nuances contained in the body of the report. The next section presents a table with all the review questions from the MoU, which are coupled with our summary conclusions and a reference to the place in the report where the full discussion is located. The final section of the Executive Summary contains our abridged set of recommendations.

II. Review Questions and Summary Conclusions

2 Has GBIF made sufficient and appropriate progress toward getting established as a mega-science undertaking and thereby making scientific biodiversity data freely and openly available over the Internet? Section 2.2	Whether GBIF has already achieved "mega-science" status or will someday is perhaps a less relevant question than whether it should exist and continue, to which the answer is clearly "yes." Nevertheless, based on the six main criteria that we have selected for analyzing whether GBIF has made "sufficient and appropriate progress toward getting established as a mega-science undertaking," we have made the following conclusions: • GBIF has made sufficient and appropriate progress toward getting established as a mega-science undertaking in terms of the numbers and distribution of participants and with regard to its core facility in Copenhagen, but has achieved uneven progress in the distributed facilities of its Participants. • The level of funding is the area in which GBIF has had the greatest difficulties in establishing its mega-science status, and falls short of what is needed even if all the in-country contributions of its Participants are taken into account. • GBIF is a complex undertaking from many perspectives—organizational, political, technical, scientific, or other applications—consistent with other similar mega-science endeavors. • GBIF has not yet achieved a level of scientific importance and relevance of a mega-science undertaking, but it has made more than sufficient and appropriate progress toward those goals, consistent with its length of operation and level of funding. • GBIF has not yet made sufficient and appropriate progress in its importance and relevance to other significant social applications for policy making, education, and general public use, with most of its progress being in the identification of future objectives rather than in actually implementing them as of this early date. • GBIF is a public mega-science infrastructure project that has made important progress

	in promoting public access to biodiversity data. In summary, GBIF has made sufficient and appropriate progress toward getting established as a mega-science undertaking according to all our criteria, except in its level of funding and in its current importance and relevance to other significant social objectives.
i. IPR: has GBIF developed sufficient and appropriate ways to deal with IPR, access, and benefit sharing issues? Section 2.3	We conclude that GBIF's policy of free and open data access, coupled with proper attribution of the source(s), is well justified and should remain the default rule. Its implementation has resulted in "sufficient and appropriate progress toward making biodiversity data freely and openly available on the Internet." This policy is appropriate for a publicly funded network for data outside market forces, it implements the main requirements set out in the MoU, and is essential to GBIF's leadership and long-term success in public science and public-interest applications. We also conclude that GBIF is developing "sufficient and appropriate ways of dealing with IPR, access, and benefit sharing issues." However, there are several concerns that need to be highlighted. The GBIF policy of free and open access to the data it serves on the Internet is viewed by some potential data providers and Participants as an entry barrier, although GBIF's overall efforts nonetheless are certain to greatly increase open availability of biodiversity data. There also is insufficient understanding of and expertise about IPR issues among GBIF's Participants and data providers, and to some extent even within the Secretariat itself, potentially undermining the organization's data policy implementation and exposing it to possible disagreements. Finally, enforcement of GBIF's attribution policy is difficult under its present implementation.
a. Work Programme: is GBIF making sufficient and appropriate progress in carrying out each of the components of the Work Programme? Chapter 3	There are several cross-cutting and overarching issues identified by the Review Committee that affect the Work Programme. These include the lack of sufficient funding to make as rapid progress as desired on all of GBIF's objectives, the related problem of having only one staff member for each major component of the Work Programme, and the inadequate involvement in many cases by GBIF's Voting Participants and Associate Participants in supporting and implementing GBIF's objectives and Work Programme elements. Also, a lack of benchmarking in the Work Programme was noted by many Governing Board respondents to our questionnaire. With regard to the individual components of the Work Programme, we conclude that GBIF is making sufficient and appropriate progress in carrying them out. This progress is understandably uneven, as the more detailed analysis in the full report describes.

g. Links to International Conventions: has GBIF developed sufficient and appropriate links to the various international conventions dealing with biological diversity? h. Links to Other International Organizations: has GBIF developed sufficient and appropriate links to other intergovernmental, non-governmental and other scientific organizations dealing with biological diversity and informatics (e.g., Biosis, IUBS, CODATA)? Section 3.6	We conclude that GBIF has developed sufficient and appropriate links to the Convention on Biological Diversity, but less so to the other conventions dealing with biodiversity issues. Similarly, GBIF has developed sufficient and appropriate links to its highest priority external organizations, but considerably less so among organizations of less central importance. GBIF has been successful in its communication and outreach to all types of external organizations to the extent that there do not appear to be any strong negative views about GBIF among them. Nevertheless, more visibility of GBIF internationally would be desirable. GBIF ultimately will need to establish relations with a broader and more diverse set of organizations and to make its connections to them (e.g., to the biomolecular community) more visible.
e. Nodes: have the Participants made sufficient and appropriate progress toward setting them up and sharing data through them? Section 3.7	The Review Committee concludes that the progress of the Participants toward setting up nodes and sharing data through them is highly variable and cannot easily be summarized. A number of strengths and weaknesses of the Nodes activities are presented in the report.
3. Has GBIF achieved sufficient profile and uptake within its target audiences? (focus on gbif.net users) Chapter 4	We obtained a fragmented picture of what the actual and the potential uses of the portal are, but the support seems to be strong in the GBIF community as well as among most experts and users. Of course, it is important to emphasize that the portal is still just a prototype, but the overall experiences with the portal have been generally positive even though the content and the functions there are incomplete. The knowledge of GBIF is quite high and increasing among its primary audience in the scientific community, but still low among its secondary audiences, including the broader scientific community. The Review Committee finds it acceptable that GBIF is not very widely known beyond its core scientific base, since the portal is still a prototype. Nonetheless, it indicates the need for much more vigorous outreach activities in the future. It also underscores the need for more demonstration projects that show the potential of gbif.net and the various applications of the data accessible from there. More important, it also emphasizes the need for developing features and interfaces targeted to the specific user groups in order to reach them properly. The perceptions of the existing outreach activities are varied, but can be summarized as follows: • GBIF is still not very active in its outreach to potential users beyond the immediate systematics community, where outreach has had an impact. • This lack of broad outreach is generally considered acceptable in the short run, since the portal is currently aimed at a highly expert audience. As long as gbif.net lacks user-friendliness and broad applicability, outreach to non-expert users should remain limited. • The nodes are crucial for further outreach – especially for the broader scientific communities in the participant countries and organizations. • There is an apparent need for good examples – demonstration projects – showing the

	full potential and usefulness of GBIF data. In general, demonstration projects have lacked sufficient attention and resources. • No user group surveys have been conducted (and our questionnaire was very limited). Therefore, it seems that there is only a limited knowledge of the demands for functions among the different groups of users outside the GBIF community. The needs from a nodes perspective have been surveyed, however. In summary, the Review Committee encourages GBIF to be cautious in its outreach to users due to the near-term deficiencies of gbif.net. We nonetheless expect that preparations for comprehensive outreach activities will be made soon, focusing on users in the scientific communities, education, and policy making.
Conclusions on Participation in GBIF: 1. Have the present organizational structure and funding been sufficient for GBIF to achieve its goals? b. Governance Structure: Should GBIF continue with two kinds of Participants? f. Voting Participation by Intergovernmental, Non-governmental and Other Organizations: the Rules of Procedure do not currently allow these organizations to be Voting Participants, and state that the possibility of offering Voting Participation to these entities should be considered in the third-year review. Section 5.2	The Review Committee recognizes the value of the current categories of Participants in GBIF. The categories – Voting and Associate participation – are well adopted in the GBIF community and also widely accepted. However, the information and opinions presented by the GBIF community raise some concerns in the Review Committee. We conclude that the two existing kinds of participation are not sufficient to cover the relevant stakeholders of GBIF and it will be necessary to formally recognize other sorts of participation. The committee is uncomfortable with the stagnation in the addition of dues-paying country Voting Participants coupled with a steady increase in Associate Participant countries and organizations that do not pay dues (although many do provide some in-kind support), since the total number of Participants is a cost driver for GBIF. It is clear to us that the GBIF community generally accepts and supports: (1) the distinction between Voting and Associate Participant status, notably that only contributing countries have voting rights, (2) the presence of both countries and international organizations as a prerequisite for implementing the vision of GBIF, and (3) the current link between the payment of dues and voting. However, the difference between Voting and Associate Participant status appears to be rather insignificant, because most decisions are taken by consensus. The GBIF community clearly accepts that countries can be Voting Participants and that non-governmental organizations can be Associate, but not Voting, Participants. It is not appropriate, however, that countries are able to maintain their status as an Associate Participant indefinitely. We also conclude that non-governmental and other organizations should not be allowed to gain Voting Participant status, whereas inter-governmental organizations should be. The legitimacy of GBIF is based on having truly global support, as well as on a highly usable portal. Thus, bringing more Participants into the GBIF community is vital for the organization. Seeking new sources of funding and restructuring its governance will be necessary for GBIF regardless of whether there is an increased number of Participants. This is needed because GBIF is changing organizationally from a developing mode to an operational status.
Conclusions on GBIF's Governance: b. Governance Structure: do the Rules of Procedure serve GBIF well? c. Legal Basis: GBIF is an independent organization, based on a non-binding, voluntary MOU. Is this basis sufficient and appropriate? d. Operations of the Governing	The Rules of Procedure (RoP) generally serve GBIF well and are by and large supported by the GBIF community. Nevertheless, the Review Committee concludes that the MoU and the RoP in several respects need to be better aligned with each other and with the operational considerations that have become evident since the establishment of GBIF. The areas that may need modification are described in the report. With regard to the question of legal instruments on which to base GBIF, we are convinced that the choice of an MoU instead of a treaty was correct and explains why GBIF was formed rather quickly. A non-binding, voluntary MoU is not only sufficient and appropriate; we also believe that it will not be possible to find support for elevating this legal status to a binding agreement. GBIF's governance system has been sufficient thus far to achieve the organization's goals.

Board: are they appropriate and efficient? Section 5.3	There are basically two ways to go with the governance structure: (1) keep the existing governance structure, in which the Governing Board is the main forum for handling political, managerial, and programmatic issues, or (2) redefine the governance structure by decoupling the politics and science. The principal argument for keeping the existing structure is that it is established and is generally considered to work well. However, we acknowledge the concerns presented to us regarding the absence of 'real' science in the Governing Board, the difficulties in segregating Voting Participants from non-voting, the increasing difficulties in stimulating discussions as the number of Participants accumulates, and the related expectation that the efficiency of the Governing Board will diminish.
Conclusions on GBIF's Funding k. Financial Mechanisms: should the Financial Contributions for Voting Participants and procedure to handle those (Annex I of the MOU) be changed? l. Additional Funding: has sufficient and appropriate progress been made by the Participants in increasing their in-country or intra-organizational investments in biodiversity information infrastructure in support of GBIF, as the Memorandum of Understanding encourages them to do? Section 5.4	The present funding has been sufficient for GBIF to achieve its goals in the initial phase of establishing GBIF and the Secretariat. It is obvious to us, however, that the next phase will require an increased level of funding in order to be able to continue the activities laid out in the Work Programme and to stabilize the present development of GBIF. A very acute need for increased funding is in the Secretariat, which is too thinly staffed even for its present level of activity. Although there are various barriers to increasing the total level of funding, as discussed in the report, we conclude there are a number of options for doing so. These include: more vigorously recruiting new Voting Participant countries and inter-governmental organizations; converting Associate Participant countries to Voting Participant status; increasing the level of financial contributions for Voting Participants; taking inflation into account in the dues structure; and changing the currency in which dues are paid from the US dollar to the Euro. These measures together can help stabilize and improve GBIF's finances significantly. We have not been able to uncover fully whether participants have made sufficient and appropriate progress in increasing their in-country or intra-organizational investments in biodiversity information infrastructure in support of GBIF. Clearly, efforts are being made – although very unevenly. One indication is the number of nodes. Another is the significant amount of data already provided to the network. However, too many Participants have not yet been able to establish the internal structure and support necessary to provide data and resources.
Conclusions on the Operational and Financial Management of the Secretariat: d. Operations of the Secretariat…: are they efficient? Section 5.5	GBIF's finances are currently stable, with a substantial amount of savings in hand that provides some room for manoeuvre by the Governing Board and the Secretariat. Improving the finances by cutting costs and by reducing staff or program activity will not increase the efficiency or effectiveness of GBIF. On the contrary, cutting down on the number of employees will either mean that the already overworked staff will have to each handle even more activities, or that activity in GBIF's core Work Programme will have to be reduced. Although GBIF basically has a sound financial position at this time, the organization has experienced some financial difficulties due to the fact that its income is in USD and a large proportion of its expenditures is in DKK. The Secretariat has been right to buy forward contracts, as recommended by the auditors, and the approval to do so is documented through the revisions made to the Financial Regulation agreed to at GB9. We must emphasize, however, that this approach should only be seen as a stop-gap measure and that a much preferred solution to this exchange problem is recommended in the section on Funding above. The financial reporting system and progress reports that GBIF and the University of Copenhagen jointly produce can be improved in several areas. Some key Secretariat staff members have indicated that they are unlikely to renew their contracts, leaving substantial uncertainty as to succession, continuity, and retention of corporate memory.

The existing strategic plan for GBIF does lay out the future challenges of GBIF, but the plan lacks specific considerations for the transition of GBIF into its next phase of development. This 3rd-year review should provide the opportunity to develop such a plan. One area that needs to be considered is expansion of GBIF's physical facilities. Another is the possible future decentralization of the Secretariat as the organization grows.

III. Recommendations

The recommendations presented below are extracted from those made in the full report. In most cases, they are only summaries of the full set of recommendations in each section. In the case of the individual Work Programme components, we have only provided the recommendations specifically germane to the questions posed in the Content of Review.

Recommendation on the Status of GBIF as a Mega-Science Undertaking

Because GBIF is a mega-science undertaking that will provide an essential informatics infrastructure for future biodiversity research and applications activities worldwide, we recommend that it be fully supported and continue, with due regard to those areas identified as needing more attention.

Recommendations on GBIF's Data Policy

1. GBIF needs to be much more proactive about explaining and promoting its data policy to its Participants, data providers, organizational partners, and users. GBIF cannot assume that all, or even most, of its potential data providers subscribe to the free and open access ethic. GBIF also needs to promote a better understanding of the broader underlying intellectual property rights (IPR) issues and policies among its Participants and users.

2. In view of the complexity and importance of the underlying IPR issues regarding its free and open data access policy, including potential liability concerns, GBIF needs to outsource some of its legal work to external legal experts. Also in the near term, a small pro bono legal advisory committee consisting of several government and academic lawyers should be convened for a limited time to provide a sound basis for GBIF staff and Governing Board members to understand their options, and to make better informed decisions about implementing GBIF's data policy and in concluding agreements with its data providers.

3. To more fully and fairly implement its attribution policy and encourage the equitable sharing of the benefits from participation in its portal, GBIF should promote greater recognition of its data providers and their original data sources.

Overarching Recommendations on GBIF's Work Programme

1. Each component of the Work Programme depends almost entirely on the work of one key staff member, potentially exposing the organization to damaging disruptions in the event of a sudden departure, or even one with some notice, in light of the time needed to train a replacement. The GBIF Secretariat must develop a contingency plan to address those eventualities successfully. GBIF also should examine options for outsourcing certain specialized functions and discrete tasks, and for hiring more staff when additional stable funding becomes available.

2. The GBIF Secretariat and Governing Board need to encourage a much greater level of participation by the immediate and extended GBIF community in the development of all its Work Programme components and related objectives.

3. In order to have a more thorough understanding of the progress on various tasks within and across the Work Programme, the GBIF Secretariat, working with its Science Committee and Subcommittees, should develop a comprehensive benchmarking process. GBIF also should consider adopting an independent, periodic review function of each major component of the Work Programme (in addition to the broader 3-year reviews of the entire organization, which are necessarily not sufficiently detailed).

4. Because the overall Work Programme is evolving in its focus and scope, the Secretariat and the Governing Board need to review staff assignments and position descriptions on an annual basis in relation to their portfolio of actual activities.

5. In consultation with GBIF, its Participants should adopt a broad range of incentives (both monetary and professional) and methods for recognition of outstanding contributions (e.g., new prizes at the national and institutional levels) to promote work on GBIF's goals and program objectives.

Recommendations on Outreach and Capacity Building

1. We recommend that GBIF reorganize OCB into two separate areas, with clearly delineated functions. Outreach functions should be performed by an Outreach Programme Officer and focus on recruitment of new Participants (in all the membership categories suggested in section 5.2), relationships with all external organizations and user groups, and the management of IPR and demonstration projects in support of the other functions. The Outreach Programme Officer would need to work on the recruitment of new Participants in close coordination with the leaders of the Governing Board and the top managers of the Secretariat. The current suite of capacity building activities, including training, education, and mentoring, would all naturally fit within the portfolio of activities of the proposed new Nodes Liaison Officer.

2. With regard to GBIF's outreach to organizations, a strategic marketing approach is necessary, similar to the approach we recommend with the user groups (see text for details).

3. In capacity building, there needs to be much more emphasis on having Participants and nodes help each other instead of having the Secretariat as the focal point. This is consistent with our recommendations in other sections of the report to devolve more responsibilities and functions on a regional basis. Other recommendations for training are to develop more distance learning training approaches, and to identify organizations with similar goals with which GBIF can plan and run training activities together. Finally, the managers of GBIF should not undertake educational activities that are not closely coupled with other major goals of the organization.

Recommendations on Nodes

1. Many of the GBIF nodes have technical development programs with overlapping functions and activities. These programs need to be better coordinated to increase their efficiency and effectiveness in the nodes and in the broader GBIF community.

2. In order to meet its future challenges, we recommend that GBIF develop a strategy for the long-term support of nodes under which a typology of nodes is created with the purpose of setting clear guidelines for them. In particular, the possibility for a more regionalized support structure should be investigated, especially when more nodes are established and GBIF's annual level of funding is increased.

3. In order to help the nodes that are struggling to get established in developing countries, GBIF should consider obtaining targeted financial help for the developing countries that have demonstrated sufficient initiative to set up a node, but are being hampered by obsolete equipment and slow communication networks. This could be a relatively low-cost but effective investment. GBIF could partner with some of the many inter-governmental and private-sector donor institutions that focus on improving ICT infrastructure in developing countries. The current United Nations World Summit on the Information Society will likely provide some near-term opportunities in this regard.

4. GBIF should complete the Best Practices Handbook for the benefit of all the nodes as soon as possible. Subsequent updates should be the responsibility of the new Nodes Liaison Officer.

Recommendations on GBIF's Profile and Uptake by Users

gbif.net

Our discussions and the comments we received from many respondents resulted in many suggestions for improvements to gibf.net, some of which are summarized here:

1. Because having comprehensive biodiversity data on gbif.net is essential for the success of GBIF, the emphasis continuously should be on identifying new data providers and building an ever larger data inventory. No matter how impressive the effort has been over the past year, the amount of data served through the portal is (understandably) still far short of being sufficient.

2. Many respondents wanted analytical tools to be provided through the portal. We strongly support this and note that gbif.org already provides links to several tools developed in the biodiversity community. We encourage GBIF to be involved increasingly in the development of analytical tools that are integrated with the portal. The integration of such tools is essential for attracting a broad range of users to gbif.net.

3. With a constantly increasing number of users, GBIF will have to establish a user support infrastructure for effectively handling their questions and concerns. A partly centralized solution is necessary, but in the future a more distributed support structure will be needed as well to handle linguistic and other specializations. The best functioning nodes may very well be important for this purpose.

4. More specific content-related technical recommendations are described in the full report.

Outreach strategy

1. At this stage of the evolution of GBIF, it is most important to demonstrate to scientists that GBIF will serve their interests. Other user groups will have to wait until suitable content and interfaces are developed. Nonetheless, it is essential to begin developing an outreach strategy focused on all the users. Outreach efforts need to be very well aligned with the development of the portal, for example, with the evolution in data quality, number of records, and interfaces. The user outreach strategy should have an analytical foundation that clearly identifies and prioritizes the various user segments and their needs, so that it establishes effective approaches for serving these various constituencies, which are partly or wholly disparate from one another.

2. Any outreach activity to a specific group of users should rely on a strategy based on: a survey of user needs; an explicit prioritization of responses to user demands; a technically mature and tested user interface on gbif.net; and a clear division of responsibility between the Secretariat and the nodes for implementing the strategy.

3. What is not as clear to the Review Committee is the situation when gbif.net is no longer a prototype and more extensive outreach activities to users in the scientific community need to be implemented. This should be considered carefully by GBIF when developing its user outreach strategy. Specific communication activities are recommended in the full report.

4. The nodes should play an especially crucial role for GBIF's outreach to users. The nodes represent the main link between GBIF and the different user communities and a user outreach strategy will need to clarify their functions. The nodes can provide one of GBIF's main goals to encourage a greater level of in-country participation in GBIF and coordination with local user groups. We realize that not all nodes are in a position to deal effectively with this or have the resources to do so, but nevertheless GBIF's strategy must clarify how the nodes can support this in the future.

5. When developing its user outreach strategy, GBIF needs to avoid some common errors, which are presented in the full report.

Demonstration projects

The Review Committee strongly supports demonstration projects as a means of presenting the vision of GBIF to providers, users, partners, and sources of funding. More effort should be put into increasing the number and scope of such projects so that they address different scientific and applications communities to help funding agencies and other stakeholders better understand the value of GBIF.

Raising visibility

1. The Secretariat has suggested in its self-assessment that a more extensive marketing of GBIF is being initiated. Based on the facts presented to us – mainly the undeveloped nature of gbif.net in its functionalities, the lack of documentation, and quality of the data – the Review Committee cannot recommend that more extensive marketing of GBIF is currently warranted. This is because the main product of GBIF – gbif.net – is not yet ready for broad advertising on mass media. Targeted advertising eventually could be important, but it would be costly and should not be implemented until gbif.net is sufficiently mature.

Recommendations on Participation in GBIF

1. We believe it is in GBIF's interest to build as many and as varied relationships as possible in order to be a truly open-ended organization, as stipulated in the MoU. In order to expand its relations beyond the existing ones we recommend that GBIF distinguish between the following different relationships and entities: Voting Participants; Observer Participants; Associate Participants; Affiliate Participants; Data Providers; Donors; Partners; and Friends of GBIF. These relationships and entities are described further in the report.

2. An entity may have – and some should have – several relationships to GBIF, such as Voting Participant, data provider, and donor. The reason why we recommend focus on the various relations and entities is to make sure that each of them is characterized properly and that consequently GBIF develops a separate outreach strategy for each. It also is important for GBIF to be able to have a formal affiliation to governmental or non-governmental institutions in non-Participant countries in order to promote in-country activities and support for GBIF goals, with a view to developing future national participation in GBIF.

3. Finally, GBIF should consider adopting a simpler, more general MoU to be signed by all Participants as discussed further in our Recommendations on the Documents of Regulation below, as well as more specific agreements targeted at each of the entities and suggested categories of relationships to GBIF.

Recommendations on the Governance Structure

1. The Review Committee suggests a significant change in the governance structure of GBIF, based on our findings and conclusions. The change should accomplish the following goals:

- Simplify the governance structure by segregating politics from operations;
- Enable an increased focus on the science aspects of GBIF;
- Create a stable structure independent of the number of participants;
- Enhance the open-endedness of GBIF in scientific and technical subjects, but not in governance subjects;
- Strengthen the responsibility and decision-making power of the Executive Committee.

2. The suggested revision to GBIF's governance structure is based on specific high-level considerations and design principles that are outlined in the report.

Recommendations on the Documents of Regulation

1. The documents of regulation should be aligned to the changing realities of the GBIF organization, which is one of the main reasons for clarifying the categories of participation as recommended above. Our recommendations are as follows:

- *The complex of regulations*. The new MoU could be shortened significantly, because a number of the existing provisions are no longer relevant. Content-related goals can be formulated and revised in the Strategic Plan and Rules of Procedure (RoP), and the Staff Rules and Financial Regulations can incorporate some of the provisions. A careful review by the Governing Board and the Secretariat of these various regulatory documents can simplify, clarify, and integrate them better.
- *Open-ended MoU*. The new MoU should not be limited in time, as the present MoU is, but should have an open-ended duration.
- *Future Reviews*. An external review should be conducted every three years after the new MoU has been established (i.e., with the next review coming five years from now and every three years after that).
- *Meetings*. As mentioned earlier regarding the reform of the governance structure, we recommend that the Governing Board meetings be fewer, more focused, and more prepared in the sense that problems be solved and discussed beforehand and in other relevant forums. Consequently, the mandates of the Executive Committee should be revised and extended significantly, and the other Committees need to meet prior to the Governing Board meeting, so that consultations by the GBIF community are comprehensive in preparation for the Governing Board meetings.
- *Voting*. The requirement of a supermajority and the convoluted process for voting for committee chairs and vice chairs is not efficient. We recommend decision making by a simple majority for chairs and vice chairs, based on one round of voting. Decision making by consensus should be the preferred method in GBIF whenever possible.

Recommendations on the Level of Funding

1. Consistent with GBIF's potential importance and relevance as described in this report, the Participants in GBIF must do more to ensure that their environmental and science policymakers understand the enormous value that GBIF could return to them if it were properly funded at both the global and in-country levels. Further, as the founding organization of this initiative, the OECD has a special responsibility to help ensure that GBIF obtains the commitments for the level of funding required to achieve its established objectives.

2. We recommend that the level of funding for GBIF be increased to a level similar to the level suggested in the 1999 OECD report that recommended the formation of GBIF– that is, in the area of 7-10 million USD. However, the drop in the USD in recent years means that the value of contributions at the 1999 level in USD is significantly lower now in the currencies most used by GBIF. Consequently, trying to reach the same Euro level as in 1999 would mean raising the USD level in 2004 to 9.7 and 13.9 million USD. We suggest a target level of 10 million USD (at the 2004 level) split according to 7 million USD in basic contributions from Voting Participants and at least 3 million USD from voluntary, supplementary sources.

3. We recommend that the increase in basic contributions be reached incrementally over a period of two or three years, and that the increase be clearly explained by specific allocations in programmatic activities. We also recommend that the Voting Participants each consider providing significant supplementary funding contributions. Flexibility in the allocation of additional supplementary funds is essential because donors generally have special interests in which activities they fund.

4. The efforts so far in attracting both kinds of funding have been poor. Nevertheless, we fully support GBIF's emerging plans to obtain additional funds and the ideas in the new fundraising strategy. Besides focusing on increasing the number of Voting Participants paying basic contributions, we recommend that GBIF's efforts to obtain more supplementary funding be focused on: government ministries, inter-governmental organizations, ad hoc consortia of nations, and philanthropic organizations and individuals. Additional funding also could be generated through a membership fee from "Friends of GBIF."

Recommendations on GBIF's Funding Mechanism

We generally support the concept of basic contributions from Voting Participants for GBIF's core funding as established in Annex 1 of the current MoU. We recommend that this mechanism be continued, but with the following suggested changes.

1. The increase in the level of funding, as justified above, should be supported by the following initiatives:

- The existing Associate Participant countries shift their status to Voting Participants, either immediately upon approval of the new MoU or

following a set period of time, thereby becoming paying contributors to the core fund.

- A continuous focus on recruiting new Voting Participant countries.
- A continuous focus on maintaining existing Voting Participants, e.g., by GBIF actively supporting and offering guidance to countries on securing their funding.
- An incremental increase in total basic contributions.

2. We suggest two potential options for an incremental increase in funding. The principles in support of each of these options are described in the full report.

3. Because the existing funding mechanism is not adjusted for inflation, the value of each contribution diminishes every year. We therefore recommend an annual increase in the levels of contribution based on the projected rate of inflation in the country that is hosting the Secretariat (presumably Denmark). This projection should be made in three-year increments and should be accompanied by a budget forecast by GBIF for the same period.

4. The funding mechanism is based on USD, which has turned out to be a severe problem for GBIF. An essential purpose of the funding mechanism should be to maximize the stability in GBIF's funding by distributing as much of the risk of uncertainty among the Participants. We recommend that the levels of contributions be set in Euros and preferably be paid in Euros, although USD are acceptable for payment as is the currency of the country where the Secretariat is located. We believe that the Euro would provide the most stable basis for GBIF finances and that the practical implications for the Participants will be insignificant, after the adjustment is made.

Recommendations on the Operational and Financial Management of the Secretariat

1. GBIF should revise its financial reporting rules in a way that enables the management and the Budget Committee to show that money is spent on Work Programme components according to the established plans and budgets to more accurately reflect GBIF's program elements and to improve the utility of the budget as a management tool. There are two categories that are especially large – salaries and the Work Programme – and these categories ought to be broken up into the specific Work Programme components (DADI, DIGIT, ECAT, OCB, ICT, and now Nodes).

2. GBIF should establish an ad hoc committee in the Governing Board with the aim of analyzing the costs and benefits of a further decentralization of the Secretariat on a regional basis as a way of handling future growth. We do not suggest a greater decentralization of the Secretariat at the present level of funding and activities, however.

1. Introduction

1.1 Background and Purpose of this Review

According to the Global Biodiversity Information Facility's (GBIF) Memorandum of Understanding (MoU):

> *…GBIF will be set up for an initial 5-year period. In the third year, an independent review of its operations, financial mechanisms, legal basis, governance structure, and links to other organizations will be conducted to determine if any changes are needed. The lessons learned will be used to evaluate the effectiveness of the governance structure and to recommend any necessary changes.*

The major focus of the review was to analyze GBIF's overall effectiveness and to make recommendations regarding its future. The review was performed by a Review Committee of six independent members appointed by the international Committee on Data for Science and Technology (CODATA) for their subject matter expertise and geographic representation. The Review Committee was supported by a team of three consultants — the Review Team — one selected by CODATA and the other two by KPMG Advisory, Denmark. A list of the Review Committee and Review Team members is provided in Appendix A, together with their affiliations and contact information.

This report was prepared in response to a formal "Content of Review" document that was based on the GBIF MoU. The following three overarching questions were posed to the Review Committee to guide the review:

1. Have the present organizational structure and funding been sufficient for GBIF to achieve its goals?
2. Has GBIF made sufficient and appropriate progress toward getting established as a mega-science undertaking and thereby making scientific biodiversity data freely and openly available over the Internet?
3. Has GBIF achieved sufficient profile and uptake within its target audiences?

In pursuing the answers to these three principal questions, the Review Committee was requested to examine the quality and effectiveness of GBIF's activities in the following areas:

a. **Work Programme**: is GBIF making sufficient and appropriate progress in carrying out each of the components of the Work Programme?
b. **Governance Structure**: do the Rules of Procedure serve GBIF well? Should GBIF continue with two kinds of Participants?
c. **Legal Basis**: GBIF is an independent organization, based on a non-binding, voluntary MOU. Is this basis sufficient and appropriate?
d. **Operations of the Secretariat and the Governing Board**: are they appropriate and efficient?
e. **Nodes**: have the Participants made sufficient and appropriate progress toward setting them up and sharing data through them?
f. **Voting Participation** by Intergovernmental, Non-governmental and Other Organizations: the Rules of Procedure do not currently allow these organizations to be Voting Participants, and state that the possibility of offering Voting Participation to these entities should be considered in the third-year review
g. **Links to International Conventions**: has GBIF developed sufficient and appropriate links to the various international conventions dealing with biological diversity?
h. **Links to Other International Organizations**: has GBIF developed sufficient and appropriate links to other intergovernmental, non-governmental and other scientific organizations dealing with biological diversity and informatics (e.g., BIOSIS, IUBS, CODATA)?
j. **IPR**: has GBIF developed sufficient and appropriate ways to deal with IPR, access, and benefit sharing issues?
k. **Financial Mechanisms**: should the Financial Contributions for Voting Participants and procedure to handle those (Annex I of the MOU) be changed?
l. **Additional Funding**: has sufficient and appropriate progress been made by the Participants in increasing their in-country or intra-organizational investments in biodiversity information infrastructure in support of GBIF, as the Memorandum of Understanding encourages them to do?

Table 1.1
Content of Review

These three main questions and the 11 subsidiary questions provided the Content of Review, or framework for inquiry, for the Review Committee.

1.2 Short Description of GBIF[1]

1.2.1 Establishment and vision

The Global Biodiversity Information Facility (GBIF) is an international mega-science project devoted to making the world's biodiversity information freely and openly available via the Internet, and especially focused on sharing primary scientific biodiversity data for science, society, and a sustainable future. GBIF's members are countries, economies, or international organizations.

GBIF was conceived by an international group of scientists and governmental civil servants convened in 1996 by the OECD Megascience Forum Subgroup for Biodiversity Informatics of the Working Group on

[1] This section is based on text provided by the GBIF Secretariat.

Biological Informatics. In its final report, the Subgroup proposed that OECD member countries should take the initiative to establish

> *"a global mechanism that would make biodiversity data and information openly accessible worldwide [GBIF]."*

In June 1999, science ministers endorsed the Subgroup's report at an OECD ministerial meeting, although they decided that GBIF should not be instituted under the auspices of the OECD, but rather should be a freestanding organization with membership open to any country. According to the agreed understanding among the ministers, GBIF should work in

> *"close co-operation with established programmes that compile, maintain and use information resources, specifically the Clearing House Mechanism of the Convention on Biological Diversity as well as the competent national/international organizations (UNEP,UNESCO and others)."*

As a result of that endorsement, an Interim Steering Committee was established to develop an MoU for GBIF open to participation of *any country* in the world that was interested, as well as international organizations concerned with biodiversity issues. A comprehensive MoU with articles on goals, governance, funding, and other essential organizational aspects, including procedures and a timetable to be followed for setting up GBIF, were unanimously agreed to in December 2000. The MoU was sent to all governments in the world with an invitation to sign and join. By March 2001 the initial conditions for establishing GBIF were met and GBIF was born as a new international organization.

1.2.2 The Facility

GBIF has the following overall goals:

- Improve the accessibility, completeness, and interoperability of biodiversity databases, by:
  - Providing access to new and existing databases;
  - Contributing data and technical resources, within an intellectual property rights framework (such as that described in MoU Paragraph 8);
  - Developing novel user interface designs that incorporate features to support their functionality in a multi-lingual global context; and
  - Developing suitable tools and standards for accessing, linking, and analysing new and existing databases, including standards and protocols for indexing, validation, documentation, and quality control in multiple human languages, character sets, and computer encodings;
- Facilitate development of an electronic catalogue of the names of known organisms;
- Design and implement SpeciesBank;

- Develop a digital library of biodiversity data;
- Build partnerships with other relevant organizations and projects;
- Improve high-speed networking and computation infrastructures;
- Share computational facilities, including high-volume data storage;
- Develop model curricula for biodiversity informatics training;
- Provide training for data managers and other relevant staff;
- Implement specific programs to enhance the biodiversity informatics capacity and technical skills base of developing countries; and
- Help to coordinate and harmonize the biodiversity informatics programs of the Participants.

To achieve these goals, the GBIF Work Programme is organized among six thematic programs:[2]

- Data Access and Database Interoperability (DADI);
- Electronic Catalogue of Names of Known Organisms (ECAT);
- Digitisation of Natural History Collections Data (DIGIT);
- Outreach and Capacity Building (OCB);
- SpeciesBank; and
- Digital Biodiversity Literature Resources.

1.2.3 Structure of the Facility

Unlike other megascience facilities that are built of bricks and mortar, GBIF operates as a virtual facility. The "bricks" of this facility are the databases, other information resources, and informatics tools made available by GBIF's Participants. The "mortar" that holds the bricks together is the shared informatics infrastructure (software tools, operational protocols, and the Internet). The GBIF Secretariat helps to provide the "mortar" by developing and implementing its Work Programme, as outlined above.

Key to GBIF's operations are the Participant nodes and their associated databases (the "bricks"). In signing the MoU, Participants agree to establish and maintain at least one GBIF node, which is defined as "a stable computing gateway that allows real-time inter-operational search of multiple institutional, national, regional and/or subregional databases containing primary or meta-level biodiversity data." Participants agree to openly share biodiversity data held by their country or organization. Implicit in this is the promise to fund within-country activities that will help to

[2] Note: the last two of these programs, SpeciesBank and Digital Biodiversity Literature Resources, are not yet formally constituted in GBIF's initial Work Programme.

achieve the digitization of biodiversity information from museums and libraries. The Participant nodes and all involved data providers are the channels through which the biodiversity data and information will be provided on GBIF's portal. Their committed participation is fundamental to fulfilling the promise of GBIF.

1.3 Overview of the Review Process

The Review Committee met twice during the review process, the first time in April 2004 to agree on the scope, process, and schedule of the review, and the second time in September 2004 to prepare the first full draft of the report and to agree on the preliminary set of findings, conclusions, and recommendations. In addition to these two meetings of the Review Committee, the three consultants met four times, two of them with the chair of the Review Committee. Besides these face-to-face meetings, there also was continuous communication via e-mail and on a virtual project room.

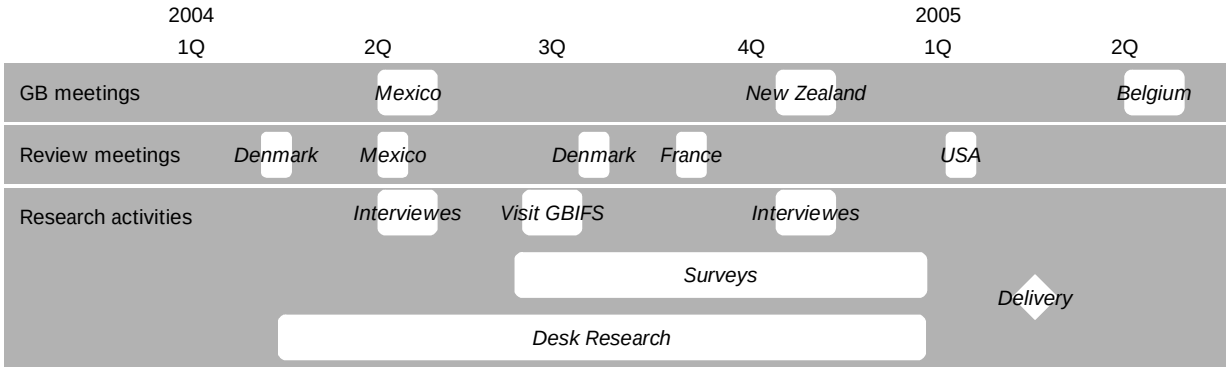


Figure 1.1
The review process

Figure 1.1 above provides an overview of the review process, particularly the meeting activities and the empirical activities. The empirical activities were based on a Review Handbook, which was one of the products from the Review Committee's first meeting.

In the process of reviewing GBIF, the Review Committee and the consultants communicated with a broad range of stakeholders who were both internal and external to GBIF. The stakeholder approach to the review facilitated the collection of valuable information about GBIF. The GBIF Secretariat was especially helpful in communicating relevant information, providing comprehensive background documentation, and clarifying specific issues and questions that came up during the course of the review.

The Review Committee's final report, which is presented in this document, is the product of a fully collaborative process between the Review Committee and the consultants. Before submitting the report to GBIF

Governing Board, the report was reviewed for potential factual inaccuracies by the GBIF Secretariat, and on a confidential basis by the CODATA Officers, by several independent experts selected by CODATA, and by KPMG Denmark.

1.4 Review Methods

Several different methods were used to obtain the information for this review:

- *Documentary methods*, which included desk research and review of the extensive documentation made available by the Secretariat on the internal GBIF CIRCA Web site. The desk research included comparative studies of some topics among a small number of international organizations with some similarities with GBIF. The Review Committee also requested Web statistics from the Secretariat on the number of hits and visitors.
- *Observational methods*, which involved several visits by the consultants and once by the Review Committee chair to the GBIF Secretariat in Copenhagen, observations by the consultants of the discussions at the two Governing Board meetings in Mexico and New Zealand in 2004, and a systematic review of the gbif.net portal by the Review Committee and the consultants to assess its accessibility and usability.
- *Inquisitive methods*, which included interviews by the consultants with GBIF officials and other GBIF professionals in conjunction with the two Governing Board meetings, as well as interviews with GBIF node managers and selected node site visits by the consultants and several Review Committee members. The consultants and some of the Review Committee members also interviewed a limited number of high-value, knowledgeable individuals between the two Governing Board meetings, either by phone or in person. In addition, the GBIF Secretariat drafted a comprehensive self-assessment based on a template developed by the consultants and the Review Committee chair, and members of the Secretariat subsequently responded to further specific questions, both in person and in writing. The consultants also sent three Internet questionnaires to different groups of stakeholders (see the next section). Finally, the Review Committee and the consultants engaged in intense discussions at their two scheduled meetings on all the processes and issues raised in this review, and had extensive e-mail interactions.

This empirical work produced a large body of valuable information. Most of the data were not statistical and objective, but more attitudinal and subjective, based on the subjective nature of the review questions in the Content of Review document (see section 1.1 above). The analysis presented in this report was based on our interpretation of and search for common denominators in these data. When analyzing the various sources of information, we took into account the context and background of the sources, such as their type of expertise, geographical location, and organizational affiliation.

1.5 Internet Surveys

In addition to the review of documents and the personal interviews with experts during the Governing Board meetings and on other site visits, the review used Internet surveys to obtain the views of stakeholders who could not be reached otherwise. A number of independent experts, the Governing Board delegates and committee members, and the users of the GBIF Web sites were targeted by these surveys.

Survey to experts

The expert survey was aimed at a broad range of independent experts identified by the Review Committee with the assistance of the GBIF Secretariat who were not formally affiliated with the GBIF Governing Board, its committees, or the nodes. This group also included representatives of organizations with which GBIF has some relationship, as well as some with which it should, in order to obtain more details about the status of GBIF's external relations. A total of 393 people received an invitation to respond to the questionnaire. In order to provide anonymity to the experts who responded, we have not provided more detailed information on their affiliation here, except for the geographical distribution of the experts shown in figure 1.2 below.

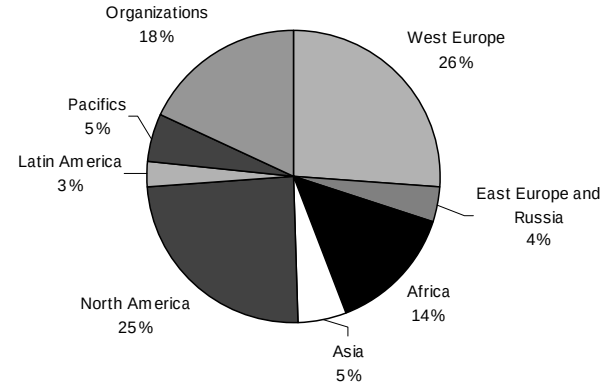
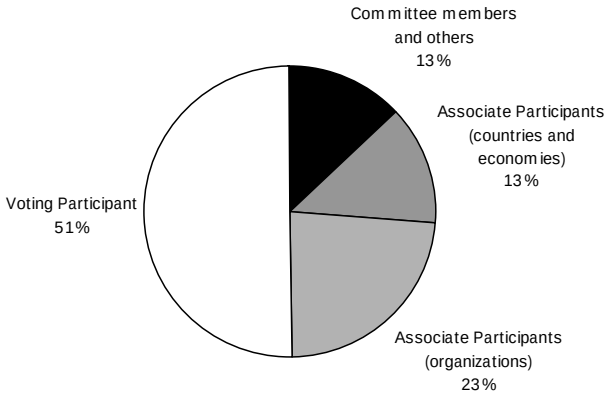


Figure 1.2
Number of responses from experts

Survey to Governing Board and Committees

This questionnaire was sent to all the delegates of the Voting and Associate Participants, the node managers, ex officio members, and members of GBIF committees. This group of stakeholders consisted of 207 people, of which 87 answered the questionnaire fully and 50 answered partially. Figure 1.3 below indicates the distribution of answers from people with respect to their affiliations with GBIF.



N=137

Figure 1.3
Number of responses from people formally related to GBIF

The online version on the questionnaire to the GBIF people had some dynamic features, such as automatic pre-filled information about the interview person. The questions showed to each respondent were controlled by background information, e.g., the respondent's type of participation and affiliation to committees. The questionnaire to the GBIF respondents consisted solely of open-ended questions, because qualitative and detailed information was particularly important for the review. Although many of the respondents complained that the survey was lengthy, it fortunately did not restrict unduly their willingness to provide extensive answers to many of the questions.

Survey of the users of gbif.net and gbif.org

From the beginning of August to the end of December 2004, visitors to gbif.net and gbif.org were able to access an online survey. During that period, 81 users fully or partly completed the questionnaire.

1.6 The Review Criteria

One of the essential considerations in the conduct of this review was the criteria used in comparing the results. We found that there were no definitive criteria or yardsticks by which we could benchmark the "sufficient and appropriate" standard used in the review questions that the Review Committee could apply in assessing GBIF and its organization, performance, and achievements. As an alternative, we used a set of different, yet interconnected, perspectives:

- *A perspective of origin,* focusing on the implicit and explicit criteria developed in the MoU, in the Work Programme, and in other essential documents describing the raison d`être, the strategy, and the priorities of GBIF;
- *A stakeholder perspective,* based on the experiences and opinions of different stakeholders; that is, people closely connected to GBIF as delegates or committee members, experts more distant to GBIF, and the end users visiting gbif.net and gbif.org;

- *A comparative perspective,* comparing GBIF with other international organizations in specific areas of similarity or particular interest; and
- *The authoritative perspective,* evolving from the individual and collaborative expertise of the Review Committee members and the consultants.

Consequently, these perspectives were used throughout the report in different combinations and with different weight. In the beginning of each chapter or major section we explicitly state which perspectives and sources of information were used.

1.7 Structure and Organization of the Report

As noted at the outset, this report is based on the three principal questions and on the 11 subsidiary questions posed in the Content of Review document. However, the order in which the material is presented in our report is somewhat different from the order of the questions. We chose a different sequence for addressing the issues based on our perception of their relative importance and their logical progression.

We begin our analysis with a review of GBIF's status as a "mega-science undertaking"—the organization's raison d'être. Chapter 2 thus addresses question 2 of the Content of Review document, and subsidiary question i on intellectual property rights and data policy. Taking the architectural principle that form follows function, we construct our assessment by beginning with GBIF's organizational purpose and its key policy of free and open access in support to that purpose.

Chapter 3 complements the discussion of GBIF's purpose in the previous chapter by examining the organization's functions as implemented through its scientific and technical activities. Chapter 3 describes and broadly assesses the major GBIF Work Programme components in response to subsidiary question a, GBIF's links and outreach to international conventions and organizations pursuant to questions g and h, and the nodes activities based on question e.

The next chapter in our analysis, chapter 4, focuses on the user perspective in response to question 3 of the Content of Review document. The long-term success of GBIF hinges on how well it will serve its diverse user base, and its actual and potential "profile and uptake" with its users.

The final chapter of this assessment focuses on question 1 of the Content of Review document, and on the remaining six subsidiary questions that deal with GBIF's governance and management. This chapter provides an analysis of the organizational form best suited to fulfilling GBIF's purpose and functions.

In each chapter, we introduce the issues to be addressed and the methods used in our evaluation of them. We then use the subsidiary questions to structure and guide the main discussion, and provide responsive conclusions and recommendations in each instance. The conclusions summarize the

Review Committee's major points from this review that we consider the most relevant in response to the questions posed. The recommendations are substantiated by the major conclusions and by the analysis and findings in the main text. The recommendations are written with a view to being actionable, but in most cases avoid being overly prescriptive in order to allow some flexibility in their implementation.

The report ends with a set of appendices that include the most essential supplementary material for a fully self-contained assessment report. All other supporting material is referenced directly in the text or in footnotes.

2. Status of GBIF as a Mega-Science Undertaking

2.1 Introduction

In our view, the main question in the Content of Review document regarding GBIF's status is the following:

> *2. Has GBIF made sufficient and appropriate progress toward getting established as a mega-science undertaking and thereby making scientific biodiversity data[3] freely and openly available over the Internet?*

There is one subsidiary question posed by the Content of Review document that is relevant to the free and open availability of data over the Internet:

> *(i) Intellectual Property Rights (IPR): has GBIF developed sufficient and appropriate ways to deal with IPR, access, and benefit sharing issues?*

In section 2.2 we address the first part of question 2; that is, whether "GBIF has made sufficient and appropriate progress getting established as a mega-science undertaking?"

The second part of question 2, whether "GBIF has made sufficient and appropriate progress toward…making scientific biodiversity data freely and

[3] Paragraph 1(1) of the GBIF Memorandum of Understanding in Appendix C defines "biodiversity", and paragraph 1(2) defines "biodiversity data." We use the term biodiversity data to cover all data types that GBIF is making or plans to make available through its portal, unless we are referring to a specific subset of such data (e.g., observational data, natural history collection legacy data, etc.)

openly available over the Internet?," is evaluated in section 2.3 of this chapter. The subsidiary question (i) on IPR is also addressed there.

Because GBIF is not a primary research organization, but rather a research enabling or scientific infrastructure project, its scientific and technical (S&T) effectiveness and progress are best assessed in terms of its major infrastructure and programmatic components. Most of the issues and themes relevant to evaluating GBIF's S&T management, therefore, may be addressed by assessing the goals and progress under its four major Work Programme components and its relationship and activities with the distributed Participant nodes. These infrastructure and programmatic components are addressed together in the next chapter.

2.2 Assessment of GBIF as a Mega-Science Undertaking

As noted in chapter 1, GBIF was initiated on the recommendation of the Organisation for Economic Co-operation and Development (OECD) Megascience Forum (subsequently renamed the Global Science Forum). GBIF was the first globally distributed mega-science project and the first biological mega-science project of the Megascience Forum. However, we were unable to find any "official" definition of mega-science, including at the OECD itself.

According to the U.S. Congressional Research Service, scientific "megaprojects" or mega-science programs have a number of common characteristics: they may necessitate the building of large new facilities or instruments, which then require large expenditures for operating funds and long-term funding commitments; they will typically involve teams of researchers working on different aspects of the project, with the consequent requirement for international communication and data exchange; and their scientific objectives cannot be fulfilled by using smaller-scale research format with the current state of technology.[4]

There are several types of very large multinational or international research projects and programs:[5]

- *Experimental facilities* for neutron beams, synchrotron radiation sources, lasers, high-energy physics, high-field magnet laboratories, and fusion experiments;
- *Fixed observational facilities*, such as ground-based optical and radio telescopes, or deep ocean drilling projects;

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[4] Genevieve J. Knezo (1994), "Major Science and Technology Programs: Megaprojects and Presidential Initiatives, Trends Through the FY 1995 Request," Congressional Research Service, Washington, DC, p.1.

[5] See Megascience and its background (1993), OECD, Paris, at www.oecd.org/dsti/mega.

- *Space science and earth observation robotic observational missions*, collecting data about astronomy, solar and space physics, planetary exploration, and earth remote sensing of the atmosphere, oceans, land surface, and geophysics; and
- *Distributed observational programs*, that collect data in many locations as part of an internationally organized research program, typically in the earth, environmental, and biological sciences.

It is the latter category of "mega-science" and smaller scale distributed observational programs that best characterizes GBIF. There are many such projects, although only a few that may be referred to as "mega-science." In that class of activity we cite the Human Genome Project and its related data centers—most notably for our purposes the European Bioinformatics Institute (EBI)—and the International Geosphere-Biosphere Programme (IGBP) and the Neuroinformatics initiative. Other, smaller scale research projects with similar goals and operational characteristics to GBIF's are the World Data Center system, the International Research Institutions for Seismology, and the International Long-Term Ecological Research program. Moreover, according to the 1999 OECD report that recommended the establishment of GBIF and the Neuroinformatics initiatives as mega-science projects in the biological informatics area, GBIF was to benefit not only international scientific research, but also policy-making, educational purposes, and the broader society.

Based on these definitions and criteria relevant to mega-science more broadly, and to biological bioinformatics projects more specifically, we have adopted the following criteria for analysis of GBIF's status as a mega-science project:

- The size or extent of the activity in terms of new facilities, numbers and distribution of participants;
- The level of funding and length of commitment;
- The complexity of the undertaking;
- Importance and relevance to scientific research;
- Importance and relevance to other significant social objectives; and
- Its inherent characteristics as a public research infrastructure initiative.

We analyze GBIF's progress in getting established as a mega-science undertaking according to these six criteria. Many of our supporting indicators and examples, however, are contained in our analysis in subsequent chapters and sections of our report. We reference those rather than reiterating them in the discussion below.

2.2.1 The size or extent of the activity in terms of new facilities, numbers, and distribution of participants

In less than three years of operations, GBIF has clearly established itself as a mega-science undertaking in view of this first criterion. As of 7 December

2004, when the Review Committee completed all its data gathering activities for this review, GBIF had 25 full Voting Participant nations, 17 country/economy Associate Participants, and 28 organization Associate Participants worldwide. Although most of the Participant countries are in the northern hemisphere, we view this as appropriate at this early stage of the organization's development for several reasons. GBIF is a project originated by the OECD and therefore should initially involve OECD countries as full Voting Participants. Most of the collected specimens and data sources for GBIF are located in these countries. Also, the funding of GBIF depends on membership by the largest economies. Moreover, when the OECD Science Ministers endorsed the idea of GBIF, they stated that it should be open to membership from all nations. Many developing countries, including a significant number of mega-diverse nations, therefore have joined GBIF as Associate Participants and are already building closer relationships with the organization.

Overall, we find the numbers and distribution of Voting and Associate Participants in GBIF to be "sufficient and appropriate" at this early stage of the organization's existence as a mega-science project. Nevertheless, additional efforts to convert the Associate Participants into full Voting Participant status, and to bring in most if not all the mega-diverse countries into the organization's membership, are needed. Section 5.2 presents a more detailed discussion of the status of GBIF's Participants, including GBIF's relationship with other entities.

With regard to new facilities, GBIF has clearly made substantial progress in developing its core facility in Copenhagen. Considerably less progress, however, has been made by GBIF's Participants in establishing new data facilities within their own territories as distributed participating nodes.

Based on the responses received to the Governing Board questionnaire and on the interviews with Governing Board members, the implementation of GBIF's goals and Work Programme at the national levels has been very uneven and in many cases weak. The better performing Participants and nodes were characterized by several respondents as being in many of the EU countries and in the Americas, while most of the less well performing Participants and nodes were cited as being in some of the Asian, African, and EU comtries. The following deficiencies were cited as reasons for sub-optimal implementation:

- A general lack of funding provided to these objectives at the national level.
- An insufficient number of people devoted to these tasks. Success frequently depends on personal commitments in key positions and institutions.
- Broad awareness of GBIF and its objectives is lacking among the experts who could contribute.
- The nodes are uneven in their implementation of GBIF objectives and thus far generally successful only where they were previously already established and have sufficient funding. Many also have poor coordination and lack of connection with other relevant institutions.

- Some Participants of GBIF are involved only at a high government level, without adequate involvement of the relevant biodiversity scientific and informatics communities. A few Participants also have had political disagreements about where to establish their node and on other contentious factors that undermine their ability to participate effectively.

Despite these various problems, which are described in more detail in various portions of this report, almost all Participants cited strong support of GBIF's goals, even if actual implementation was uneven. All Participants also generally saw their interests converging with those of GBIF.

2.2.2 The level of funding

Although about half of the Governing Board respondents did think that GBIF had already achieved "mega-science" status, the other half did not. Whereas almost everyone considered GBIF's goals to be appropriate for a mega-science undertaking, the main reason cited for not perceiving GBIF as a mega-science project at this time was insufficient levels of funding. Most of those who did not think that GBIF had yet attained mega-science status, however, indicated that they thought it would eventually, if not soon.

We agree that funding is the area in which GBIF has had the most difficulties in establishing its mega-science status. The intent of the OECD Global Science Forum Working Group that recommended the establishment of GBIF was that GBIF would have a budget of USD 7 to 10 million per year. Even the budget recommended by OECD at the outset would be small compared to that of a large experimental mega-science facility such as the European Organization for Nuclear Research (CERN) and most other previous mega-science projects, although in the field of biodiversity science it would be quite large. With the recommended budget, GBIF would have been able to move forward on its Work Programme goals at a pace that would have much more closely met the expectations of the Participants. We nonetheless believe that GBIF has made remarkable progress toward meeting those expectations on a budget that is only one third of what was envisioned as necessary.

Although the core budget of the GBIF organization in Copenhagen does not approach that of other OECD mega-science projects, the highly distributed nature of the activity further complicates this assessment. Despite the uneven implementation of GBIF's goals and Work Programme at the national level by the Participants, the amount of additional funding expended annually by the Voting Participants and Associate Participants in support of GBIF's goals and programs multiplies the overall effort of the organization many times over. At the same time, the natural history botanical and zoological museums that care for the specimens on which much of GBIF's data access depends typically are themselves under-funded. Museum and other collections that are ready to digitize their materials are unable to do so for lack of funds to hire the individuals to do the work in a reasonable amount of time. These factors therefore need to be taken into consideration as well in assessing GBIF's funding status. Taken in the

aggregate, GBIF begins to approach the status of a mega-science activity, but with an inadequate amount of funding at the central level, and with a great many gaps at the national and institutional levels worldwide. The specific assessment of GBIF's funding is addressed in greater detail in section 5.4.

2.2.3 The complexity of the undertaking

GBIF is unquestionably a complex project from many different viewpoints. This is true from a scientific perspective or other socio-economic standpoints, as discussed further below. However, it is also complex organizationally and politically, and in some respects, technically. The organizational and political complexity is already described under the first criterion above. GBIF is also a technically complex undertaking in light of the major technological and semantic interoperability requirements posed by its many different data providers, both current and future. The huge digitization challenge of museum specimen collections and the need to scale up the system as much greater amounts of heterogeneous data become available through the GBIF portal add to this complexity as well. The technical complexity issues are discussed further under the analysis of the DADI and DIGIT Work Programmes in sections 3.2 and 3.3, respectively.

We also see GBIF as a leading international model of a "federated data management system." Such a model is based on a highly distributed network of interdependent nodes[6] that maintain responsibility over their activities and control over their data, but are provided with strong leadership from a small central Secretariat that establishes policy and standards.[7]

2.2.4 Importance and relevance to scientific research

Science in all disciplines is increasingly data driven. As noted in the Report from the Working Group on Biological Informatics to the Global Science Forum of the OECD, the information that GBIF strives to provide is much more than "relevant" – it will be essential to developing a sustainable relationship by society with the environment. During the OECD process that gave rise to GBIF, the specific areas of biodiversity informatics to which it could contribute were carefully identified. These are areas to which no other existing efforts are directed on a global basis, but that are fundamental to building an information infrastructure for the future that makes available and promotes the integration of scientific data about biodiversity, especially

[6] "Nodes" are defined in paragraph 1(3) of the GBIF MoU in Appendix C.

[7] The concept of a federated data management structure was first identified in National Research Council (1995), *Preserving Scientific Data on Our Physical Universe*, National Academy Press, Washington, DC, p. 51, and was based on the principles of a "flat" corporate organizational model as described in Handy, C. (1992), Balancing Corporate Power: A New Federalist Paper, *Harvard Business Review* 70(6): 59-72.

at the species and specimen level. GBIF thus may be expected to become an essential source from which scientists throughout the world can obtain the primary biodiversity datasets for analysis.

As the Secretariat pointed out in its self-assessment, GBIF enables the easy, worldwide, online accessibility of data from its numerous providers, most of whom are in the OECD countries. The data can thus be used in research or applications virtually anywhere. GBIF's work also promotes the evolution of standards for both data and metadata, as well as digital protocols that allow access to databases by a multiplicity of search mechanisms, and the encouragement of programs that digitize the data currently in print.

Most of the information initiatives that have been established in the past two decades have focused on previously digested information about biodiversity. The GBIF Work Programme areas and its ICT activities are focused on delivering access to databases that contain primary specimen and species data via the Internet and significantly increasing the amount of data that is available, linking legacy museum data with new museum and observational data. Meeting these challenges is a mega-science infrastructure activity, both in the area of development of content and in the area of information management and dissemination. Although many other organizations and programs are undertaking tasks that form part of the "GBIF vision" of a fully interoperable biodiversity information infrastructure, GBIF provides the integrated data access for this worldwide effort. The facility has clearly "furthered technical and scientific efforts to develop a global digitized information facility for biodiversity data," as required by the GBIF MoU.

There are some indicators already that GBIF is beginning to be perceived as a leading facility within the biodiversity science community. According to the Secretariat, for example, many proposals for grant funding to the European Commission, the U.S. National Science Foundation, the Canadian National Science and Engineering Research Council, and the Australian and New Zealand agencies that require natural history collection information, or that will generate such information in the course of the research, are already citing GBIF as the conduit for that information. In addition, the UK's Biotechnology and Biological Sciences Research Council has released a call for biodiversity informatics proposals that will contribute to DADI and ECAT.

GBIF also is providing a forum where scientists from various fields are able to interact, and is actively forging links between them. Some examples include the recent Danish Biodiversity Information Facility (DanBIF) conference on "Molecular Biodiversity;" the joint funding by GBIF and the Scientific Environment for Ecological Knowledge (SEEK) initiative to develop a protocol for defining and sharing taxonomic concepts; and a workshop jointly sponsored by GBIF and the World Federation for Cultures Collections to define the appropriate protocols and data definitions for microbial data. Many additional examples of GBIF's potential importance and relevance to scientific research as a mega-science infrastructure project are discussed in the context of GBIF's individual Work Programme elements in chapter 3.

Almost all of the Governing Board respondents to our questionnaire indicated they thought that GBIF was already or would become scientifically relevant, and most indicated that they believed strongly about that. Most of these respondents also believed GBIF was already a leader in biodiversity informatics globally, and the remainder agreed that GBIF had a strong potential to become a leader in this informatics area in the near term. Scientific leadership (in contrast to relevance) was not seen as strong as the informatics achievements, however. Many of the Governing Board respondents nonetheless reflected the notion expressed by one of the respondents that "GBIF is the right initiative, at the right time, with the right goals."

The independent expert questionnaire respondents were somewhat more circumspect, although they were broadly complimentary. More of them saw the potential rather than the actual relevance. GBIF has not yet significantly advanced "research in many scientific disciplines" as the GBIF MoU proposes in its preamble. While many would no doubt agree with one expert respondent's characterization of GBIF eventually becoming "the one-stop-shopping link to systematics databases worldwide," they viewed GBIF as a biodiversity informatics infrastructure and science enabling activity, not as a scientific research and applications organization per se. Moreover, the expert respondents also cited various limitations and cautions that GBIF would need to address, including the following:

- Despite the fact that the task of making available the world's taxonomic data resources in a digital, interoperable format is itself a worthy, if daunting, challenge this primary data focus is nonetheless quite narrow. Many Governing Board and expert respondents noted this can be a limitation on GBIF's scientific importance and relevance.
- The quality of the data served by GBIF will be an essential determinant of the organization's relevance and long-term success.
- GBIF's relevance and success as a federated network of distributed data resources and activities means that it will only be as good as its partners and cooperating organizations. Because GBIF is still in its formative stages, the breadth and depth of its cooperation and partnerships, including the contributions of its Participants, remain uneven.
- Finally, a potential weakness of GBIF is that it "could become an end in itself," as one respondent put it. The number of gigabytes served through the portal could become a misleading indicator of the initiative's success, absent a focus on the results achieved with those data in research and in other user applications.

Overall, we agree that although GBIF, when more fully implemented, should be expected to be highly scientifically important and relevant, constituting a "mega-science" infrastructure project, it has not yet achieved that level of accomplishment.

2.2.5 Importance and relevance to other significant social objectives

In recent years there has been a growing recognition of the societal need for scientific contributions to the public debate about biodiversity and how it can be sustainably protected and used to benefit humanity. GBIF seeks to make available almost 300 years' worth of biodiversity data from museum systematics collections and other sources to all parties in this debate throughout the world. Investments made in digitizing such legacy data and putting them online in an integrated information infrastructure will be paid back many times over through continuous re-use by scientists and non-scientists alike. Figure 2.1 is a schematic diagram developed by the Global Earth Observations System of Systems initiative of some of the many potential linkages between the data that will ultimately be provided through GBIF's portal and other science and applications areas.

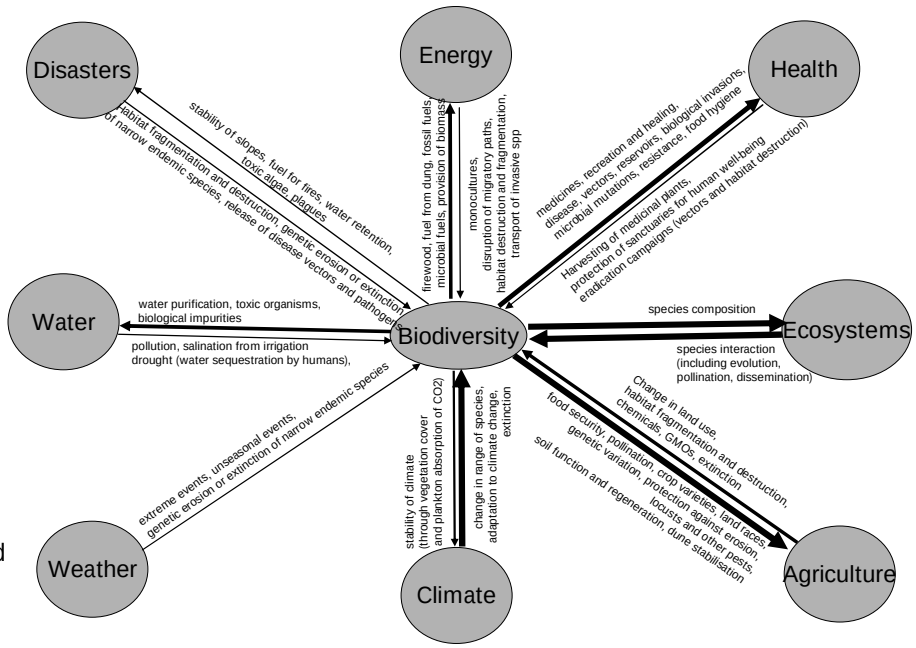

Figure 2.1
Biodiversity Linkages (provided by Gladys Cotter, U.S. Geological Survey. Developed by Martin Sharman)

GBIF's focus in the longer term beyond the scientific research community is on providing data that are relevant to policymakers, educators, and the general public. These broader objectives are certainly appropriate — though more difficult to achieve in practice — and could eventually exceed what many other "mega-science" projects are able to achieve.

In our view, an essential applications link that GBIF needs to cultivate is in the area of environmental and biodiversity conservation policy, from the local to the global levels. As the Secretariat has noted, policy makers want rapid identification and information about the control of invasive species, or the ability to understand effects of ecological change on, for example, species distribution. Natural resource managers need a better analysis of areas most suitable for parks and wildlife reserves. Conservationists require

current species occurrence data, correlation of species occurrence with ecological parameters, and potential localities for species believed to be rare.

The data made available by GBIF are expected to eventually help support such environmental applications. They also will form a foundation for measuring achievement of the goal of reducing the rate of biodiversity loss by 2010, as called for by the World Summit on Sustainable Development, as well as serve the goals of the Convention on Biological Diversity and related international initiatives such as the Global Invasive Species Programme, the Global Strategy for Plant Conservation, and others. GBIF's organizational links to these initiatives and to other environmental and biodiversity conventions may be expected eventually to make it an indispensable information resource for them.

Another example of the broad applicability of data served through GBIF's portal cited by the Secretariat are the global "authority files" for scientific names that facilitates Web searches, and that will serve science and applications in a number of other ways (such as providing taxonomies for GenBank). One of GBIF's major data providers, FishBase, demonstrates what can be achieved when such an "authority file" is in place. Initiated years ago to serve the fishing industry and fishing regulatory agencies, the vast majority of user "hits" received by FishBase now come from other sectors (education, the general public, etc.).

While some of these broader applications, such as the ones connected with FishBase, are already possible, many of the broader policy and educational applications suggested by the Secretariat above are still at least a few years away from being realizsed. Many of the Governing Board and independent expert respondents found the applications of GBIF data beyond basic science objectives to be the most difficult to implement, and these views are discussed in detail in chapter 4. As one basic limitation, the current lack of geo-referencing and longitudinal time series make many research and applications objectives impossible. In short, GBIF still needs to do a great deal of work to realize its more ambitious vision of a broad array of applications.

2.2.6 Inherent characteristics as a public research infrastructure initiative

One attribute shared by all mega-science projects is their public, non-commercial nature that makes them fully appropriate to support on a cooperative international basis through government funding. These types of projects typically support fundamental, exploratory research that does not have immediate, commercial applications.

In this context, perhaps the most important characteristic in terms of GBIF's potential results in both science and the broader applications is its policy of free and open availability of the data through its portal (see the next section on Data Policy). By providing data resources at no cost and with as few restrictions on reuse as possible to millions of potential users worldwide,

GBIF will enable myriad unpredictable, serendipitous discoveries and results that could not be achieved if the data were kept hidden from view, or made difficult to access or unaffordable. Placing the data freely online allows instantaneous cross-referencing, improvements in existing data, identification of unknown specimens in many places, stimulation of international cooperation and interdisciplinary research, and a general enrichment of the global knowledge base in this important area. This public aspect of the endeavor is not only a strong attribute of its potential success as a mega-science infrastructure project, but holds the promise of reaping great dividends beyond even those initially conceived.

2.2.7 Conclusions

In our view, GBIF represents an essential step forward in global systematics and related biodiversity and ecological research and applications. If it did not exist, it would need to be created. Whether it has already achieved "mega-science" status or will someday is perhaps a less relevant question than whether it should exist and continue, to which the answer is clearly "yes."

Based on the six main criteria that we have selected for analyzing whether GBIF has made "sufficient and appropriate progress toward getting established as a mega-science undertaking," we have made the following conclusions:

- GBIF has made sufficient and appropriate progress toward getting established as a mega-science undertaking in terms of the numbers and distribution of participants and with regard to its core facility in Copenhagen, but has achieved uneven progress in the distributed facilities of its Participants.
- The level of funding is the area in which GBIF has had the greatest difficulties in establishing its mega-science status, and falls short of what is needed even if all the in-country contributions of its Participants are taken into account.
- GBIF is a complex undertaking from many perspectives—organizational, political, technical, scientific, or other applications—consistent with other similar mega-science endeavors.
- GBIF has not yet achieved a level of scientific importance and relevance of a mega-science undertaking, but it has made more than sufficient and appropriate progress toward those goals, consistent with its length of operation and level of funding.
- GBIF has not yet made sufficient and appropriate progress in its importance and relevance to other significant social objectives for supporting policy making, education and general public uses, with most of its progress being in the identification of future objectives rather than in actually implementing them as of this early date.
- GBIF is a public mega-science infrastructure project that has made important progress in promoting public access to biodiversity data.

In summary, GBIF has made sufficient and appropriate progress toward getting established as a mega-science undertaking according to all our criteria, except in its level of funding and in its current importance and relevance to other significant social objectives.

2.2.8 Recommendation

Because GBIF is a mega-science undertaking that will provide an essential informatics infrastructure for future biodiversity research and applications activities worldwide, we recommend that it be fully supported and continue, with due regard to those areas identified as needing more attention.

2.3 Data Policy

2.3.1 Introduction

As noted at the beginning of this chapter, the primary question under GBIF's data policy activities is "whether GBIF has made sufficient and appropriate progress toward…making scientific biodiversity data freely and openly available over the Internet?" A related, subsidiary question regarding intellectual property rights (IPR) issues is:

> *i. IPR: has GBIF developed sufficient and appropriate ways to deal with IPR, access, and benefit sharing issues?*

We address these questions by focusing first on the GBIF policy of free and open online access together with IPR issues, and second on benefit sharing, which helps stimulate open access.

The analysis in this section is based on the Secretariat's self-assessment, the responses to the Governing Board and experts questionnaires, the results of a March 2004 IPR Experts workshop organized by GBIF, and other research performed by the Review Committee.

2.3.2 The Status of GBIF's Progress toward Making Scientific Biodiversity Data Freely and Openly Available on the Internet

GBIF's IPR-related considerations are covered under Paragraph 8 of its MoU. This paragraph, reproduced in Box 2.1 below, establishes the framework under which GBIF must operate.

Paragraph 8. Intellectual Property

1. Applicable Law
   Nothing in this MOU should be read to alter the scope and application of Intellectual Property Rights and benefit sharing agreements as determined under relevant laws, regulations and international agreements of the Participants.

2. Access to Data
   To the greatest extent possible, GBIF is foreseen as an open-access facility. All users, whether GBIF Participants or others, ought to have equal access to data in databases affiliated with or developed by GBIF.
3. Intellectual Property Rights to Biodiversity Data
   GBIF should encourage the free dissemination of biodiversity data and, in particular:
   a. should not assert any Intellectual Property Rights in the data in databases that are developed by other organizations and that subsequently become affiliated to GBIF;
   b. should seek, to the greatest extent possible, to place in the public domain any data commissioned, created or developed directly by GBIF; and
   c. should respect conditions set by data providers that affiliate their databases to GBIF.

   When establishing affiliations or linkages with other databases, GBIF should seek to ensure that the data so made available will, in effect, be in the public domain, and will not be subject to limitations on its further non-commercial use and dissemination, apart from due attribution.
4. Attribution
   GBIF should seek to ensure that the source of data is acknowledged and should request that such attribution be maintained in any subsequent use of the data.
5. Access to Specific Data
   Nothing in this MOU should be read to restrict the right of owners of databases affiliated with GBIF to block access to any data.
6. Validity of Data
   It should be a condition of access to and use of GBIF that users acknowledge that the validity of the data in any databases affiliated with GBIF cannot be assured. GBIF should disclaim responsibility for the accuracy and reliability of the data as well as for the suitability of its application for any particular purpose.
7. Legitimacy of Data Collection
   Where the collection of new data has entailed access to biodiversity resources, GBIF should ask for reasonable assurances from the data holder that such access was consistent with applicable laws, regulations and any relevant requirements for prior informed consent.
8. Intellectual Property Rights to Biodiversity Tools
   GBIF may claim appropriate Intellectual Property Rights available within applicable national jurisdictions over any tools, such as search engines or other software products, that are developed by GBIF while carrying out the GBIF Work Programme.
9. Technology Transfer
   The Participants acknowledge that, subject to any relevant Intellectual Property Rights, GBIF should seek to promote the non-exclusive transfer to research institutions in developing countries of such informatics technology as it has available, especially in conjunction with training and capacity development programs.

Table 2.1
Section on IRP from MoU

As noted in a report by Manuel Ruiz Muller "An analysis of the implications of intellectual property rights on the Global Biodiversity Information Facility" (February 2004), that was commissioned by GBIF, IPR issues are complex and a source of great concern in many parts of the world. There are significant differences in legislative and regulatory approaches in different jurisdictions that can lead to confusion and even legal conflicts regarding the use of data and other information products

accessed through GBIF. Moreover, IPR in the context of data and databases constitutes a new and emerging field of law and regulation. New concepts are being developed and previous assumptions and norms are being changed. Although a discussion of these differences and changes is beyond the scope of our review, GBIF needs to address the various IPR and data policy issues seriously, and in an open and transparent way, to ensure the long-term success of the facility.

GBIF has in fact made some important progress in this area, especially over the past year. It initiated a wide consultation process on its data access and data use agreements and presented version 12 for final approval at the Governing Board (GB) 9 meeting. Interim versions were available online prior to their adoption by the Governing Board. In addition, GBIF commissioned the background document on IPRs by Ruiz, and convened an experts meeting in Madrid in March 2004. A detailed presentation on the results of that meeting and on GBIF's data policy and related IPR issues was provided at GB 9 by the OCB Programme Officer.

Nevertheless, there is a general lack of understanding of IPR issues as they relate to data, leading to confusion, not only by the broader scientific community, but even by the Governing Board members and participating organizations. Many Governing Board and expert respondents to our questionnaire said they did not know enough to respond fully, or they noted that the lack of knowledge was a problem generally. Even the Secretariat lacks a deep understanding of the legal issues underlying its data policy, especially across the many jurisdictions of its Participants and data providers. It also should be noted that a majority of the Participants in the Madrid meeting of experts were not experts in IPR and data policy issues, but were themselves seeking a better understanding and guidance on this topic.

Despite the apparent lack of expertise by many representatives affiliated with GBIF, the organization's open access policy was strongly supported by almost all Governing Board and independent expert respondents. Most scientists seek out open sources for primary data and try to avoid services where access is restricted or based on payment of a fee. This is especially true for users in developing countries, for whom any access fee can pose an insurmountable barrier. The GBIF policy follows the original OECD recommendation, and also is compatible with article 8(j) of the CBD. The analogy to the policy for basic genomic data in GenBank (i.e., the Bermuda Principles) is appropriate. As noted in section 2.2.6, GBIF's policy also is very important as leading by example and for promoting OA to publicly funded data globally. The free and open data policy has many benefits for scientific collaboration and synergies, as well as myriad other potential applications as the databases it serves become more robust.

One implication of GBIF's data policy is that the public sector has a special responsibility to make data available openly and freely. This further implies that it is the responsibility of governments to adequately fund these activities to fulfil the free and open data requirement, although this is far from being actually realized.

Some Governing Board members are absolutist about the free and open policy in that they believe everyone must follow this model for all types of users, while a few believe only not-for profit users should have free access. No one believes that GBIF would succeed with a closed and proprietary approach, however. GBIF thus needs to maintain and promote its established free and open policy, but also actively deal with the problems that may arise.

Of course, the data are not "free" in the sense that they cost money to produce. Hence, the question is, who pays? Because of the basic and primary nature of the data that GBIF wishes to make available, the data essentially are outside the market economy, with a user base primarily consisting of public-sector scientists, other public-interest users, and students. This makes it all but impossible to recoup even a small percentage of the providers' costs in making the data available online. Their rewards, therefore, are based primarily on non-economic incentives such as individual and institutional recognition for their contributions to the public good, greater visibility in the biodiversity community, and promotion of related interests.

One concern is that the free and open data policy leads some providers to supply less useful information and withhold information they believe thay can otherwise sell. This is a question of product differentiation and price discrimination. Whereas the primary data may be free, related services or value-added data may be able to be sold. Since the GBIF portal is focused on providing access to the primary biodiversity data, however, such behaviour on the part of the data providers is not necessarily problematic and can be accommodated under the terms of the data policy (MoU Paragraph 8, articles 3(c) and 5). Different models of access may be needed and there are different ways to structure these relationships using more nuanced approaches. Thus, while the default principle of free and open access is correct and must be defended for the primary biodiversity data, the reality may not always match the ideal. An important factor here is for GBIF to exert sufficient quality control and promote quality standards pertaining to the data that are provided freely and openly, and this issue is discussed further in section 3.2 below.

There also are some problems associated with the need to keep certain types of data confidential. One well-recognized concern is not to make data on the location of endangered species available. Data providers can block access to certain fields of their databases and also maintain ownership and control over the content of the data, and hence are responsible for obeying all laws and for any consequential damages that may arise. However, the question of GBIF's complicity in any liability caused by the original data provider remains open and can vary across different jurisdictions.

For observational data gathered by groups of scientists in field work, there may be a need for more attention to the investigators' IPRs or to proper acknowledgement of contributions. Another sensitive issue is data on indigenous plants that may need to be kept proprietary because of a legitimate fear of loss of derivative IPR and commercial benefits. This latter concern is sometimes used spuriously, however, to justify withholding of

information that can otherwise be made openly available without any risk of direct or derivative economic loss. Efforts therefore need to be made to differentiate between that narrow class of data that may legitimately require secrecy and proprietary protection from the vast amount of primary data that do not have such attributes.

Yet another problem that has been identified pertains to the digitization of legacy analog data sets in systematics collections. The original copyright holder cannot always be ascertained and there are concerns of possible infringement if the copyrightable portions of the original data sets are made freely and openly available online without proper attribution.

There also appears to be an unfounded concern that was raised at the March 2004 experts' meeting. Some institutions or organizations that hold large collections from other countries, many of which are historical collections and for which there are no "formal permissions" to make the data available, have expressed a concern that the countries of origin may wish to reclaim the specimens on which the data are based. The study that GBIF commissioned from the Centro de Referência em Informação Ambiental (CRIA) in Brazil on experiences regarding data sharing with countries of origin (i.e., "data repatriation") showed exactly the opposite situation, however. Countries generally were reported to be pleased to receive data and information that come from specimens collected in their home countries and housed in collections overseas. GBIF needs to be proactive in explaining the benefits of its data policy, in educating providers and users of important related legal issues, and in countering unfounded or spurious concerns.

2.3.3 Benefit sharing

Because GBIF operates outside the market economy and neither pays its providers for access nor charges its users, there are no tangible economic benefits to share, either among the Participants or with the providers. Any benefits that might accrue from GBIF's activities are largely non-economic, as has already been noted above, and are best implemented by providing recognition and by promoting other non-economic incentives and values among all the Participants and data providers. The sharing of data has its own rewards.

Under paragraph 8, article 4 of GBIF's MoU, data providers are supposed to get due attribution for their data. The data use and data sharing agreements clearly spell out that the sources of data must get due attribution. Every time data are accessed they are supposed to be accompanied by metadata that describe all the contributions made by the data providers. This is supported by the presumption that greater recognition and attribution means that more sources will be willing to share their data. It also should encourage more quality control by the originally cited source, and allow subsequent user feedback to go back to the source.

Based on the Governing Board responses, everyone believed that acknowledgement of the sources of the data is important and most believed

that GBIF is dealing well with that issue. Some noted problems with proper acknowledgement and GBIF's implementation of this requirement, including the following points:

- The metadata about providers is confusing and there are no agreed standards yet;
- Responsibility for proper attribution lies with the provider and GBIF will not be able to enforce it; and
- Attribution is needed for more than just the institutional data providers and should include those who did the data-related work (to the extent that is either possible or practicable).

However, at least two potential data providers who responded to the questionnaire that was sent to independent experts expressed a reluctance to share data (in these cases, from museums) because they felt that GBIF will get more benefit and recognition than the original providers. As one of them put it:

> *Currently, I fear that GBIF is seen as yet one more external organization asking front-line [data providers] to hand over taxonomic data, without concern as to its validity, accuracy, or provenance. There might, therefore, be a reluctance to participate by some stakeholders.*

Perhaps the problem in which GBIF needs to make the greatest effort is to help guarantee that the proper attribution has not been modified or omitted by the users in any re-use of the data. Acknowledgement currently is based on trust and peer pressure, rather than on legal enforcement, which is expensive and counterproductive. Some users are not honest or do not actually read the data use requirements before "agreeing," or may "agree" without honoring that commitment. One way to help improve compliance and allow return users to be properly identified is to require registration of users and have a login password. Such a mechanism can enhance the usability of the portal, as discussed in chapter 4. However, restricting access or having a login password or identification of the user also could keep many potential users away. Many people refuse to use any site where a login or personal details are required. There are several reasons for this, including fear of getting spam, privacy concerns, and the extra time required to complete such a registration.

Moral suasion and community self-policing may be the best approach in the near term, since additional controls could lead to negative implications and the user community at this point is still quite small. This is the de facto approach being used by GBIF today. However, the Creative Commons organization and its newly formed Science Commons have developed several model licensing provisions that include terms such as "attribution required" that are accompanied by machine readable tags that help to automatically enforce such a provision with each data file.[8] GBIF generally

[8] See: http://www.creativecommons.org

needs to examine in more detail the options it has for improving the implementation and enforcement of its data attribution policy.

2.3.4 Conclusions

We conclude that GBIF's policy of free and open data access, coupled with proper attribution of the source(s), is well justified and should remain the default rule. Its implementation has resulted in "sufficient and appropriate progress toward making biodiversity data freely and openly available on the Internet." This policy is appropriate for a publicly funded network for data outside market forces, it implements the main requirements set out in the MoU, and is essential to GBIF's leadership and long-term success in public science and public-interest applications.

The GBIF policy establishes a positive international policy standard and discourages the development of "isolationist" proprietary and commercial data activities that benefit only those who can or are willing to pay. Instead, it promotes an equitable sharing of the data by not discriminating among users who are unable to afford paid access (e.g., students, people in developing countries). It provides de facto repatriation of the information on specimens collected in developing countries, but curated and stored in museums and other institutions in more developed ones. Finally, the policy is simple and straightforward—getting agreement on this principle itself was a major accomplishment for GBIF.

We also conclude that GBIF is developing "sufficient and appropriate ways of dealing with IPR, access, and benefit sharing issues." However, there are several concerns that need to be highlighted. The GBIF policy of free and open access to the data it serves on the Internet is viewed by some potential data providers and Participants as an entry barrier, although GBIF's overall efforts nonetheless are certain to greatly increase open availability of biodiversity data. There also is insufficient understanding of and expertise about IPR issues among GBIF's Participants and data providers, and to some extent even within the Secretariat itself, potentially undermining the organization's data policy implementation and exposing it to possible disagreements.

Finally, enforcement of GBIF's attribution policy is difficult under its present implementation. Not making the whole chain of data sources, starting from the primary observer, immediately visible is another related concern. If this were done more thoroughly, there could be more participation and less reluctance to share data. More thorough attribution also would be another way to show where the primary responsibility is with data quality, accuracy, and reliability.

2.3.5 Recommendations

1. GBIF needs to be much more proactive about explaining and promoting its data policy to its Participants, data providers, organizational partners, and users. GBIF cannot assume that all, or even most, of its potential data providers subscribe to the free and open access ethic. GBIF also needs to

promote a better understanding of the broader underlying IPR issues and policies among its Participants and users. To do this, GBIF should provide more explanatory information and links to authoritative sources through its Web site and promotional literature, and strongly encourage all the Participant nodes to provide links to such information on their Web sites as well. The GBIF free and open access and proper attribution policy, its rationale, and its implementation requirements also should be emphasized in all GBIF training and outreach activities.

2. In view of the complexity and importance of the underlying IPR issues regarding its free and open data access policy, including potential liability concerns, GBIF needs to outsource some of its legal work to external legal experts. Also in the near term, a small pro bono legal advisory committee consisting of several government and academic lawyers should be convened for a limited time to provide a sound basis for GBIF staff and Governing Board members to understand their options, and to make better informed decisions about implementing GBIF's data policy and in concluding agreements with its data providers.

3. To more fully and fairly implement its attribution policy and encourage the equitable sharing of the benefits from participation in its portal, GBIF should promote greater recognition of its data providers and their original data sources.

3. Scientific and Technical Implementation

3.1 Introduction

In determining the status of GBIF as a mega-science undertaking, it is essential to assess GBIF's progress in the implementation of its scientific and technical (S&T) activities. GBIF performs its major S&T functions through its four current Work Programme components: Data Access and Database Interoperability (DADI), Digitization of Natural History Collection Data (DIGIT), Electronic Catalogue of Names of Known Organisms (ECAT), and Outreach and Capacity Building (OCB). To these we add the GBIF Nodes activities, and the Information and Communication Technology (ICT) activity, the major network technology component.

The GBIF Statement of Task asked the following more specific questions about the Work Programme:

> *(a) Work Programme: is GBIF making sufficient and appropriate progress in carrying out each of the components of the Work Programme?*

In reviewing the Work Programme we used the following sources: the Secretariat's self assessment and the staff's responses to our additional specific inquiries; the answers we received from the Governing Board representatives and independent experts to our questionnaires; our extensive interviews with the chairs and members of the various Scientific Subcommittees that advise on the Programme components, as well as with the responsible staff, node managers, and Governing Board representatives; site visits to the GBIF facility and to several nodes; a review of the various GBIF planning documents and reports pertaining to each major component of the Work Programme; and the results of other research.

In the next section we present a number of overarching considerations that cut across the entire Work Programme. The current four Work Programme components are discussed in sections 3.3-3.6 below. The GBIF node activities are reviewed in section 3.7, and the ICT activity is discussed in section 3.8.

It should be noted at the outset that assessment of GBIF's progress on the specific components of the Work Programme was beyond the scope and capability of this review. There were too many individual actions and projects to consider, and the Review Committee did not have sufficient resources or expertise to review all of them individually. Our assessment therefore focused on the broader goals and functions established for each major component of the Work Programme, using examples of specific actions that demonstrated either significant accomplishments or a notable lack of progress.

3.2 Overarching Considerations

Although the Review Committee was asked to assess progress on each of the components of the Work Programme individually, they also need to be seen as an integrated whole in support of GBIF's goals. As the overall 2005 GBIF Work Programme in Appendix E indicates, the individual Programme Officers are assigned primary responsibilities and budgets for specific tasks, but in many cases one or more of the other Programmes is expected to contribute to any given task. The separate Programme components thus form an integrated Work Programme and are managed by the Secretariat and Governing Board.

The Programmes also are all guided by their respective Scientific Subcommittees of the GBIF Science Committee. These Subcommittees are advisory bodies composed of experts from the GBIF community who provide high-level advice to the Programme Officer and the broader Secretariat on the development and implementation of the Work Programme and the individual programme elements. The Subcommittees are tasked with contributing to the setting of longer-term strategic directions for their programme area and to make recommendations for their implementation to the GBIF Science Committee, which establishes the integrated GBIF Work Programme for each year. The Subcommittees, however, are not particularly involved with the actual work in implementing the Work Programme, although many individual committee members are extremely active and supportive of GBIF's work and goals. Nevertheless, most of the tasks within the Work Programme are performed by the Secretariat staff, together with other experts within and outside GBIF on both a paid and volunteer basis.

There are several cross-cutting and overarching issues identified by the Review Committee that affect the Work Programme. These include the lack of sufficient funding to make as rapid progress as desired on all of GBIF's established objectives, the related problem of having only one staff member for each Programme, and the inadequate involvement in many cases by GBIF's Voting Participants and Associate Participants in supporting and implementing GBIF's objectives and Work Programme elements. Also, a

lack of benchmarking in the Work Programme was noted by many Governing Board respondents to our questionnaire. The issue of insufficient funding is addressed in detail in section 5.4. With regard to the other problems identified above we offer the following broad recommendations here. Additional, more specific conclusions and targeted recommendations in these areas are presented in subsequent sections of this report, as appropriate.

3.2.1 Recommendations

1. Each Work Programme component depends almost entirely on the work of one key staff member, potentially exposing the organization to damaging disruptions in the event of a sudden departure, or even one with some notice in light of the time needed to train a replacement. The GBIF Secretariat must develop a contingency plan to address those eventualities successfully. GBIF also should examine options for outsourcing certain specialized functions and discrete tasks, and for hiring more staff when additional stable funding becomes available. This issue is also addressed in section 5.5.

2. The GBIF Secretariat and Governing Board need to encourage a much greater level of participation by the immediate and extended GBIF community in the development of its Work Programme components and related objectives. The key factor is to get more skilled individuals working on these tasks and contributing to the development of the necessary global infrastructure, whether these individuals work in the immediate GBIF community, or in related organizations and projects. All the Science Committee and Subcommittee chairs and vice chairs also need to take their GBIF committee commitments seriously.

3. In order to have a more thorough understanding of the progress on various tasks within and across all the Programmes, the GBIF Secretariat, working with its Science Committee and Subcommittees, should develop a comprehensive benchmarking process. There is a greater need to set specific goals and achieve them, using pilot projects to show results. GBIF also should consider adopting an independent periodic review function of each major component of the Work Programme, either using independent consultants as it did with the ICT infrastructure review or using visiting committees of external experts (in addition to the broader 3-year reviews of the entire organization, which are necessarily not sufficiently detailed).

4. Because the overall Work Programme is evolving in its focus and scope, the Secretariat and the Governing Board need to review staff assignments and position descriptions on an annual basis in relation to their portfolio of actual activities.

5. In consultation with GBIF, its Participants should adopt a broad range of incentives (both monetary and professional) and methods for recognition of outstanding contributions (e.g., new prizes at the national and institutional levels) to promote work on GBIF's goals and program objectives.

3.3 The Data Access and Database Interoperability Programme

3.3.1 Introduction

As discussed in the previous chapter, GBIF relies on its Participants' ability and willingness to treat biodiversity data as openly available common goods. The goals of the Data Access and Database Interoperability (DADI) Programme are to help implement that policy through the following activities:

- Facilitate free global access to biodiversity information (addressed in terms of policy in the previous chapter);
- Establish data standards for biodiversity content and its exchange;
- Develop a broad range of well-defined biodiversity data services;
- Create linkages between biological and non-biological information; and
- Enable a global network to accelerate scientific investigations of global biodiversity.

3.3.2 Description of the Status of the DADI Programme by the Secretariat

Developing effective standards for biodiversity data

As the report from the Secretariat noted, GBIF has been developing a variety of software and metadata standards, with a view to being able to integrate biodiversity data globally. For example, GBIF through DADI has adopted the DiGIR-Darwin Core and BioCASe-ABCD schema standards for specimen observation data and has assisted many institutions with getting started with these standards. Working together, DADI and ICT have also contributed to development of software tools which have accelerated take-up of these standards (e.g., the Zope Repository tool, packaged DiGIR provider software, UDDI registration tools, DiGIR and BioCASe client software, BioCASe configuration software). In using these standards, GBIF Participants, the DADI Programme Officer and the ICT staff have tested the tools in many different environments and have provided feedback. The details of the standards have been widely discussed and GBIF has contributed to the evolution of improved versions. The DADI Programme is currently funding activity to merge the DiGIR and BioCASe protocols so that there is a single effective standard for data access in this area.

At a higher level, GBIF has started to investigate developing a central registry of data models and schemas, which could be used to automate transformations between different schemas and different versions of the same schema. GBIF has collaborated with the Taxonomic Database Working Group (TDWG), SEEK, Species 2000 and others to start work on a new data standard for the exchange of taxonomic name and concept data (with joint funding by GBIF and SEEK). This has led to the re-use of elements from the ABCD schema in the taxonomic name/concept work, and to concepts developed through work on Structured Descriptive Data (SDD)

in ABCD. A new initiative to standardize metadata and high-level structure across all of these biodiversity standards is in progress (Unified Biosciences Information Framework - UBIF). Early reviews indicate that the proposed model for names and concepts is suitable for exchange of a wide range of different classes of taxon data. This was presented to TDWG in October 2004, leading to a set of suggestions (currently being addressed by the TDWG Taxonomic Names subgroup), and GBIF expects to start using the standard during 2005. GBIF intends to use this standard to build a federated network of name and concept resources parallel to the existing network of specimen and observation resources.

Another major issue of standardization is quality assurance and quality control and how data presentation and organization problems are followed up by GBIF with its data providers. The gbif.net data portal includes links to allow users to provide feedback on data. In all cases these messages are forwarded to the data owners (and in a number of cases have led quickly to changes to fix real problems). The Secretariat also receives copies of any feedback messages so the DADI Programme Officer is able to handle any that represent problems in GBIF's software, rather than in the actual data. Many institutions do not wish to attempt to maintain their data to use the very latest taxonomy for every group and in most cases do not have the staff to support such activity. As GBIF gains access to more structured data on the taxonomy (and particularly synonymies) for different groups, the data portal will be able to serve as the integration layer to manage the presence of these obsolete names. Wherever GBIF knows of synonyms, the organization can present information shared under each synonym with the data shared under the accepted name. As GBIF develops XML Web services, users will be able to choose whether or not to make use of known synonyms when issuing queries.

According to the GBIF Executive Secretary, erroneous data fall into three categories: (1) demonstrably wrong data that need to be corrected as quickly as possible; (2) obsolete taxa or locality descriptions that are no longer valid or are suspect, which can be addressed by improving search mechanisms that will be developed by the DADI and ECAT Programmes; and (3) data issues that are the subject of genuine scientific disagreement, that will take time to resolve within the systematics community.

Because the GBIF Secretariat is not maintaining any of the data itself it is unable to delete erroneous or duplicate data itself. Moreover, the ownership and responsibility for the data reside with the data providers themselves. If the Secretariat were to try to delete duplicate or erroneous records, this would rapidly become a completely un-scalable solution and would force GBIF to make judgments that only the original data providers are qualified to make. Feedback can be provided on any data record and this is provided to the data owner. In many cases this has led to immediate changes.

Experts on taxa can help to correct errors in taxonomy or identification of specimens found via GBIF by using the Feedback buttons that occur on the portal next to each item that might need such feedback. As of this point, the GBIF network must depend on the scientific community for this help; the

task of making corrections rests with the data providers (a major GBIF principle), and those providers will always need such help.

The DADI Programme Officer also has been canvassing opinion on a number of different issues about the presentation of the data through the portal. The main issue is with the way that GBIF presents non-authoritative taxonomic names. Users currently browsing the taxonomy are shown all names that GBIF has obtained from any of its providers, whether these have been presented as currently accepted names, or as (non-accepted) synonyms, or simply as names that are otherwise unknown, but are attached to specimen records. The interface indicates the status of these names, but lists them all together. GBIF will soon be taking the important step of splitting these out in the presentation, so that known accepted names are presented clearly, with names of the other two classes listed but kept separate.

Until recently, GBIF had no software developers (other than the DADI programme officer) working on the portal software. There now are two programmers on contract and they have already been making some essential changes to the code (to support reporting of data usage and to fix miscellaneous small problems) and are working on some key enhancements (fully automating the indexing process, redeveloping some of the components to allow the portal software to be re-used in other portals and shadow installations, and implementing XML interfaces for applications and portals to access the data). They will also carry out improvements to the data presentation.

Developing relations to software providers in order to create the right supply of software tools is another activity in this area. The DADI and ICT Programmes pursue such connections. They have already established contracts with three organizations to extend various components of the data and communications portals, as well as to the nodes toolkit.

Developing a broad range of well-defined biodiversity data services

According to the Secretariat, the fundamental architecture for the GBIF network has been defined and accepted by the GBIF participants. It apparently has been viewed favorably wherever it has been fully explained, removing negative preconceptions. This was the major achievement of the DADI Programme in 2003, according to the DADI Programme Officer.

The GBIF architecture calls for two levels of services. First, there are the primary data resources that are the basis for all of the rest of GBIF's work. This area is reported to be progressing well with many specimen and observation data sets, and with various taxonomic name and concept data sets ready to be integrated as soon as the standards and software are complete. More work is needed to improve the interfaces and searchability of these data, but the Secretariat believes that the overall progress has been very encouraging.

Second, there are services that are based on the primary resources. The most important of these will be those that provide access to a central database of metadata describing all of the other resources and to a central index of data throughout the network. The foundations for these services were laid in the

first half of 2004 with the development of indexing software at the GBIF Secretariat to manage the central information stores. Web services based on these resources (along with client software to access them) will be developed by early 2005. In addition, GBIF Participants have started the development of additional secondary services, in particular mapping services (available from the Belgian and Canadian GBIF nodes).

The DADI Programme is also a little behind plan in offering XML Web services for applications and portals to access data from the central index. During 2005 this is expected to lead to greatly increased use and visibility for GBIF data. As a result, GBIF enters 2005 with solid foundations in both of its key focus areas (specimens and names), and will be able to expand the same models to other areas and focus on wider linkages, especially to molecular and ecological data sets.

Creating linkages between biological and non-biological data information

Up to this point, almost all effort has been directed towards establishing the basic architecture and essential services based on core biological data. Wider linkages will follow in the next few years. According to the Secretariat, the DADI Programme has made initial contact with the GIS community. The issues associated with this integration and broadening of contacts to other organizations and user groups is discussed in more detail in chapter 4.

Establishing a global network to accelerate scientific investigations of global biodiversity

GBIF considers this to be the key area of success for GBIF so far. The range of data providers is already expanding to provide a very significant pool of records. GBIF Participants have added millions of records in 2004. Although the coverage is still highly variable and patchy at the continental level, several data sets have already been identified as suitable for scientific analysis. The DADI Programme Officer noted that GBIF has received several requests for access to data for large-scale analyses. These include a large international proposal to NSF to build a model and tools for assessment of species diversity and biogeographic analysis, and a Danish project to compare coral-reef biodiversity data with latitudinal gradients to assess the regional- and global-scale controls on reef biodiversity.

3.3.3 Assessment of Progress by the DADI Programme

A key strength of the DADI Programme is in being able to bring different projects to work together under a neutral international umbrella. GBIF has earned the acceptance throughout the systematics community to make this collaboration feasible even with the limited budget and staff available.

The Governing Board representatives generally expressed very strong support for the DADI staff capabilities and accomplishments. With regard to standards development, they believe that GBIF has identified and endorsed de facto standards and that GBIF Participants have begun to adopt these standards. Governing Board respondents made comments such as GBIF has the "ability to foster global acceptance of standards and functions." Working with TDWG is viewed as "reducing redundancy of implementation" of standards. The collaboration with TDWG has widely been viewed as a success.

Originally, just DiGIR and Darwin Core were to be supported, but in a very short time DADI also supported the BioCASe protocol and ABCD Schema. The ability to operate with both BioCASe/ABCD and DiGIR/Darwin Core is an important achievement and a great strength for future development. The customized mapping between Darwin Core and ABCD has been necessary. The schemas are now flexible and can meet both the need of those nodes that demand a simple and effective tool, and those that need a more advanced and complex tool, or both. A drawback of this approach, however, is that GBIF now has to maintain the interface between the two schemas itself unless GBIF can get other parties to take over this responsibility.

The open-source software environment that GBIF uses is endorsed by the scientific community and is consistent with GBIF's open access philosophy and public research infrastructure status, as discussed in chapter 2.

The architectural framework and vision adopted by GBIF is proving to be highly acceptable to a very wide range of organizations and individuals, and is itself serving as a motivation to data owners to join in to share data at a global level.

These results could not be achieved without an extremely skilled and energetic team and key personnel who are the real factors behind the success of DADI. The DADI Programme is fortunate to have access to many skilled individuals who have already been working in core areas of biodiversity informatics and whose projects contribute directly to GBIF's goals. It has been encouraging to find a broad readiness to collaborate in moving disparate solutions to become shared standards. At the same time, the future success and continuity of the DADI Programme is vulnerable because of the thin organization in the Secretariat and the lack of adequate funding, as noted above, but is more acute in the DADI Programme than in most others (with the possible exception of OCB, as discussed below).

Another issue of great concern to the Review Committee is that the data quality on gbif.net is very uneven. GBIF is dependent on the data that it retrieves from providers and it is their responsibility to provide high data quality. Also, the different types of users are not all able to validate, interpret, and distinguish between good and poor data quality. One problem is that the complexity of the network will result in data redundancy. The different classes of users should be aware of the mixed quality of data and what the procedures are to verify data (e.g., for decision making purposes). Another problem is that there is no assurance that the primary data providers will correct or delete the erroneous data. The quality of the data served through the GBIF portal will determine the credibility and acceptance of the organization by its user community.

Finally, according to the DADI Programme Officer, there is some danger of "scope creeping" within DADI, which is mostly due to the fact that all the Secretariat staff are overburdened. The DADI Programme interlinks with most areas of GBIF activity, especially the DIGIT and ECAT Programmes, and is responsible for initial development of software to be deployed by ICT. It is also the Programme with responsibility for considering technical

issues relating to SpeciesBank and molecular and ecological linkages. Because of the breadth of these activities, they have not all been able to receive as much attention as they might deserve. Moreover, the DADI Subcommittee is drawn from the most active members of the wider biodiversity informatics community and all of its members are already very busy with their projects. Many of these are projects that will contribute directly to GBIF and its goals, but it does mean that the Subcommittee is also unable to give adequate attention to all of the areas listed above. The result is that the DADI Programme is both a key facilitator and a potential bottle-neck for the implementation of the GBIF vision.

3.3.4 Conclusions

The DADI Programme has made sufficient and appropriate progress in most of the areas under its purview. Indeed, it has achieved remarkable results in light of the fact that almost all of this work was done by the DADI Programme Officer. The Programme has been especially successful in establishing the GBIF portal in 2004 and in developing effective software and metadata standards that have become broadly accepted within the GBIF community and beyond. The DADI Programme also has made some progress in biodiversity data services. Practically no effort has been devoted at this point to creating linkages between biodiversity and non-biodiversity information, although this reflects an entirely appropriate prioritization of tasks within the Programme.

3.3.5 Recommendations

1. As part of GBIF's overall portal tool development efforts, the DADI Programme should develop: data cleansing tools; software migration/upgrading tools; Web services for providers to connect in a standard way; and an integrated data presentation/visualisation layer for the portal to show the value of the data better.

2. The DADI Programme, working with the nodes and other data providers, should develop and implement comprehensive quality assurance and quality control guidelines, as well as improved error correction procedures.

3. The Participants in GBIF should more actively promote efforts within their own countries to work with the global community to develop semantic ontologies for Web searching that allow "cross-walking" among databases developed by different types of scientific investigation (e.g., DNA sequencing or ecological monitoring).

3.4 The Digitisation of Natural History Collection Data Programme

3.4.1 Introduction

The overall goal of the Digitisation of Natural History Collection Data (DIGIT) Programme is to "facilitate the digitisation of the estimated 1.5 billion specimens found in the world's natural history collections and through the use of interoperable standards make both these specimen databases and other species level observational databases publicly accessible through the GBIF network. Making this digitised data globally available will open up totally new opportunities for scientific analysis and provide new sources of data for decision making purposes." Because GBIF's resources to fund such digitization efforts are extremely limited, the GBIF activities in this area have focused on aspects of the digitization effort "that will stimulate the development of partnerships and networking among natural history institutions, particularly at the international level, the development of significant data sets that can be used in support of global initiatives, and aspects of international training and capacity building."

3.4.2 Description of the Status of the DIGIT Programme by the Secretariat

The most significant source of historical data documenting the distribution of life on earth is the cumulative holdings of the world's natural history collections. Unfortunately, few of these collections are digitized. Globally, there currently is very limited support targeted at electronically cataloguing these invaluable resources. This is partly due to the lack of understanding by many curators and their local management of the considerable increase in value that their collections would have if they were electronically catalogued and electronically accessible. This electronic accessibility allows the combining of information from many collections to produce an information resource that far exceeds the value of the information associated with any single collection.

The DIGIT Programme through its seed money awards has begun to make a significant contribution in getting specific collections to start digitizing their collections, to increase the quality of other data sets through improved quality control and additional geo-referencing, and to make this information electronically accessible. As a result of the 2003 DIGIT Request for Proposals (RFPs), approximately US$710,000 was awarded to 17 projects from around the world. Successful completion of these projects was expected to bring over 1,000,000 specimen records, including over 70,000 digital images of type specimens, online by the end of 2004.

The DIGIT seed money grants have had a significant impact in raising the awareness in the global natural history community of the potential for sharing data as a result of the digitization process. In addition, the seed money awards reportedly have been successful in leveraging additional significant funds for digitization activities. Over the next few years, the data

from these new digitization programs are expected to add significant blocks of content to the GBIF network and fill many current taxonomic and geographic gaps.

Also, in 2003, GBIF contracted with the Library Services department at the American Museum of Natural History to undertake an intensive survey of literature and web-based sources for information that documents the world's natural history collections and to collate this information. Their report, *A Preliminary Worldwide Survey of Systematics Collections Holdings*, is available on the GBIF CIRCA intranet system.[9] An additional $25K has been budgeted for 2005-2006 to expand and refine GBIF's understanding of the global distribution of natural history collection data.

Indeed, the task of digitizing the data about specimens (now estimated to be well over 2 billion specimens) in the world's natural history collections is so challenging and costly that it is essential that a global prioritization plan be developed. This was recognized in the DIGIT Scientific and Technical Advisory Group (STAG) meeting held in Washington in June 2002.[10] The DIGIT STAG recommended a two-tier plan:

- 1) In the short term, GBIF should target rapid projects with a high likelihood of success, i.e., low-hanging fruit. Within this, consideration should be given to quantity (larger is better), and quality (well-curated, recently-revised collections are better than the converse).
- 2) The second tier is a longer-term approach based on a global prioritization plan.

In the first two years of the DIGIT seed money awards, as recommended by the STAG, GBIF generally has been targeting projects that can be rapidly implemented with a high-probability of success with the intent of quickly accessing larger data sets, but as this process moves forward, GBIF plans to develop a more strategic approach. In the 2005-2006 Work Programme, GBIF decided that the priorities for the seed money grants will be developed through a gap analysis of current network content and through stakeholder consultations.

A number of possible approaches to prioritization could be taken. Priority could be based on taxonomic group, geographic area, or current level of digitization. For example, GBIF could expand the global data store for groups such as mammals that currently have extensive coverage for North America as a result of the Mammal Networked Information Service (MaNIS) effort, or it could attempt to fill in gaps for groups where few data records are available.

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[9] See: http://circa.gbif.net/Public/irc/gbif/digit/library?l=/natural_collections&vm=detailed&sb=Title

[10] See: http://circa.gbif.net/Public/irc/gbif/digit/library?l=/meetings/digit_stag_meeting&vm=detailed&sb=Title

The 2002 DIGIT STAG suggested that factors such as economic impact, active curators/quality of data, current level of digitization, availability of world checklists, potential for capacity building, potential for leveraging additional funding, potential for networking or leveraging other kinds of additional resources and cost per specimen all be considered in the prioritization exercise.

It must be recognized, however, that institutions and individual curators will have their own priorities and it is unlikely that the GBIF priorities will have a large global impact unless significant resources can be made available either through GBIF or from other sources to promote the digitization efforts in priority areas.

In addition to the increased digitization activities at the institutional and national levels, the DIGIT Programme has been encouraging the development of international partnerships between institutions. This was one of the areas of emphasis of the DIGIT 2004 RFP and is beginning to demonstrate not only the potential for effectively repatriating information to countries of origin, but also demonstrating the scientific value of electronically sharing large-scale, specimen-based data sets covering broad temporal and spatial extents.

In addition to data sets based on records of vouchered specimens in natural history collections, the DIGIT Programme is also encouraging the developers of non-vouchered data sets based on observational records to contribute their data to the GBIF network. Currently about 40% of the records in the GBIF network are based on observational data. Traditionally, the natural history collections community and the communities that collect and maintain observational data have seldom worked together to share information on species occurrences. One of the significant goals of the GBIF network is to promote the integration of data from these two sources.

However, the most significant achievement of the program has not been from the distribution of this relatively limited funding, but is the increased recognition of the value of digitizing and sharing natural history collection information that has resulted from the promotion of the DIGIT Programme, the existence and advertising of the DIGIT seed money competition, and the development of the GBIF portal for sharing specimen-based information. All of these activities have helped raise the awareness of curators, institutional managers and governments of the need to support digitization and of the benefits of networking collections information. For the first time in history, there is an opportunity for institutions to participate in sharing their information holdings using technologies that start to give some insight into the tremendous value of the combined institutional resources. GBIF is beginning to see significant institutional and national level investments in digitization that are in part the result of the GBIF process. For example, the recent investment of the Netherlands of €2.35 million in digitization activities was based to a large extent on the Netherlands' commitment to GBIF. National networks in Argentina and Austria are also partly the result of the existence of the DIGIT Programme. This leveraging of additional funding for digitization is one of the most significant outcomes of the DIGIT Programme.

Raising awareness of the value of digitization and the resulting increase in funding in this area will take time. The major challenge that GBIF faces in this regard is how to increase the rate while maintaining or increasing data quality. Currently, the digitization process is extremely slow and labour intensive. How can the process be industrialized in the most cost effective manner? GBIF is now beginning to help raise the global awareness of the value of digitization; the next step is to increase the efficiency of the process.

By addressing the issues of data quality and documenting the broad potential for the use of primary biodiversity data, it should be clear not only to data custodians but to funding agencies in general that it is in their best interests to insure the long-term sustainability of these data stores. Since any single data collection only has a small portion of the data required to address broad issues in biodiversity science, the real value is in the combined resources of all the data stores. As the value of these combined resources is demonstrated through increased use, the arguments for long-term sustainability will be strengthened. In addition, GBIF has identified in the 2005-2006 Work Programme for both DIGIT and ECAT an activity to investigate methods to ensure long-term availability of data sets, including business models to support extended life of databases and encouragement of academic recognition for publication of taxonomic data.

Finally, the first version of the DIGIT 'Best Practices Handbook' will be available in early 2005. Chapters on 'Data Quality', 'Approaches to Data Cleaning' and 'Uses of GBIF Data' are currently under review. In addition, the 'Review of Digitization Software'[11] that was commissioned in 2003 will be updated. However, since the DIGIT 'Best Practices Handbook' is intended to document the current state of the art approaches to digitization, it is not viewed as a static product but as a dynamic one that will be continually updated as technologies and new procedures are developed.

3.4.3 Conclusions

The DIGIT Programme is making tangible progress on the daunting challenge of supporting the digitization of the world's legacy analog natural history data holdings. Not only is the scale of this challenge enormous (the number of specimens that require digitization of their data is now estimated to be over two billion), but the work cannot be done centrally by GBIF itself, so there is no direct control by the DIGIT activity over this work. GBIF only has indirect leverage, including especially through its many Participants and nodes, which the DIGIT Programme has sought to exploit in various constructive ways.

When viewed in this broader context, the DIGIT Programme has made sufficient and appropriate progress in stimulating the development of

[11] See: http://circa.gbif.net/Public/irc/gbif/digit/library?l=/digitization_collections&vm=detailed&sb=Title

international partnerships and in the digitization of significant data sets through the use of seed money grants. Less obvious progress has been made on support of training and capacity building in this area.

Nevertheless, the current digitization process continues to be too slow. This is not the fault of the DIGIT Programme per se, but rather endemic in the broader community because of costs and other barriers. Changing the attitude of natural history collections staff and management is a slow process, despite some perceived improvements in recent years. It will take time to see the benefits of this change and there is a threshold level of activity that is necessary before the scientific community will begin to benefit from this change.

The actual scope and nature of the digitization task worldwide remains unclear, affecting the accuracy of the assessment of priorities for what should be digitized, where, when, how, by whom, and why. For example, there is an overall lack of incentives and rewards to the repositories of analog legacy data and to their potential funding sources to undertake the large-scale digitization of those resources. A comprehensive global strategy for making progress on the digitization challenge needs to be developed.

3.4.4 Recommendations

1. In broad consultation with the systematics community and other scientific user groups, GBIF should produce a list of near-term scientific questions that cannot be answered without digitized data (more near term than those listed in the GBIF Strategic Plan, as discussed in section 4.2).

2. The characteristics of the legacy data need to be described more fully so that coherent strategies for digitization can be developed. This cannot be done by GBIF alone, but in cooperation with the global systematics community, and should build on the results of the recent AMNH survey and other efforts. Such characteristics ought to include, among others:

- Amount and extent: What is the size and distribution of legacy data holdings worldwide?
- Structure and organization: How are legacy data organized? What are the difficulties and advantages caused by this organization? What are the differences in accessibility? What are the special issues involved in digitizing the legacy data (e.g., fragile samples that cannot be moved to be photographed)?
- Types of formats: A full description of the types of formats in which legacy data are maintained should be developed by GBIF in collaboration with the institutions that hold these data and with other experts so that the relevant issues concerning the digitization of the different data types can be assessed (e.g., text, numeric, image).
- Local issues: What are the different local conditions that may require specific actions (e.g., languages used in voucher specimens and observational data, or institutional differences in museums, universities, government departments, etc.)?

- Organizational differences: What are the unique issues among different species that must be taken into account in developing a comprehensive global digitizing strategy (e.g., for micro-organisms versus macro-species, among many others).

3. GBIF should continue to work with all its members and with the systematics and broader scientific community to develop a well-justified policy for prioritizing data digitization based on agreed, relevant criteria. Such criteria could be based on the following questions, among others:

- What key scientific questions could be answered if the data were digitized? [see recommendation #1 above]
- What core conservation issues could be addressed?
- What is the economic and non-economic relevance or value of the various taxa and the legacy data about them? For example, data sets selected for digitization should be assessed on their value, not necessarily on their size.
- Are there particularly knowledgeable curators of certain high-value legacy data sets or collections that should be prioritized before the curators retire?

4. New or improved technologies and techniques can be used to speed up and make less expensive the digitization of legacy data. GBIF should work with information management and technology experts to create a set of recommendations for such technologies and approaches for digitization that could be adopted or promoted by the nodes, and especially by other data providers and institutions with legacy data collections. Examples might include robotics, handwriting recognition programs, and high throughput image capture. Although GBIF resources are limited, the formation of strategic partnerships or collaborations with industrial or academic developers of such technologies could be beneficial.

5. The GBIF Secretariat together with the broader GBIF community should develop financial, scientific, and political strategies to provide incentives to GBIF's actual and potential providers to digitize their legacy data.

Financial incentives could include:

- An expansion of seed grants, since the vast scale of the digitization challenge worldwide requires an increase in funding from as many sources as possible; and
- Assistance to legacy data holders in raising local funds for digitization projects, by supporting their proposals to granting agencies and philanthropic organizations at the national and regional levels.

Scientific incentives could involve the highlighting of newly digitized data that demonstrate the relevance of the GBIF project and allow Participants to explore new research programs.

Political incentives would focus on high-value socio-economic applications of digitized legacy data that may be politically attractive (e.g., for conservation or reducing the threats of invasive species).

6. In addition to the incentives suggested in the previous recommendation, GBIF together with the representatives of institutions with legacy data and those who have already digitized their holdings should develop strategies and processes to assist in overcoming operational barriers or constraints in the digitization of biodiversity data. Considerations in this context include the following:

- Identify constraints and opportunities that are faced by developing nations and not by developed nations, and vice versa (e.g., IPR issues, technology access, costs, and funding).
- Physical and human infrastructure, including: donations, pooling, or loaning of equipment that is appropriate for the institution and its workforce; training of existing curators and taxonomists, and improving information management skills in curricula for the next generation; and labor sharing where labor costs are lower, or enlisting the assistance of volunteers from the general public or secondary schools.

3.5 The Electronic Catalogue of Names of Known Organisms Programme

3.5.1 Introduction

The rationale for the Electronic Catalogue of Names of Known Organisms (ECAT) Programme that is given on the gbif.org Web site is that “for the global enhancement of biological research and resource management, a centrally available list of the names applied to the organisms of the Earth is needed. This list, including names, synonymies and classification, will be freely accessible to everybody at any time and should provide the user with reliable data, organized in a structured manner. It will serve as a global resource and with time, is intended to become an authority file for taxonomy. The ECAT will also serve as a reference, to make the integration of specimen-level data in the GBIF Network possible.”

As in the case of the DIGIT Programme, because the resources that GBIF has available to fund taxonomic activities are extremely limited, its activities have been focused on "facilitating taxonomic projects that will develop significant data sets that may be used in support of global initiatives.

3.5.2 Description of the Status of the ECAT Programme by the Secretariat

The indexing of the world’s species will be a major achievement that will benefit all of biological science, as well as natural resource management and

conservation. The general public and education sectors also are expected to be frequent users of such an index.

Unfortunately, agreed-upon lists of all the known animals, plants, bacteria, and fungi used by biologists to count and measure the world's biodiversity do not yet exist. At this time, such lists are found only for a very limited number of biological groups – often the most "popular" or well-studied like birds, butterflies, and flowering plants. GBIF is collaborating with Species 2000 and the Integrated Taxonomic Information System (ITIS) to add a wider range of datasets. Moreover, in these cases there are frequently disagreements among experts as to the actual delimitation of species and their relationships. In principle, a species can have only one scientific name, but in reality many species have multiple names applied to them as they have been described more than once or their definition (circumscription) has been disputed, leading to splitting or lumping of species and causing additional naming confusion.

To solve these disagreements, scientific work is needed and is going on throughout the world, resulting in high-quality revisions of the names and definitions of many groups. According to their coverage, these treatments are known as Global Species Databases (GSDs) or Synonymic Taxonomic Checklists.

The ECAT Programme's purpose is to gather as much scientific opinion on taxonomy as possible and implement and display this in a form that presents all extant, presumably valid, opinions in a clear and useful framework. A working taxonomy that then links or integrates other names in use, but clearly identifies their alternate nature, would be a useful approach. The immediate purpose for GBIF to develop this electronic catalogue is two-fold. First, GBIF needs taxonomies as a back-bone for mediating queries against the GBIF network data; the specimen and observation data as well as external resources like genomic and ecological data are all searchable through species names. In order to produce meaningful answers it is necessary to understand how these names relate to each other. Second, GBIF wants to provide the systematics community and the world at large with a fully indexed taxonomy of all life to serve as a reference and general look-up table.

The main achievement of the ECAT Programme up to this time has been the development of the GBIF Names Service. An initial - very large - data component was provided by forming a Memorandum of Cooperation (MoC) with the Catalogue of Life partnership (CoLp, presently constituted by ITIS and Species 2000). This MoC outlines the conditions under which the data compiled by the member databases of the CoLp is employed in the GBIF Network. The main conditions are that the ownership of the data rests with the original compilers and that due source recognition must be provided when the data are utilized in the GBIF Network. In addition, ECAT has a three-year contract with the CoLp to help speed up the process of getting names data available to GBIF.

Compilation of additional names data resources has been supported through the ECAT Seed Money process. In 2003, 12 taxonomy projects were

supported with seed money awards, and in 2004 the number was 14. Among the 2003 Seed Money recipients, most projects are now ready to provide data to GBIF. However, the actual route for connecting these data in most cases still remains to be sorted out. Some of the projects are already connected to Species 2000 or ITIS in order to provide their data through these organizations. Others are waiting for development of proper direct transfer mechanisms between names data providers and GBIF.

The organizations maintaining the nomenclators (records of changes in naming of organisms – including new names) of all taxonomic groups have been contacted in order to negotiate access to their very valuable data. All organizations were enthusiastic to contribute and the strategizing for the linking up of these data is progressing. Those nomenclators that have their data stored in appropriate databases are very close to getting connected to the GBIF network, and both technical and IPR questions are getting resolved.

ECAT is also collaborating with Species 2000 and the Royal Botanic Gardens, Kew in order to coordinate the development of a comprehensive global checklist of vascular plants, in support of Target 1 of the Convention on Biological Diversity's Global Strategy for Plant Conservation.

These initial achievements have been encouraging to GBIF and its CoLp partners. It probably means that GBIF, in collaboration with its partners, can reach its 2005 goal of having authoritative names for 40% of the world’s known species. Reaching anywhere near completion by 2010 or even 2013 will still need a significant increase in the rate of compilation, however.

In addition to supporting and collaborating with the compilers of names data, the ECAT Programme collaborates with the DADI Programme on bringing forth methods and standards for intelligent transfer and dissemination of taxonomic data. In collaboration with TDWG, a contract has been let to Jessie Kennedy of Napier University to research an advanced, "next generation" XML schema for collecting and exchange of taxonomic data. When properly developed, this schema is expected to be proposed for approval as a standard for exchange of taxonomic data and will be implemented on the GBIF Network. In the near term, CoLp and GBIF are using the SPICE protocol that was developed at the Universities of Cardiff and Reading in the United Kingdom.

The major topics for the ECAT Programme in the fall of 2004 were the enhancement of the GBIF Portal and Name Service to automate exchange of names data and to display the data to a human user in an integrated way. The DADI Programme is also involved in these tasks. Major achievements will be the development of tools enabling data providers to connect their taxonomy data to the GBIF Network, machine access to the Name Service, and analytical and visual tools to handle incongruent taxonomies.

3.5.3 Conclusions

The ECAT Programme is beginning to make sufficient and appropriate progress, largely through the involvement of the CoL partnership to date. The recognition of the work done by systematists by an international organization like GBIF – both through the seed money programme and through the source recognition put in place by the GBIF portal – is leading to a major change in the perception of systematics work. It is becoming increasingly apparent that organizations and individuals are loosening the grip on their data as they experience that data provided to GBIF are credited in a concise way and the ownership of the data also is not changed.

However, taxonomic resources still cannot be linked dynamically to the GBIF network – tools for connecting Global Species Databases and checklists to the portal are still to be developed, although such developments are under way. The Napier Schema, which may become the standard protocol for exchange of names data between institutions and databases, would close a prominent gap in the ability of GBIF to transfer name information between providers and the GBIF portal. The need for such standard and associated tools has stalled GBIF's ability to perform live connections to name data providers, so we urge that their provision be a high priority for the near future. We are aware that such development is proceeding in several venues, and that tools will be shared with GBIF.

It also must be noted that the ECAT Programme drew the most contentious comments from the Governing Board respondents to the questionnaire and in interviews, in particular questioning some of GBIF's earlier relationships with its external partners. A large part of the systematics community seems to have been left out of the ECAT process so far.

Some members of the GBIF community also question the concept of authority files for taxa. The Review Committee concludes that although the use of authority files is necessary, the GBIF system must provide synonyms and alternative classifications. The key point is to maintain adequate flexibility in accommodation of new names and revisions.

3.5.4 Recommendations

1. GBIF needs to be innovative in its own program of work for ECAT and not be constrained by only a few models. For example, it might consider the development of new, situation-specific models. In this regard, the ECAT Programme needs to be in closer touch with the committees on nomenclature of the various biological communities.

2. The ECAT Programme should develop a suitable schema for the delivery of information directly to GBIF by those providers who, for whatever reason, are not using the Catalogue of Life. Such a schema would help make accessible local and regional checklists, many of which are of a high standard and are often associated with digitized information.

3. In its seed-funding activities, the ECAT Programme should develop a stronger linkage to the names provided under the DIGIT Programme so that

the data are maximally useful and cross-references can be made between records of the same species under different names.

4. A more strategic prioritization of name gathering could be advantageous. As in the case of prioritization of efforts in the digitization of legacy analog data, however, due care must be taken to establish well-founded criteria for such prioritization and to consult broadly within the global systematics community.

5. The relationship between the ECAT Programme and the nodes should be strengthened further. ECAT should be more proactive and opportunistic with regard to what is available from the nodes.

6. More attention needs to be devoted to the scientific, technological, and sociological problems when different, but comparable, lists from diverse data sources need to be merged.

3.6 Outreach and Capacity Building Programme

3.6.1 Introduction

The Outreach and Capacity Building (OCB) Programme has two major tasks under it. One is to focus on outreach to various countries and organizations with interests related to GBIF, to users of the portal, to potential new members, and related activities. The issues associated with outreach to users, however, are discussed in response to a separate question from the Content of Review document, while the outreach to potential new GBIF Participants is reviewed in section 5.2 as an integral part of the governance and management issues that are addressed in chapter 5.

The other major function of OCB is to provide capacity building through training, a mentoring program, focused education initiatives, and the management of IPR and GBIF's data policy implementation vis-à-vis GBIF's data providers and users. The IPR and data policy issues are addressed in section 2.3 in response to a separate Content of Review question as well.

As noted by the GBIF Executive Secretary, the GBIF Secretariat staff works as a team to accomplish all the tasks – in terms of reaching out to many different groups of potential users, providers and partners, everyone on the scientific staff has at one time or another made presentations or other kinds of contact. For each activity, though, there is one person who is the lead. In the case of outreach to national governmental agencies, international NGOs, and groups of people associated with international conventions relating to biodiversity, the OCB Programme Officer is the lead. She leads activities relating to attracting the attention of potential GBIF Participants. She also works with the ICT staff to set up training in the use of GBIF software, and in considering questions related to IPR.

In the case of identifying appropriate meetings of scientific societies to attend and appropriate scientific projects with which GBIF could partner, both international and national, and reaching out to those memberships and partners, the Scientific Liaison Officer is the lead. Working with the OCB Programme Officer, she plays a role in attracting the attention of potential GBIF Associate Participants that are organizations. The Scientific Liaison Officer writes promotional materials and drafts documents such as the Strategic Plan. Additional details about these functions are presented in the discussion below.

3.6.2 Description of the Status of Outreach Activities by the Secretariat

The table below outlines GBIF's outreach plan.

Type of External Relation	Advice from	Who leads	Indicators
National governmental agencies (Participants)	OCB's STAG and Science Subcommittee	OCB, with ES, DDM, GBC	Increase in Participation.
International NGOs, and groups of people associated with international conventions (potential Assoc. Participants and partners)	OCB's STAG and Science Subcommittee	OCB with ES, DDM, GBC	Recognition of GBIF as an important contributor to global efforts (e.g. in CBD documents, etc.); increase in Participation
Scientific societies (some are Potential Assoc. Participants and partners)	Science Committee	PR, with ES, DDI, DIGIT, ECAT, DADI	Increase in data providers and records in scientific users of GBIF data, and in Participation
Scientific project partners (e.g. ALTER-net, MARBEF, SynBioSys, SEEK, EBI, NCBI and others)	Science Committee	PR with ES, DDI, ECAT, DADI	Forming of linkages between GBIF data and molecular and ecological data
Data providers	DIGIT Science Subcommittee	DIGIT with PR, ES, DDI, ECAT	Increase in data providers and records
Data providers – training activities	OCB Science Subcommittee	OCB and DDI with SSE	Increase in number of people trained in application of GBIF software
User groups	OCB Science Subcommittee, Science Committee	OCB and PR with ES, DDI, DIGIT, ECAT, DADI	Increase in number of "hits" on the data portal
Funders	Ad Hoc Committee on Fundraising	ES, DDM, OCB, PR	Increase in contributions to the Supplementary Fund

Table 3.1
Plan for outreach

Legend for the "Who leads" column: DADI=DADI Programme Officer; DDI=Deputy Director for Informatics; DDM=Deputy Director for Management; DIGIT=DIGIT Programme Officer; ECAT= ECAT Programme Officer; ES=Executive Secretary; GBC=Governing Board Chair; OCB=OCB Programme Officer; PR=Public Relations Officer; SSE=Senior Software Engineer.

The discussion of GBIF's outreach activities below focuses on: (1) treaty organizations that deal with different aspects of biological diversity; and (2) inter-governmental, non-governmental and other scientific organizations in this subject area. The relations of GBIF with these two sets of organizations are specifically called out in the following two subsidiary questions in the Content of Review document:

> *Has GBIF developed sufficient and appropriate links to the various international conventions dealing with biological diversity?*
>
> *Has GBIF developed sufficient and appropriate links to other intergovernmental, non-governmental and other scientific organizations dealing with biological diversity and informatics (e.g., BIOSIS, IUBS, CODATA)?*

The Review Committee relied in particular on the responses to the expert questionnaires in its assessment of these issues, since the experts were also representatives of many of the key organizations with which GBIF already has some type of relationship. Other important sources of information included the Governing Board member interviews and questionnaires, the Secretariat's self-assessment, and desk research.

Treaty organizations

One of the goals in GBIF's MoU is for GBIF to establish relations with the treaty organizations that focus on issues in biodiversity in order not to duplicate their work. The Secretariat pointed out that it has taken pains not to stray into the territory of such conventions. The Convention on Biological Diversity (CBD) was identified specifically by the GBIF Secretariat as meriting the greatest near-term focus.

In its self-assessment, the GBIF Secretariat stated that it has an excellent relationship with the CBD. GBIF considers all of the international biodiversity conventions relevant because GBIF-supplied primary data will help them to make informed, fact-based decisions. During its initial period of existence, however, GBIF has focused its work around the CBD, because of both GBIF's and CBD's mutually reinforcing mandates. GBIF has emphasized the following CBD activities: the Global Taxonomy Initiative (GTI), the Global Invasive Species Program (GISP), the Global Strategy for Plant Conservation (GSPC), and the the 2010 initiative to reduce the rate of biodiversity loss on the planet. As evidence of its significant involvement with the CBD, the Secretariat noted that the CBD Executive Secretary has invited GBIF to be a member of the Clearing House Mechanism (CHM) Informal Advisory Committee, the GTI Coordination Mechanism, and the GSPC Advisory Committee. The CBD also has invited GBIF to actively participate in the 2010 initiative (and the discussions on indicators).[12] Also, based on GBIF's work with the CBD's Conference of the Parties (COP) and the COP's Subsidiary Body on Scientific, Technical and Technological Advice (SBSTTA), it has been identified by them as a significant

[12] The references to GBIF's participation in the CBD can be found at: www.biodiv.org/decisions/ and www.biodiv/recommendations/.

contributor to the implementation or monitoring of these initiatives.[13] The CBD Secretariat is an *ex officio* member of the GBIF Governing Board and CBD Secretariat staff are members of the OCB Scientific Subcommittee. The CBD thus has recognized the importance of GBIF, and acts as a supporter rather than as a competitor.

GBIF staff noted that GBIF also has placed priority emphasis on the CBD because it is a good way to communicate with governments on biodiversity issues and to attract new national members. The CBD is a magnet for all biodiversity organizations as well, thus helping GBIF's broader outreach goals. CBD thereby helps set the GBIF agenda and provides an important framework for GBIF. At the same time, GBIF will be essential to the success of the CBD.

GBIF staff identified the Convention on International Trade in Endangered Species (CITES) and the Ramsar Convention on Wetlands (Ramsar) as two other biodiversity conventions of potential importance to GBIF. Because CITES is concerned with the very sensitive topic of trade in endangered species, it will require special negotiations to establish an effective relationship. The principals at Ramsar certainly know of GBIF and this is being followed up by both organizations. Each convention has its own processes and issues. The biodiversity treaty regimes are important, but not easy to deal with given the available staff at GBIF.

The Secretariat stated that GBIF's role fits well into assisting the biodiversity conventions (and their Parties) in achieving their goals and supporting their active implementation. The Secretariat also asserted that one of its strengths has been its attention to identifying and publicizing GBIF's role vis à vis these conventions. Its recent decision to develop demonstration projects that can show decision makers how the GBIF data can be used is an example of this. In the case of biodiversity conventions, GBIF is seeking to demonstrate how its work helps to implement the mandates and decisions of the CBD and other conventions, particularly at the national and regional levels.

Inter-governmental, non-governmental, and scientific organizations

In its self-assessment, the Secretariat expressed the view that GBIF is well known by virtually all relevant inter-governmental organizations (IGOs). Not surprisingly, the Secretariat considered the most important organizations to its goals as those focused on biodiversity information. GBIF must tread a careful line, not focusing on biodiversity per se, but on information about biodiversity. It cannot become an all-purpose biodiversity or conservation organization, as then it would start to compete with existing organizations like the World Conservation Union (IUCN). Therefore, GBIF attempts to identify the information-focused components of such organizations and develop connections or even formal agreements with them.

[13] Numerous cites in support of GBIF's involvement in both the COP and SBSTTA initiatives are provided in the Secretariat's self assessment.

The GBIF Secretariat identified organizations working in molecular biology and ecological data at both the inter-governmental and non-governmental levels as essential for partnerships. These types of organizations were chosen because they are active in biological informatics and can benefit from the contributions that GBIF will make to overall interoperability. The links to both the biomolecular and ecological data communities are important for both scientific and credibility reasons. The Review Committee believes in particular that GBIF would benefit substantially if the powerful biomolecular community were to form strong ties with it. As the List of GBIF Participants in Appendix B indicates, several ecological and environmental organizations are already Associate Participants in GBIF, but only one biomolecular organization, Nordic Gene Bank, has joined on a formal basis.

In its self assessment of outreach to non-governmental organizations (NGOs), the Secretariat correctly pointed out that the NGO universe is a huge one. The Secretariat asserted that GBIF is rather well known among science-oriented biodiversity NGOs, and among the larger conservation-oriented NGOs.

Finally, concerning GBIF's relations with scientific organizations, the Secretariat noted that GBIF is becoming increasingly better known in the scientific community, especially by the museum and herbarium sectors. The Secretariat believes that one of GBIF's strengths in this area is its attention to identifying and publicizing GBIF's role through such mechanisms as developing demonstration projects (discussed in chapter 4) that can show decision makers how the GBIF data can be used.

3.6.3 Description of the Status of Capacity Building Activities by the Secretariat

The capacity building activities under the OCB Programme have several components. These include developing and implementing training programs, establishing a mentoring program, and some initiatives focused on education in biodiversity informatics – a GBIF/UNESCO Chairs in Biodiversity Informatics program and a "School of Biodiversity Informatics." According to the OCB Programme Officer, these activities demanded more time than originally planned, mostly due to the fact that GBIF needed to plan and coordinate with many external institutions and people to initiate them.

Developing sufficient training systems

A strategic plan for training was developed and discussed within the Secretariat in early 2004. The OCB Science Subcommittee was asked to provide comments and suggestions and the plan was approved by the Governing Board at its October 2004 meeting.

Up to that point, seven DiGIR training sessions were conducted in English, French, and Spanish. A total of 135 persons coming from 55 countries (including 31 from non-Participant countries) and 13 organizations have been trained. Participants who have attended the DiGIR training sessions

have used those newly acquired skills to upgrade their capabilities within their own national organizations.

Some examples of nationally-driven training activities include:

- The National Biological Information Infrastructure, a GBIF node at the U.S. Geological Survey, has conducted UDDI training for data providers in the USA.
- Canada and the Netherlands have also conducted national DiGIR training activities after attending GBIF training sessions.

Mentoring programme

An important GBIF initiative to leverage resources for capacity building objectives involves encouraging strong nodes to take responsibilities not only for supporting their own countries, but also to get engaged in supporting regional data activities. The idea is to develop the kind of competencies, knowledge, and support that is necessary to maintain and develop nodes and to support data providers. The OCB and the Nodes committees conducted a survey of mentoring services that existing nodes could provide. This was used to develop a call for mentoring projects that was released at the end of 2004. In addition, a similar approach is being considered to establish a program to provide longer-term technical assistance to some nodes in developing countries, taking advantage of information technology experts under the United Nations Information Technology Service (UNITeS) volunteer program.

GBIF's members are connecting national/institutional needs with the transferring of new technologies and building of capacities at the national level. This allows them to fully benefit from these new information technologies and to implement them with little delay, thus making biodiversity data available through the GBIF nodes. In the future, as more members join GBIF, additional demands for such training and capacity building activities may be expected.

Focused educational initiatives

Two educational initiatives are currently being planned. The first is a network of GBIF/UNESCO Chairs in Biodiversity Informatics, the purpose of which is to establish academic positions around the world in the emerging field of biodiversity informatics. The other is a School of Biodiversity Informatics, to develop curricula and courses that will be available around the world. The OCB Programme Officer has not yet had the time to devote to the latter project.

3.6.4 Assessment of the OCB Programme's Progress

Our assessment of GBIF's progress on the various OCB Programme areas is presented below in the same order as described above. We examine first the two outreach activities.

Treaty organizations

In the responses to our questionnaires, almost all Governing Board and independent expert respondents noted that GBIF has been successful at reaching out to the CBD and has established a positive relationship. However, one Voting Participant representative expressed the opinion that

GBIF is "rarely referenced appropriately when mentioned within CBD decisions," which may be an issue for GBIF to follow up.

Nevertheless, based on all the evidence, the Review Committee believes that GBIF has developed sufficient and appropriate links to the CBD and that this relationship has properly been its primary focus in the initial stages of GBIF's evolution. The question remains as to whether GBIF has established sufficient and appropriate links with the various other international conventions dealing with biological diversity?

Practically all responding Governing Board members and experts stated that GBIF should reach out to the other biodiversity treaties as well. The ones most often expressly cited were Ramsar and CITES, consistent with the Secretariat's emphasis. Prioritization of fora and effective use of staff time were the main issues raised. In an ideal world, GBIF would participate in many more meetings and contact a wider range of stakeholders, particularly at the national level.

Some Governing Board members noted that GBIF needs to improve its collaborative work with the other conventions. The conventions are establishing the political frameworks needed to enable conservation and GBIF will provide the basic information needed to support those conservation regimes. The conventions also provide an important set of external policies with regard to data policy and management, as discussed in chapter 2. It is therefore a high priority area for engagement by GBIF, with significant mutual interests and benefits.

Inter-governmental, non-governmental, and scientific organizations

Almost all Governing Board members were positive about GBIF's status of interactions with IGOs and none offered any additional useful comments, either pro or con. The external experts were not asked different questions about GBIF's relations with IGOs, NGOs, and scientific organizations in order to keep the questionnaire relatively shorter. They were asked instead to identify which IGOs, NGOs, and scientific organizations they considered as the most relevant for GBIF to link up with, and to state why. There were no surprises in the potpourri of organizations identified in their responses, and reiterating all of them here would add little value. Several comments, however, were particularly noteworthy. One expert from an NGO noted that:

> *GBIF's long-term survival depends upon the enthusiasm of these [global conservation and environmental] organizations to support GBIF's role as a catalyst in stimulating interest in a concerted international effort to organise and disseminate the world's biodiversity information resources, rather than a regionally based disparate approach.*

Another expert from a university stated that:

> *…[for] organizations that deal with global environmental problems, GBIF should be seen as a key player in these efforts, and not just as an internet-based tool that serves the needs of a relatively narrowly focused community (i.e., taxonomists).*

What both of these thoughtful comments indicate is that GBIF needs to engage with the global environmental and conservation community and its organizations to succeed over the long term.

Finally, one expert from a national botanical garden in a developing country and an officer in a major global scientific conservation program offered a highly complimentary assessment of GBIF as an organization that is highly desirable for forming a partnership:

> *We see, in broad terms, however, that the GBIF has by now succeeded in establishing itself as a (perhaps "the") definitive platform in biodiversity information, with not only tolerance, but also support from a variety of individuals and organizations who/which are frequently highly critical or sceptical of such initiatives. This is an impressive accomplishment, and helped influence [my global program's] decision to collaborate closely with GBIF in the future.*

With regard to GBIF's outreach to NGOs, the Governing Board and expert respondents reinforced the view that the possible number of NGO relationships that GBIF could pursue is huge. Overall, they stated that either GBIF was well-known already or having mixed recognition (e.g., better known by conservation and scientific NGOs than in other areas, more by organizations in developed rather than developing countries). One node manager added that NGOs want to remain "politically independent" and view collaboration that is too close as risking that independence, or in some cases as competition for funding.

According to the Governing Board respondents, GBIF's profile among scientific organizations is medium to high, with a similar distribution as described under the NGOs. One expert, however, noted that "GBIF has no profile in any of the activities relating to the development of spatial data infrastructures" either at the governmental or non-governmental levels in his [developed] country. As we point out in several other places in this report, GBIF will need to make those connections to the geospatial data community and add spatial data functions to its portal to improve the applications and interoperability of its data.

In summary, the strengths of GBIF's outreach to external organizations of all kinds include:

- Effective representation by the Secretariat staff through travel to key fora, presentations, and solicitation of input and involvement in GBIF's activities. This has paid dividends by steadily increasing the number of organizations that are Associate Participants of GBIF.
- GBIF is generally very collaborative and transparent in its activities and most of the organizations that have already come to know GBIF appreciate this, which makes them willing to cooperate. The free and open availability of data through GBIF's portal is an essential factor in encouraging such participation and cooperation.

- GBIF's leadership and authority at the global level in primary biodiversity data make it an integrating force and naturally attractive for other organizations with related interests to want to form partnerships with it.

Although GBIF has initiated partnerships with many relevant organizations and projects on an opportunistic basis with some prioritization, much more still needs to be done. For example, GBIF has not yet created a database of all its external partnerships and other organizational relationships. The Review Committee also did not find that GBIF has developed well-founded criteria for determining which external relationships should be formal relationships and which ones are most important or have priority in the near term. All the formal relationships and partnerships that GBIF has established to date serve some important internal goals, but GBIF still needs to develop a comprehensive strategy for promoting its broad array of external relationships and clarifying how they can be mutually beneficial.

A significant weakness, as in other areas discussed in this review, is insufficient staff time to devote to the development of these important relationships. Although staff are viewed as effective ambassadors in those fora in which they are able to participate, there are opportunities missed because the number of staff is limited. GBIF therefore needs a phased and prioritized strategic approach to establishing and developing key external relationships.

At the same time, GBIF needs to establish its portal and get better organized before having a big external relations push. We make the same conclusion with regard to the users of gbif.net in the next chapter. The near-term focus should be on the product, rather than marketing, although comprehensive and phased plans for the latter need to be established now as well.

Capacity building

In the capacity building area, the OCB Programme, in conjunction with the Secretariat's ICT staff, provides training of trainers, and thus generates a ripple effect. The OCB Programme Officer believes in building collaborations and synergies with other organizations for the purpose of training node employees. This is now being promoted by a new mentoring program that seeks to leverage existing expertise in the GBIF network.

Training needs around the world are always bigger than what any single organization can provide. Issues identified by the Governing Board respondents that require attention include prioritization between focusing assistance on developed or developing countries, language barriers, and a lack of resources and staff.

3.6.5 Conclusions

The OCB Programme has made sufficient and appropriate, though uneven, progress in both its outreach and capacity building areas. Just the existence of the Programme is seen as a positive development (which is a common perception about all the other Work Programme components, much to GBIF's credit). A lot of work has been done under the very diverse portfolio

of activities, and the overwhelming amount of work seems to have been appropriately prioritized based on a needs-driven approach.

In its outreach activities, we conclude that GBIF has developed sufficient and appropriate links to the Convention on Biological Diversity, but less so to the other conventions dealing with biodiversity issues. Similarly, GBIF has developed sufficient and appropriate links to its highest priority external organizations, but considerably less so among organizations of less central importance. GBIF has been successful in its communication and outreach to all types of external organizations to the extent that there do not appear to be any strong negative views about GBIF among them. Nevertheless, more visibility of GBIF internationally would be desirable. GBIF ultimately will need to establish relations with a broader and more diverse set of organizations and to make its connections to them (e.g., to the biomolecular community) more visible.

In the OCB Programme's capacity building activities, training programs appear to have been considered effective and well received. A difference of opinion exists between GBIF representatives from the developing world, who would like to see more training in the less developed countries, and those from the developed world, some of whom would prefer to have additional focus on training their nodes personnel.

The two small education programs focusing on biodiversity informatics have not progressed sufficiently to be evaluated at this point.

3.6.6 Recommendations

1. We recommend that GBIF reorganize OCB into two separate areas, with clearly delineated functions. Outreach functions should be performed by an Outreach Programme Officer and focus on recruitment of new Participants (in all the membership categories suggested in section 5.2), relationships with all external organizations and user groups, and the management of IPR and demonstration projects in support of the other functions. The Outreach Programme Officer would need to work on the recruitment of new Participants in close coordination with the leaders of the Governing Board and the top managers of the Secretariat. The current suite of capacity building activities, including training, education, and mentoring, would all naturally fit within the portfolio of activities of the proposed new Nodes Liaison Officer.

2. With regard to GBIF's outreach to organizations, a strategic marketing approach is necessary, similar to the approach we recommend with the user groups as discussed in chapter 4:

- First, GBIF needs to perform a typology of all organizations and develop a comprehensive database with relevant contacts and descriptions, and with a tailored strategy for each category of organization. There are different rationales for engagement and different implementation approaches for each type. As a major aspect of this activity, GBIF must ensure that its niche in biodiversity information is well defined and overlaps as little as possible or is complementary to

the missions of others. Developing a schematic diagram of interactions and responsibilities among the identified organizations would help to clarify what is being done and what is still needed.

- Second, GBIF needs to complete its strategy for dealing with organizations with which it has already established partial relationships (e.g., systematists, related scientific disciplines, and conservationists), as well as focus on organizations that it has not yet had time to approach. This includes establishing high-value partnerships with the private sector, which so far has been avoided (and is discussed further in the next chapter).
- Third, GBIF should promote standard administrative methods and reporting of information among the different organizations on key activities and issues to improve coordination, avoid redundancies, and maximise return on investments and efforts.
- Fourth, GBIF should enlist much more help from its Governing Board members and encourage them to be more proactive in implementing the outreach strategy through the numerous contacts of the members at various organizational levels and types. GBIF staff cannot and should not do this by themselves.

3. In capacity building, there needs to be more emphasis on having Participants and nodes help each other instead of having the Secretariat as the focal point. This is consistent with our recommendations in other sections of the report to devolve more responsibilities and functions on a regional basis. Other recommendations for training are to develop more distance learning training approaches, and to identify organizations with similar goals with which GBIF can plan and run training activities together. Finally, the managers of GBIF should not undertake educational activities that are not closely coupled with other major goals of the organization.

3.7 Nodes

The Task Statement for the review posed the following question about the nodes:

> *e. **Nodes**: have the Participants made sufficient and appropriate progress toward*
> *-setting them up and*
> *-sharing data through them?*

Background material

The primary sources of information used to answer these questions are the node progress reports from the two 2004 Governing Board meetings, the Secretariat's self-assessment, and the questionnaire responses and interviews with the Governing Board members, particularly the node managers.

According to the Secretariat's self-assessment, three meetings of the Nodes Managers' Committee (Nodes Committee) were held during 2003 where a common direction, reporting mechanisms, and working practices were established. Tool kits for nodes became available in the autumn of 2003 and

were installed by the first nodes in 2003. Seven regional training workshops were held under WP2003. In 2004 there were Nodes Committee meetings in Oaxaca (GB8) and in Wellington (GB9), with progress reports produced on both occasions.

The Nodes Committee members reported twice during 2003 (February and September). The February reports list significant events in the past six months, plans for the next six months, and needs and requests for assistance. These reports provide a good picture of what is happening at the nodes. A more elaborate questionnaire was distributed by the GBIF Secretariat in September 2003, covering the skills, capacities, and technologies that the nodes have; it also asked about the barriers for progress.

As noted in the OCB section, the Secretariat is also developing appropriate mechanisms for capacity building, in conjunction with the nodes, to implement mentoring activities and to identify IT experts who could assist some nodes in developing countries (also in partnership with UNITeS).

The Participant nodes show a large variability with regard to hosting, funding, staffing, and links. These can be seen in the reports made by the nodes to the Nodes Committee.[14] Typically only about 70-80% of the nodes send these regular reports. The summaries of these reports made for the Nodes Committee meetings were highly relevant for this review.

3.7.1 Description of a Participant node

Most often, a Participant node is hosted either at a major national taxonomic centre of excellence or by a museum. The level of human resources at the nodes varies from as many as three full time staff to none. Ten Participants have not appointed a node manager. In the better cases, the node manager is a part-time scientist/administrator, and is assisted part-time by a computer technician and possibly a secretarial staff person. When looking at successes in making data available, what matters most is that the node manager is scientifically and technically competent.

Nodes implementation is highly variable

The nodes have very different resources available (e.g., funds, connected and committed individuals, technical foundation). This divergence can also be observed in the different levels of commitment by the Participants to the goals of GBIF. Some countries are doing much more at this point than can be expected from signing the MoU. They are the ones driving GBIF forward towards its goals. Other countries have been unable to set up a DiGIR server, let alone participate in the different node activities. The lower levels of activity are not consistent with the obligations made by those Participants in signing the MoU.

As of 7 December 2004 when the Review Committee ended all of its data collection activities for this review, there were 96 data providers uploading

[14] Node reports available from: http://circa.gbif.net/Public/irc/gbif/nodes/library?l=/status_reports

44 million records from 337 collections. Data were provided from 23 out of 56 countries, and from 5 out of 28 economies and organizations.

3.7.2 Progress reports from the nodes

The Participant nodes have been given the opportunity to report on their progress on two occasions: in a questionnaire in September 2003 and a report in March 2004. Not surprisingly, the most cited barrier was a lack of funding. After funding, in 2003 the top barriers cited were understanding technology and the hurdles of installing it. In 2004, after a round of training in new software, the top barriers shifted to motivating data owners to share their data, digitization, and IPR concerns.

Due to lack of resources in the Secretariat and because all effort in the Secretariat has been occupied in supporting data nodes technically, GBIF has not been able to help the Participant nodes in their organizational challenges. The Participant nodes generally have had to find their own way and try to learn from the other nodes that are more advanced. Up to now, there have been only generic recommendations and requirements set by GBIF for the nodes. These recommendations need to be supplemented with a Best Practices Handbook, which has still not been completed. The mentoring program and the employment of a nodes liaison officer are both initiatives that will be of great help to the nodes in organizational matters.

The portal toolkit for Participant nodes has never been developed fully and is largely outdated. It does not contain the functions for making an inventory of collections and potentially available data. Such solutions are now becoming available from the BioCASe project and could be implemented. There also is an increasing number of requests for a customizable portal to show a Participant's data.

3.7.3 Progress in setting up nodes

According to the MoU, the GBIF Participants should seek to form a node or nodes, accessible via GBIF, that will provide access to biodiversity data. It can be argued that organizations are joining GBIF for other reasons than sharing data, for example, for collaboration, exchange of knowledge on areas other than data, agreement on standards. However, countries should all provide data within a given membership period.

This picture reinforces the earlier conclusion (or it is another symptom of the same root cause) that Participant countries and Participant nodes are on extremely different levels. As was mentioned in the data policy section above, in some instances there might be some national political and cultural barriers for sharing data. Also, there might be a lack of funding resources in developing countries leading to an inability or reluctance to provide data through GBIF. Nevertheless, the overall picture is that half of the countries still have not been able to fulfil their obligations under the MoU to provide data.

3.7.4 Organization of nodes

The main role of the national nodes is to promote the digitization and sharing of digitized data, but they are not required to serve as a distributor for the other data nodes or providers. In the document "GBIF Nodes, Requirements and Recommendations," this model is described as follows:

> *In some countries and organizations a highly-centralized model may be adopted with all data services coordinated and registered through the main Participant Node. In some such cases there may be no separate Data Nodes. Other Participants may prefer to encourage data providers to register directly with the central GBIF Registry. In such a case every provider would be a Data Node, but one node should still be designated as the Participant Node that provides a member for the Node Managers Committee. (p.7)*

As said before, the typical characteristic of the Participant node organizations is that the node manager has many other duties in addition to the responsibilities to GBIF. Few – if any – node managers therefore can devote full-time attention to GBIF goals and activities. Node managers also have to spend time raising funds to finance their activities. Some countries have found it useful to host their node within museums, while others have decided that a more "neutral" ground may be needed in order to establish good relations with other existing and potential national data providers.

The technical organization allows the use of both Darwin Core and ABCD schemas responding to DiGIR and BioCASe protocols. This flexibility is valued among node managers, but it has been the GBIF Programme Officers who have made the customized interface between Darwin Core and ABCD schemas, and GBIF will need to develop systems to manage future upgrades.

Progress: 2.5-3% of providers

The potential numbers of providers and records among existing Participant nations were estimated in the Nodes Committee Report to GBIF GB8 in early 2004 to be between 2300-2800 providers and between 190-200 million digitized records already potentially available. These figures would increase with an increase in the number of Participants. As of the time of writing of the Nodes Committee Report, GBIF had reached between 2.5 and 3% of the potential providers in the Participant countries, and approximately 20% of the records digitally available in those countries. This indicated that GBIF has been able to get some of the larger providers to share data through the nodes, which is a significant success. There are large numbers of smaller providers, however, who are not yet in a position to share data through the GBIF nodes.

Progress: 19-20% of digital records available in Participants' institutions

This issue can be divided further into two parts. The first concerns the difficulties in setting up national nodes. This issue is addressed in the Nodes Committee Report with a prioritized list of barriers. The second involves difficulties in getting the providers to engage with the national node. This issue is mentioned in the Nodes Committee Report as "help and resources are needed to help nodes engage with providers, solve the people, policy and priority barriers, and deliver this increase in content, i.e.: technical

barriers are not the main ones at present." (p.1). Both of these problems need to be addressed in order to enable further progress in the development of the node network.

Best Practices Handbook

GBIF also is undertaking several new initiatives to help the nodes overcome some of the recognized difficulties. It is developing a Best Practices Handbook to help guide the countries in organizing a node and to help them overcome the technical difficulties in setting up the node. This handbook could be a very helpful tool, especially for the developing countries. This work appears to have gotten a lower prioritization due to two other initiatives.

One is that GBIF is establishing a mentoring system where the most advanced nodes can help other nodes overcome initial difficulties. Perhaps most important, GBIF is hiring a Nodes Liaison Officer in the Secretariat. This will give the other Programme Officers more time to make progress on their primary assigned Work Programme components (especially in the existing OCB Programme), while the Nodes Liaison Officer can provide focused assistance to the nodes. All these initiatives are welcomed by the Nodes Committee and will be helpful in creating further momentum in the process of organizing and setting up the nodes.

3.7.5 Barriers to setting up and organizing the participant nodes

The 2004 Nodes Committee Report compiled a list of barriers to consider based on the responses or 30 nodes.

Barrier category	Number of nodes reporting the barrier
Resources	14
Resources and science policy	9
Network expansion and capacity building	9
IPR	8
Digitization activity support	7
Team work and shared services	4
Data issues	4
Schemas – Darwin Core, ABCD, etc.	4
Portals	3
Name services, controlled vocabulary	3
Computer resources requirements	2
DIGIR Code	2
Training	1

Table 3.2
Barriers

Major barriers identified

As can be seen from this table, the main barriers perceived by the node managers are resources, science policy (i.e., the decision by the nation's science policy community about where to establish the node), network expansion and capacity building, IPR, and digitization activity support. Our interviews with nodes managers and Governing Board members, as well as the input of the Secretariat, indicated that network capacity could be a limiting factor, especially in developing countries. Some universities in the developing countries affiliated with GBIF have a line capacity of only 256 Mbit/sec for the entire institution. The minimum line capacity of a provider alone is considered by the Secretariat to be 256 Mbit/sec. Also, some

providers are using very old equipment or have to share servers with other purposes. These problems arise from the fact that some institutions do not have the money to procure the right equipment or communications facilities, or the local ICT infrastructure has insufficient bandwidth.

Science policy issues

Some countries have experienced policy problems and related rivalries in deciding which national institution should host the node. There is – to quote from some interviews – little help provided by the MoU in this regard. This issue, however, should be kept distinct from the policy issue concerning which national agency should represent the national interests in the Governing Board (the latter issue is addressed in section 5.2). Hosting a national node generally is considered prestigious and therefore can attract funds or other types of benefits to the hosting institution. A Best Practices Handbook would be very useful is this area as well.

IPR issues were mentioned in some interviews and questionnaires as possible barriers, and this issue is discussed in more detail above in section 2.3 on Data Policy.

3.7.6 Barriers in getting providers to engage in national nodes

The barriers for getting the potential providers to engage in the national nodes and in GBIF more generally is the key to understanding how fast GBIF might grow within Participant nations.

Drivers for sharing biodiversity data via the Internet

The Nodes Committee Report cited a number of drivers for sharing biodiversity data online. These are useful for getting a picture of what the perceived benefits of GBIF are and how these benefits are distributed among the providers and potential providers.

The highest scores for drivers for Internet access of biodiversity data are:

- Conservation and sustainable use of biodiversity;
- Conservation monitoring;
- Providing data for research – ecology and applied research (agriculture, forestry, etc.); and
- Meeting international commitments, e.g., GBIF or CBD requirements.

The latter is almost tautological, but the other three reasons show that the Participants are focusing on professional use of data among policy makers, policy implementers, and researchers in applied science. Only half of the Participants' nodes mention the following factors as drivers: providing data for taxonomic research, education, public awareness, increasing perceived value of collections, and public purposes.

3.7.7 GBIF experts' opinions

Consistent findings

The results of our interviews with node managers were consistent with the answers that we received from the questionnaire sent to the Governing

Board. The findings correspond especially well with the interviews with the managers of nodes that are still struggling to get established and deliver data.

Many Participants are praising the progress that GBIF has made and view GBIF as a necessary mega-science undertaking. The overall picture, therefore, is that Participants are pleased with the progress and the concept of national nodes, but they still have some concerns and criticism. The statements below should be viewed in this light.

Funding, funding, and funding

A big part of the funding discussion within GBIF concerns the funding at the national level. Just as GBIF is struggling to get funds for the Secretariat initiatives, the Participant nodes are struggling to get the national activities funded. The nodes managers find this a difficult task, and one that may become more difficult in the future after the "novelty effect" of GBIF has diminished. These issues are discussed more fully in section 5.4 on Funding.

Special concerns in the developing countries

Many Participants from the developing countries find that GBIF lacks a sufficient commitment to their particular problems, but that the progress and the overall concept of GBIF is appropriate. Several developing country Participants suggested that GBIF should provide financial subsidies in order to get the developing countries to actively share data. Also, the developing countries appear to be more concerned with IPR as a nodes issue than the more developed countries.

Value of contributing and sharing data should be demonstrated

GBIF has to do training sessions in order to provide technical support and promote knowledge about GBIF. When GBIF is doing this in the developing countries, the experts believe that the money and effort might be wasted if there are no follow-up actions. Although most Governing Board respondents are of the opinion that GBIF is on the right track, there is a major validation issue when Participant nodes seek to get more data providers or resources into GBIF. Nodes managers cite the need for compelling demonstration projects, as noted elsewhere in this report, that are able to show to the funders and providers the benefits of sharing data (e.g., showing how their own data will integrate with GBIF data and make the provider's data much more valuable). This so-called "killer application" could help get more providers to share and upload data. The main point, however, is to show the value of sharing data with GBIF and other collections worldwide. At the same time, in promoting GBIF to data providers, GBIF should also be careful not to create false expectations.

Data validation

Finally, some Participants emphasized the need for investments and the adoption of procedures for improving data validation. Issues include the development of criteria for what observational data should be included in the gbif.net portal, or criteria for geo-referencing. These validation functions need some standardization and should be considered especially in the context of the DADI Programme.

3.7.8 Conclusions

The Review Committee concludes that the progress of the Participants toward setting up nodes and sharing data through them is highly variable and cannot easily be summarized. Strengths of the Nodes activities include the following:

- The GBIF node network is starting to show encouraging results (e.g., more than 44 million records available as of 7 December 2004).
- GBIF is using a federated data management model for engaging data providers that is considered to be the best approach to this type of distributed data network infrastructure. The concept of organizing the nodes and data providers within a flexible, voluntary, and democratic structure seems to work well.
- One of the major strengths of GBIF is that it has a good reputation and a positive image in the scientific community, to the extent that we have been able to discern. GBIF is seen as a scientific organization rather than a political one.
- The announced recruitment of a Nodes Liaison Officer demonstrates that the GBIF Secretariat is listening to its node managers and is serious about addressing some of the weaknesses that have been identified (see below).
- The DiGIR tool is a simple and effective way of getting the nodes to share data.
- Although there are still some technical issues for GBIF to handle, it should be seen as a strength that the technical issues have moved down in the list of barriers for setting up nodes and providers. This indicates that GBIF has been successful in addressing the major technical problems.

Potential weaknesses and concerns:

- Many Participants are not making an adequate effort or providing sufficient support to promote GBIF, and in particular they are either not establishing or adequately supporting their node(s), consistent with their commitment in the MoU. This is unfortunate because the network can only be as good as its participating entities. Moreover, strong support at the national level can provide the strongest stimulus to breaking down the cultural resistance to sharing data.
- Although the federated data management structure as outlined in section 2.2 is an appropriate approach for integrating the many nodes, it has some downsides. For example, it makes it more difficult for the GBIF Secretariat to exert much influence over the activities or performance of individual nodes. Also, the decentralized structure means that the Participant countries have to solve internal policy differences and rivalries before they can get to work, raise the necessary funds, set up the node, and start creating the necessary relations with other data providers.

- Many respondents to the Governing Board questionnaire find that the quality of data must be improved dramatically. To some degree it can be argued that the quality of data is a shared responsibility between users and providers. Considering the target audience (not only scientists), however, the GBIF network will have to promote quality assurance processes more vigorously in order to prevent the dissemination of bad data. Connected to this issue is the problem of redundant data served through the GBIF network by its multiple data providers.
- An important question is whether GBIF is getting the results fast enough to demonstrate to GBIF's funding Participants that their investments in GBIF is money well spent. Clearly, there already are different expectations for GBIF results. Some Voting Participants and Associate Participants perceive the achieved results (e.g., in the Nodes Committee Report and in the Governing Board questionnaires) as a success, while others do not. This can be a concern if there is an expectation of unequivocal success, which the Review Committee considers unrealistic at this early stage.
- Despite the fact that GBIF cannot do everything at the same time, it might be perceived as a weakness that it is not giving the developing country nodes enough support. Although some training and other assistance has been provided to nodes in developing countries, GBIF is focusing initially on the large and best prepared datasets (the "low hanging fruit"), mostly in the developed countries.
- The nodes have indicated that some countries need help in more ways than GBIF is currently providing (e.g., training, guidance, and "plug and play" software). For some nodes in developing countries especially, outdated equipment and low bandwidth Internet connections pose the main hurdles. GBIF will have to make a strategic decision as to how and in which cases there is a mutual interest in helping some nodes with these kinds of upgrades, and with other types of support services. How GBIF, under the current budget restrictions, will be able to address such needs is not obvious. Certainly, the proposed Nodes Liaison Officer is an important first step. In the longer run, however, the need for multilingual support will grow, which would indicate the need for an even more decentralized support structure.
- The mentoring program and the proposed Nodes Liaison Officer are major steps forward in strengthening the effectiveness and capabilities of the nodes, but the Review Committee believes that the Best Practices Handbook will be especially useful for the developing countries and it should still have priority for completion. This effort is somewhat behind schedule.

3.7.9 Recommendations

We are not able to recommend much that has not already been addressed by the Nodes Committee or by the new Work Programme for GBIF as it was presented at the October 2004 Governing Board meeting. The planned hiring of a Nodes Liaison Officer and the new mentoring program are substantial initiatives that will help meet many of the expressed needs of the

Participants. The recommendations below therefore are ancillary to internally recommended and planned actions of GBIF.

1. Many of the GBIF nodes have technical development programs with overlapping functions and activities. These programs need to be better coordinated to increase their efficiency and effectiveness in the nodes and in the broader GBIF community.

2. In order to meet its future challenges, we recommend that GBIF develop a strategy for the long-term support of nodes under which a typology of nodes is created with the purpose of setting clear guidelines for them. In particular, the possibility for a more regionalized support structure should be investigated, especially when more nodes are established and GBIF's annual level of funding is increased.

3. In order to help the nodes that are struggling to get established in developing countries, GBIF should consider obtaining targeted financial help for the developing countries that have demonstrated sufficient initiative to set up a node, but are being hampered by obsolete equipment and slow communication networks. This could be a relatively low-cost but effective investment. GBIF could partner with some of the many inter-governmental and private-sector donor institutions that focus on improving ICT infrastructure in developing countries. The current United Nations World Summit on the Information Society will likely provide some opportunities in this regard.

4. GBIF should complete the Best Practices Handbook for the benefit of all the nodes as soon as possible. Subsequent updates should be the responsibility of the new Nodes Liaison Officer.

3.8 ICT Infrastructure

As with the other major elements of GBIF's Work Programme, the key question concerning the ICT infrastructure is whether GBIF is making sufficient and appropriate progress in carrying it out. Given GBIF's role as the hub of a global network of biodiversity information providers and nodes, the organization's ICT infrastructure is fundamental to GBIF's current and future success. We already have discussed some of the technical aspects of GBIF's ICT activities in our discussion of the other Work Programme components, notably various software initiatives under DADI. Here we focus primarily on the hardware components and on the overall architecture of the network.

It also should be noted that the ICT activities were examined as part of a GBIF architecture review in a 2004 report by computer scientist John L. McCarthy. The Review Committee supports the findings and recommendations made in that report. However, the McCarthy review was completed prior to the launch of the prototype gbif.net portal and the submission of data by GBIF's providers. The Review Committee also took notice of the reservations noted in the McCarthy report that GBIF's "continued success may depend on whether GBIF resources can grow to

cope with demands for expanded services and membership that their initial work is likely to stimulate" (p.1).

Therefore, in the course of the Review Committee's review the consultants interviewed the GBIF Secretariat program officers, several node managers, and some expert users in order to obtain our own picture of how the GBIF staff and Participants perceive and anticipate the progress of GBIF's ICT-related activities. At the same time, because the McCarthy review was quite comprehensive at the time it was conducted, we have limited our discussion only to a few issues raised by GBIF's changed circumstances since the McCarthy report and to those identified by our site visits, interviews, questionnaire responses, and subsequent analysis. Our assessment of the gbif.net portal is presented in section 4.3 in the next chapter.

The GBIF network architecture is shown in the figure below.

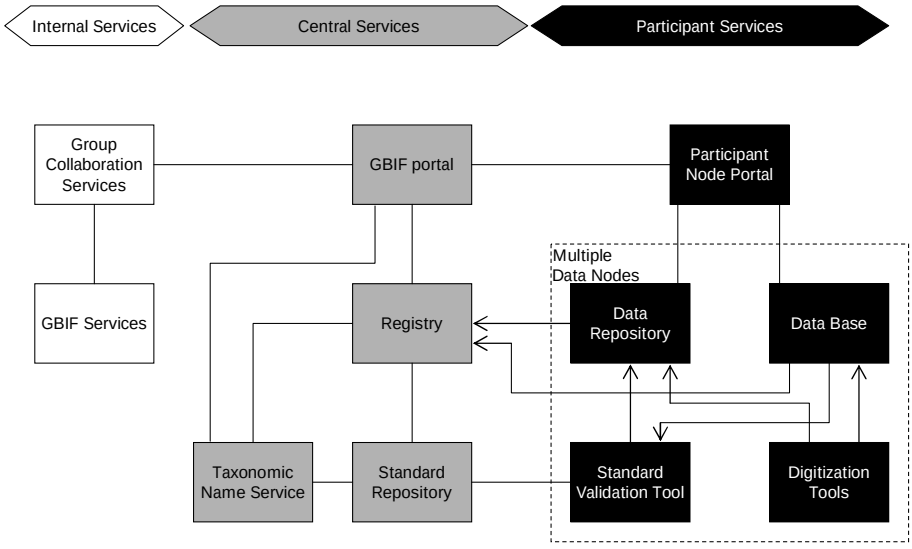


Figure 3.1
Overall architecture (Source: WP03)

3.8.1 Assessment of Recent ICT Developments at GBIF

According to the responses we received from the GBIF representatives and node managers, the existing ICT network architecture and hardware capabilities are adequate for the current level of use and are well organized. The collaborating organizations value working with GBIF people highly. The nodes managers appear to be supportive of the open-source approach to software development, the use of Java programming language, and the robustness of programming techniques.

The central hardware components continue to be located in a server room in the basement under GBIF's offices at the Copenhagen University. The room in which this equipment is housed is deemed to be secure, based on a site visit by members of the Review Committee.

The criticisms of the ICT Programme were fragmented and identified the following deficiencies that require some improvements, but none of which we perceived as posing difficult problems:

- Most important in the near term is that the servers are not mirrored, although preparations for mirroring servers are being made in the new Work Programme presented by the Executive Secretary at GB9. One Governing Board representative noted that the central GBIF portal site is "very deep in Denmark" for the Asia-Pacific region, with the number of hops required to reach GBIF very high. This can make the connection and response times unnecessarily slow.
- There also is no separate system for training or for the development and testing of new applications. These functions are still all performed on GBIF's operational production system rather than in a segregated safe environment. While this may be necessary in a start-up phase, the GBIF system is already operational and this mixing of development and operational functions is no longer appropriate.
- Several kinds of new functionalities that enable the data providers to make better segmentations of the data are needed.
- The user friendliness of the Participants' local portals needs to be enhanced, the connections and accessibility from other portals improved, and more assistance provided by GBIF (this is addressed in more detail in the Nodes section 3.7).
- In the longer term, the most important issue is that the portal will need to become more "robust" and scalable over time, including both the technical components and additional personnel.

3.8.2 Conclusions

Our overall conclusion is that the people in the Secretariat who are working on the ICT infrastructure are very competent and have achieved a lot with fairly limited resources. The ICT infrastructure therefore has developed beyond what might have been expected at this point of GBIF's existence and level of resources.

3.8.3 Recommendations

1. GBIF should augment its ICT strategy to migrate some aspects of the ICT support structure to a regionally decentralized level. Specific functions that should be performed on a regional basis include:

- Mirroring of the central servers as a part of a regionalized infrastructure. Mirror sites should be established in Japan or the United States first in order to improve the very slow TTL rate between Denmark and the Asia-Pacific countries. The Secretariat should assess the need for other regional mirror sites.
- Basing the nodes mentoring program on a regional basis, and perhaps identifying some GBIF nodes as "Centres of Excellence" in different professional areas.

2. The ICT programme should establish a separate training and applications development and testing environment – working on separate hardware and databases, rather than all on GBIF's operational production system – as soon as possible.

3. The ICT programme also should improve the technical collaboration with other entities that have resident capabilities and related interests. This might include support from global IT companies.

4. GBIF should continue to outsource parts of the ICT development in order to have some key external suppliers with which GBIF has confident working relations. This will lower the barriers for using external expertise and for maintaining the use of internal resources on a flexible basis.

5. The CIRCA intranet system should be upgraded to a more user-friendly program.

4. The User Perspective

4.1 Introduction

One of the three key questions in the Content of Review document was whether GBIF has "achieved sufficient profile and uptake within its target audiences." The Review Committee interpreted this question primarily as a key indicator of GBIF's relations with the existing and potential users of the data served through GBIF's portal. Because the success of GBIF's functions and objectives are contingent upon its relationships with its users, the activities of the organization with regard to identifying, establishing, and enhancing those relationships is especially important.

Based on our discussions with the Secretariat, we understood the term "profile" as referring to how well GBIF is known by its principal stakeholder groups and how they perceive it, and the term "uptake" as meaning how well GBIF has succeeded in attracting use of its products and services by these various stakeholders and in establishing formal relationships where necessary. Whether the profile and uptake have been "sufficient" is, of course, a highly subjective question that we endeavored to answer in light of all the evidence we were able to collect from our many sources and to interpret as fairly as we could by consensus.

Finally, the issue of what a "target audience" is deserves some comment at the outset. The users of GBIF's network—defined by GBIF as scientists, educators, policy makers and policy implementers, and the general public—are the most obvious component of that target audience. Given the nascent character of GBIF.net, however, the users still need to be considered mostly in terms of their prospective, rather than current, uses. GBIF's relations with the major organizations related to GBIF's goals are discussed in the OCB section in the previous chapter.

When reviewing GBIF and specifically the data portal from the perspective of the users it must be understood that the portal is still a prototype with many more records being added and increasing functionality planned. For

the Review Committee it raised the question of what to review exactly. Because the data portal has been developing in extent, content, and functionality continuously during the review we have focused on the actual and potential use of the portal at the time of the review.

As ancillary issues to question 3 of the Content of Review document, the Review Committee has focused more specifically on:

- *User characteristics*. From the user survey and from Web statistics we are able to describe some of the characteristics of the visitors on gbif.net. Beside the user characteristics, section 4.2 presents the contents of and traffic on gbif.net.
- *The perception of the data portal*. The assessment of the actual and perceived value of the portal, even though it is still a prototype, is based on the opinions presented by the users, GBIF people, experts, and by the Review Committee's review of gbif.net. Section 4.3 deals with this issue.
- *Knowledge and perception of GBIF among user groups*. The external experts, the GBIF Secretariat and the people formally connected to GBIF have been asked about their opinions on the knowledge and perception of GBIF among different groups of users: the scientific community, educational users, policy makers and policy implementers, commercial users, and the general public. Their responses are summarized along with the users' and the Review Committee's opinions in section 4.4
- *Visibility of GBIF and outreach to users*. The strength and the weakness on GBIF's outreach to users and the visibility of GBIF in various communities and in the specialized and general media are addressed lastly. Section 4.5 deals with this issue.

In assessing the status and plans of the organization's relations with its target users and its portal, the Review Committee relied on the self-assessment of the Secretariat, on the interviews and questionnaire responses of the Governing Board members and external experts, and on a review of the documentation provided by GBIF. In addition, our assessment of the users and the portal was based on the anonymous responses of visitors to gbif.net between the beginning of August and the beginning of December 2004 who responded to the online user questionnaire, as well as on statistics of uses of the data portal compiled by the Secretariat.

4.2 gbif.net – content and users

This section presents an overview of the content of gbif.net as of December 2004. The section also characterizes the visitors on the data portal and provides information about the traffic on the site.

4.2.1 The content of gbif.net

By the time the Review Committee completed its user survey in early December 2004, visitors on gbif.net had the possibility to search among more than 44 million records from 96 providers and 337 collections. The prototype portal basically provides access to two types of data: data on taxonomic names and data on specimens and observations.

The taxonomic names come from the Electronic Catalogue of Names of Known Organisms, which integrates authoritative information about scientific and common names for organisms from several different organizations. Not all taxonomic names are authoritative and are listed tentatively since they occur in specimen or observational records, but not in taxonomic records. In early December 2004, the portal included over 486,000 scientific names and 217,000 common names.

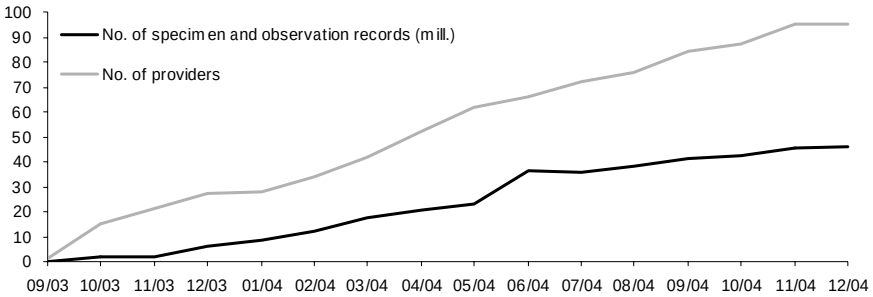


Figure 4.1
Numbers of records and providers of records on gbif.net from the beginning to December 2004

Source: Spreadsheet provided by the Secretariat (January 2005)

The gbif.net portal also provided access to over 44 million records of occurrences of different organisms. These records are on specimens in natural history museums and herbaria, or on living cultures of micro-organisms, or on observations of plants and animals in the natural world. Some of these records are geo-referenced, which is essential for generating maps of the distribution of organisms and other applications.

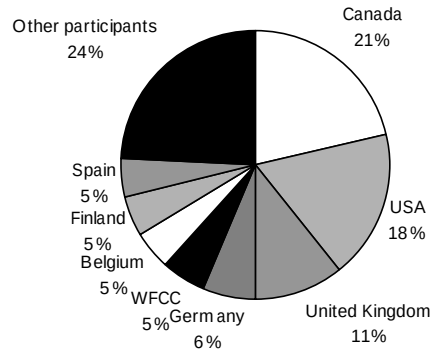
The data portal also offers access to more detailed taxonomic information or to information on counts of specimens and observations, and on geographic distribution. Furthermore, it is possible to download datasets. The data portal provides information about the origin of each record and every visitor is able to send feedback on a data item to the original data provider.

This short description is based on information from gbif.net as of 7 December 2004. The increase in records and providers in the short period of time since the launch of gbif.net has been tremendous. More than one fourth (nearly 9 million) of the records are provided by the United Kingdom and a large percentage of these records is provided by the Botanical Society of the British Isles vascular plants database. The United States has provided more than 8.6 million records from 27 providers and 60 collections, which makes

the United States the second largest provider of data. The Ocean Biogeographic Information System is the third largest provider, with nearly 7 million records.

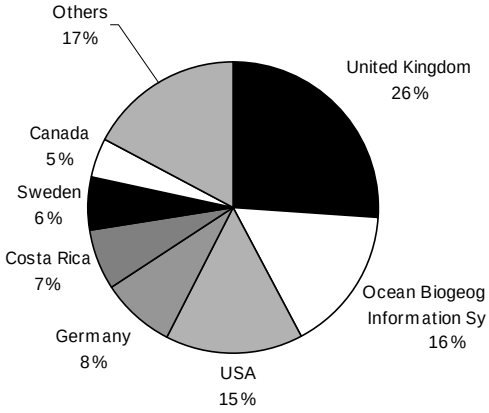
The two pie charts below illustrate the distribution of collections and records among the participants of GBIF.

The distribution of collections providing data to gbif.net from different Participants



Source: gbif.net (7 December 2004)

The distribution of records provided to gbif.net from different Participants



Source: gbif.net (7 December 2004)

Figure 4.2
Records and collections on gbif.net

The Review Committee has noted that many of the collections are significant or leading in their specific scientific areas.

4.2.2 The users

Visitors on gbif.net have had the opportunity to follow a link from the site to an online questionnaire for nearly half a year. Just over eighty visitors fully or partly filled in the questionnaire during the four months that it was available on gbif.net.[15]

The survey suggests that most of the visitors on gbif.net not surprisingly are users in the scientific community. Other types of visitors who filled out the questionnaire were educational users and students, policy makers and implementers, and the general public as illustrated in the figure below.

[15] It should be noted that the sampling used in the user survey on gbif.net may be characterized as convenience sampling or self sampling. This means that the Review Committee did not have a direct opportunity to encourage users to respond. It also is important to emphasize that the results from this questionnaire are anecdotal and are not statistically relevant.

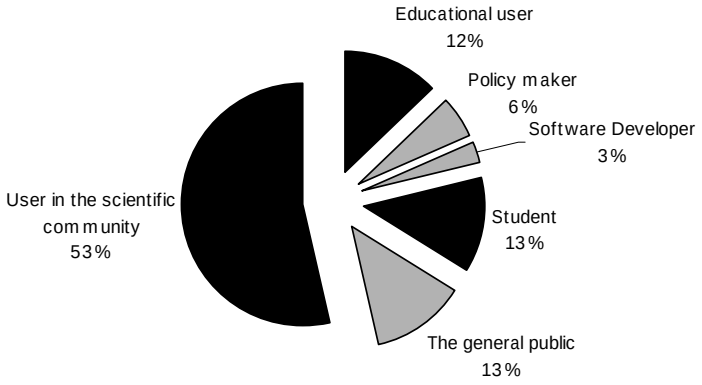


Figure 4.3
Who are the users of the portal

Nearly one third of the respondents indicated that they visit the portal on a weekly basis or more often, whereas 36% visited it much less frequently. The final 35% of the respondents indicated that they were visiting the portal for the first time.

More than 60% of the respondents heard about gbif.net from non-Internet sources such as friends, colleagues, brochures, or somehow knew about GBIF before the portal was launched. The rest of the respondents heard about gbif.net from Internet sources such as Google or other search engines, or from biodiversity or bioinformatics Web pages.

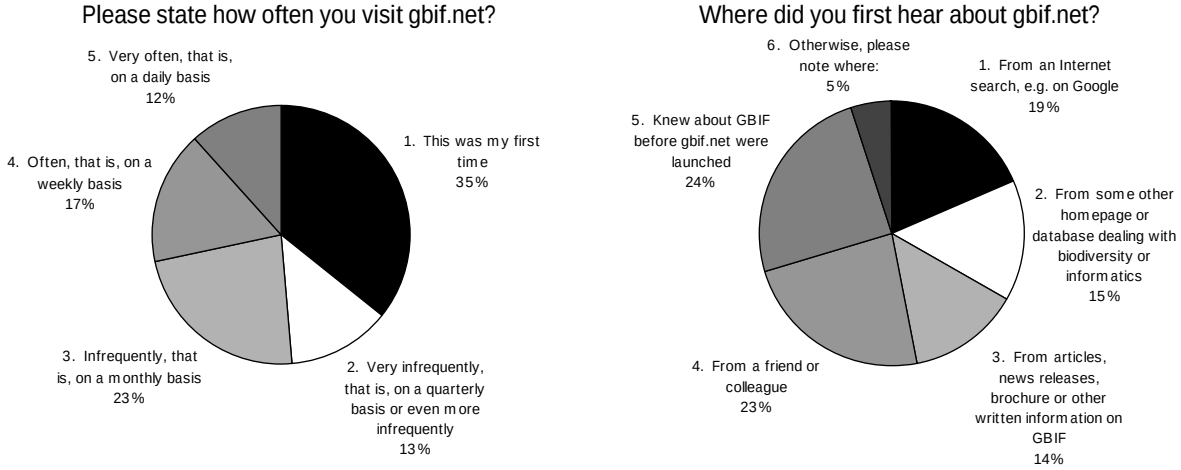
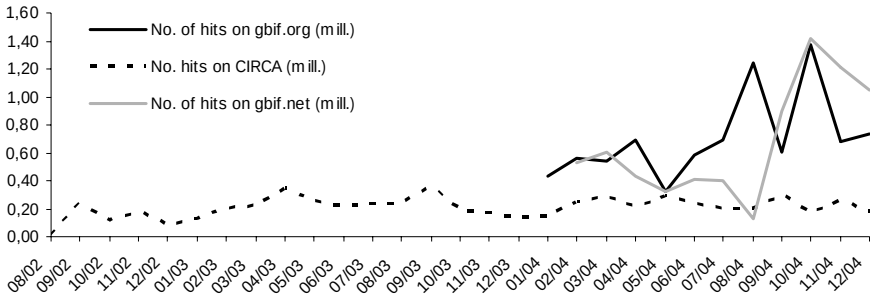


Figure 4.4
The users of gbif.net

4.2.3 Traffic on gbif.net

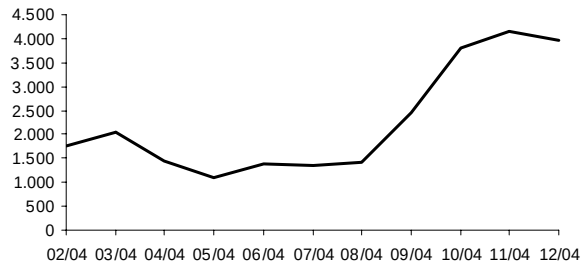
The graph below demonstrates the traffic on the three GBIF web sites – the data portal on gbif.net, the communications portal on gbif.org, and the closed document management system on circa.gbif.net.



Source: Spreadsheet provided by the Secretariat (January 2005)

Figure 4.5
Hits on the GBIF web sites

The traffic on GBIF's CIRCA intranet system is stable except for a few peaks around the Governing Board meetings. The traffic on the two open portals is fluctuating and somewhat unstable so far. Gbif.org has existed since 2001 on three different machines and platforms, but logs of visitors to the site have only been saved from December 2003 onwards. Gbif.net exhibits a variable but generally increasing trend which is consistent with the growth pattern of the data provider base. A future review, however, should address the issue of traffic more thoroughly.



Source: Spreadsheet provided by the Secretariat (January 2005)

Figure 4.6
Session counts on gbif.net

The session counts depicted in the graph above show the number of users that have gone past the "Accept use agreement" button or cookie, thus entering the search interface of the portal. Apparently, one session on gbif.net generates about 300 hits.

4.3 The perception of gbif.net – from a user perspective

As stated in the outset, the GBIF portal is only a prototype. Nevertheless, the Review Committee considers it fair and relevant to assess the portal at this point. Our assessment is based on several sources – the Secretariat's self-assessment, input from the GBIF community, and the opinions of users and experts. Furthermore, the Review Committee conducted its own structured review of the portal during the late summer of 2004.

4.3.1 The Secretariat

In its self-assessment, the GBIF Secretariat took a prospective view of the user community and GBIF's future applications. It noted that once GBIF has had sufficient time to fully implement its information architecture, it will add many values that may be predicted, but cannot at present be estimated in monetary terms. Neither is it possible to predict a priori exactly how the data will be used, except to say that that they will be used in many new and innovative ways.

The October 2003 GBIF Strategic Plan provided a vision of the broad range of applications that users of its portal could do with the data ten years after the founding of the facility:

> …**a bureaucrat in the Ministry of Healt**h who needs to know what species of insects occur in her country that might become vectors for an emergent disease.
>
> **…a graduate student in Southeast Asia** who needs to know all the names (scientific and vernacular) that have ever been applied to a plant species from tropical Africa that he is studying for his thesis on its physiology and potential for cultivation.
>
> **…a conservation biologist** who needs to understand the habitat requirements and naturally co-occurring species of an endangered species of primate (or whale, otter, orchid, parrot…).
>
> **…a molecular genetics researcher** who is looking for a gene in a member of the agriculturally important grasses that is analogous in function to one she has found in goosefoot that allows the plants to tolerate dry, hot, saline conditions.
>
> **…a PhD taxonomist in Europe**, who is **beginning** the daunting task of monographing a genus of primarily tropical beetles that comprises at least 1,000 species.
>
> **…a pharmaceutical chemist** who has found a promising drug compound in a fungus species, and would like to know if there are related species that produce similar compounds or the same compound in greater quantities.
>
> **…a lawyer for a group of indigenous peoples** who needs to establish the exact identity of a plant on which they claim rights of intellectual property.
>
> **…an elementary school class** that is studying praying mantises, and wants to know about their prey and their predators.

…a robotics researcher who needs inspiration from nature about how to solve a particular engineering problem.
…a curator at a storage site for genetic resources who needs to know whether the tissue samples from an organism of interest in her collection are a thorough sampling from throughout the range of the species.
…a government agency that must interrogate multiple large datasets in order to set aside a biodiversity reservation that will preserve the largest possible number of species within the smallest possible area, while still providing opportunities for ecotourism and sustainable harvest of wild products.
…a natural resource manager who needs to prevent the advance or combat the depredations of invasive species.
…a parataxonomist in Latin America, who needs to identify the specimen he has just collected, and determine if it is known or is new to science.
…and so on, and on, and on. The applications and utility are endless, and of inestimable value. Because many different kinds of interfaces that each serve a different audience can be developed to access the same data resource, this one focused effort to provide primary data about biodiversity is an investment that by 2011 has paid off in multiple ways—and the payoffs will continue far into the future beyond 2011.

Table 4.1
Visions of application (source: GBIF Strategic Plan 2003)

4.3.2 The GBIF community

The perceptions of the actual value of the portal differ, but generally the Governing Board respondents to the questionnaire and those interviewed have tremendous confidence in the vision of the portal and its perceived value. According to the experts formally related to GBIF, the actual value of the portal is linked to the following characteristics:

- *The principles of knowledge sharing*. Some respondents emphasized that the free access to the portal is of great value. This principle is apparently implicitly accepted, since only a few mentioned this as an actual value of the portal. It is acknowledged and valued much more explicitly, however, in their response to the questions about GBIF's open access data policy as discussed in section 2.3.
- *Accessibility*. The access to the portal is considered of substantial value already. The portal strengths are numerous, e.g., that it is becoming the single point of entry to biodiversity data from different sources, that it gives access to data from different sources globally, and that access to data is fast and easy.
- *The content of the portal*. The essence of the portal of course is the content. The general perception is that there are not enough data yet, but that the portal shows its potential even though the prototype is rudimentary. Some find the data credible, though it is also emphasized that there is need for watching out for errors, especially because taxonomic errors will undermine users' confidence in GBIF and its providers' data as discussed under the DADI assessment in section 3.2.

The presentation of data, even in the prototype, is considered to be good overall because of the geo-referencing, the references to collections and feedback opportunity.

- *The standardization efforts*. The actual value of the portal from a user perspective is also the emerging results from developing uniform and documented standards for making taxonomic data available, which also is discussed in some detail in section 3.2.
- *The use of the data*. The amount of data on the portal generally is still too limited, but the portal is becoming interesting for scientists, though the data are still too incomplete to be of much use outside the scientific community. However, as the Secretariat also points out, much of the actual value of the free and open access policy is the possibility of continuously re-using the data.
- *GBIF as an institutional instrument*. Finally, GBIF has shown its value through the portal as an instrument for building relationships and enhancing communication among initiatives, organizations, and biodiversity researchers.

The prototype also raises some preliminary concerns among the Governing Board respondents:

- The future usability and value from a user perspective remain uncertain, since the functions of the portal are still not fully developed.
- As noted above, there are erroneous and redundant data, since the quality control of data is primarily the responsibility of the data providers and Nodes. A feedback mechanism is already functional, but it may not be sufficient.
- The potential for users outside the scientific community, e.g., educators, policy makers and the general public, remains unclear, since the prototype does not indicate how these users can benefit from the portal.
- There is a lack of multi-language functionalities, since the prototype remains available only in English so far.
- Overall user-friendliness still needs to be improved.

The Review Committee was particularly concerned by the fact that as of the beginning of September the portal presented itself as fully operational, though it is far from that. The Secretariat responded immediately to this problem by clearly labelling the portal as a prototype.

4.3.3 The users

The respondents to the user survey were generally very positive when assessing a number of specific features of the data portal. Their assessment is summarized in the figure below.

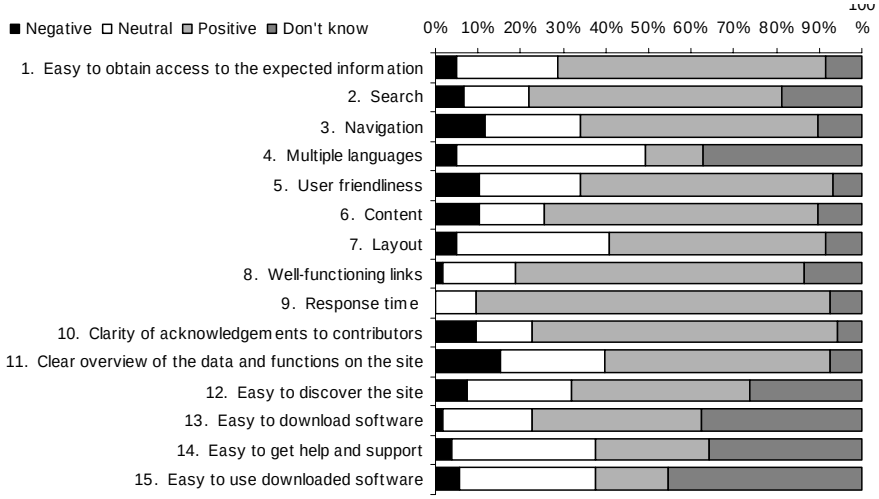


Figure 4.7
The users' assesment of some features of the portal

The Review Committee has no further comments regarding the metrics from the user survey. Instead, we refer to some of the comments provided by the users in the rest of this section.

Among these respondents there seemed to be a tremendous trust in the future potential of GBIF as the single portal to taxonomic information, to natural history collections, and partly to observational data. So far, gbif.net has proved its value by showing that is possible to link taxonomic databases and collections in one network with one single point of entry. But most of the respondents were asking for a lot more data, although the focus differs among those who are content with an authoritative taxonomic catalogue, those who prefer easy access to data on specimens in collections, and those who are most eager to get updated geo-referenced observational data. Despite the overwhelming approval of the idea of GBIF, the comments from the user respondents clearly showed the diversity of expectations that gbif.net is supposed to meet.

According to the user respondents, the strength of gbif.net – in addition to the single point of access to data – is:

- *A global mandate*. The facility is based on an apparently real mandate from the international community showing an increased awareness of the societal need for bioinformatics among governments worldwide. Consequently, the scope and volume of GBIF is truly global and collaborative.
- *Coordination*. Taxonomic and biogeographic programs are being coordinated and distributed data sources are being integrated across scientific areas.
- *Technology*. gbif.net is based on open standards and a simple architecture with high server uptime and good, user-friendly layout.

As stated, many users saw lots of strengths in gbif.net in particular and in GBIF in general, but they also pointed out several weaknesses:

- *The quantity of data*. Many users noted the obvious fact that the amount of data is not enough and needs to be increased significantly. Some pointed out that the data appear biased "since some organisms are more prevalent than others," and that "datasets are incomplete," and that "areas of the world are underrepresented" due to the lack of data.
- *The quality of data*. Several users expressed doubts about the quality of data in the portal and mentioned examples of "misspelling, missing coordinates and missing dates." One also pointed out "that metadata standards are poor when applied to the resources that data providers expose. These must link to established metadata repositories, such as the NASA Global Change Master Directory at gcmd.nasa.gov." Another user commented that apparently there are too many of the records that are simply nomenclatural files needed for housekeeping - and not real records for a facility that is making data from collections available. As that respondent pointed out: "Clothing manufacturers do not say how many yards of cloth they have purchased; only how many suits etc. they have manufactured." Finally, one respondent found that the portal does not create clarity about the authority to determine the taxonomic status of organisms.
- *Features on gbif.net*. Only a few respondents mentioned weaknesses with the technological features of gbif.net, such as dead links, poor mapping, and difficulties in finding information. One also considered it a weakness that the portal supports two schemas and not just one.

The respondents to the user survey also provided us with many suggestions for improvements to the portal and to other aspects of GBIF's activities. These ideas are included in section 4.6.

4.3.4 The experts

More than thirty independent experts commented on the actual or potential value added by GBIF from a user perspective. Except for a very few, all the experts expressed high confidence in the raison d'être of GBIF, specifically the concept of one single point of access to biodiversity data and also the possibility of accessing one authoritative list of taxa.

One third of the experts commenting on this topic emphasize the one-stop shopping vision of gbif.net as an added value of GBIF. According to several of these experts, the facility already provides rapid and easy access to a large quantity of distributed data from many providers around the world who, without this mechanism, would have to operate in isolation. Other experts found that GBIF is progressing toward this goal but is not there yet, because there are still too few data and features such as more detailed geo-references, image galleries, and more complex queries using multiple search criteria still need to be developed.

As one expert pointed out, from a user perspective "GBIF is an infrastructure that plays its role in the background. The real players that will make GBIF a real success are the organizations and partners providing data, but also developing a portal linking to the GBIF infrastructure." This might

also be the source of the most critical potential problem for GBIF – as another respondent pointed out – since "data are secondary (or further removed) and thus nearly impossible to check and verify."

The actual value of gbif.net is only visible from the perspective of working scientists, as far as several experts viewed it. The potential value, however, is expected to increase if the scope of gbif.net is expanded to user segments other than scientists, e.g., to users in industry, government, and education. Experts in the developing world seem to be particularly focused on expanding the potential use of gbif.net into non-scientific areas such as decision-making.

One expert – representing a data collection – had not yet used data from gbif.net, but emphasized the value of having the data collection listed and accessible from gbif.net.

4.3.5 The Review Committee's review of gbif.net

As part of its activities, the Review Committee conducted a structured review of gibf.net focusing both on content and usability. The assessment of the content on gbif.net was based on the following input from committee members:

- The specific search command;
- The members' expectations of the outcome of the search command;
- A description of the search process and an assessment of the portal's usability;
- An assessment of quality and comprehensiveness of the information gathered;
- An assessment on the clarity of the IPRs for the records found; and
- An overall conclusion about the search.

The Review Committee searched for 15 specific organisms. Six of these searches had a satisfactory or acceptable outcome whereas the remaining nine searches did not. We presented these results to the Secretariat, which in return provided feedback on the causes of the poor result and made some immediate adjustments to the portal.

Much of the Review Committee's disappointment with the content on gbif.net had to do with the lack of data and with the fact that the portal is still a prototype, where several features were not functioning or did not have proper disclaimers stated for the users at the time of the review. Our main criticisms of gbif.net in early September were the following:

- The fact that gbif.net was not prominently designated as a "PROTOTYPE" could potentially raise negative impressions among visitors to the portal. By subsequently labelling the portal as such, the Secretariat has helped mitigate a potential negative impression of the

portal by users based on (fully understandable) initial deficiencies such as missing data or not fully functioning features.

- The portal had French and Danish language options listed that were not yet implemented. The committee believed that native speakers of those languages would be insulted when they tried to use those non-existent options. These options were removed by the Secretariat and will not be reinserted until full translations of the pages are implemented.
- The IPR user agreement was disconnected from the "accept" button, which was making it possible for the user to click "accept" without having to open the agreement. This disconnection was rendering the agreement invalid. The agreement is now imported as a frame field within the window, above the "accept" button.

The Review Committee was pleased to see that the recommended changes were implemented immediately by the Secretariat.

Furthermore, the Review Committee suggested that observational data records be deleted until a critical mass was reached in order to mitigate a negative impression due to unfulfilled user expectations regarding the quality and comprehensiveness of those data. We subsequently agreed with the Secretariat that this potential problem of addressing such expectations could be properly dealt with by explaining the nature of the data on the opening page of the portal. This improvement also was implemented by the Secretariat before the end of 2004.

The Committee's assessment of the data portal's usability is generally positive concerning other features, such as navigation, well-functioning links, response time, user friendliness, and layout.

4.3.6 Conclusions

The various responses gave us a fragmented picture of what the actual and the potential uses of the portal are, but the overall support seems to be strong in the GBIF community as well as among most experts and users. Of course, it is important to emphasize that the portal is still just a prototype, but the overall experiences with the portal have been quite positive even though the content and the functionalities there are incomplete. These very positive signals from all sides primarily show the trust – in the opinion of the Review Committee – in the future usability of the portal rather than in its actual use.

Even though there is a great trust in the potential of the portal, there are some diverging emphases:

- *The scientific use approach*, which emphasizes the scientific character of GBIF and focuses on building a data network infrastructure that primarily supports research and users in the scientific community.
- *The applied use approach*, which emphasizes the potential of GBIF in education, policy making, nature conservation, and other applications.

These two approaches might co-exist very well; they have so far in GBIF's plans. But as the network and the portal develop they will also increase the expectations from different kinds of users about the contents, the functionalities, and the presentation of data on the portal. Consequently, GBIF will have to develop gbif.net simultaneously in diverse directions in order to satisfy the very different expectations from the user segments, and also continuously manage user expectations by presenting clear information on what can and cannot be found on gbif.net.

The figure below illustrates the link between the content on gbif.net and the user segments. As an emerging scientific infrastructure facility, GBIF's raison d'être would solely be to provide an increasing amount of data to scientists.

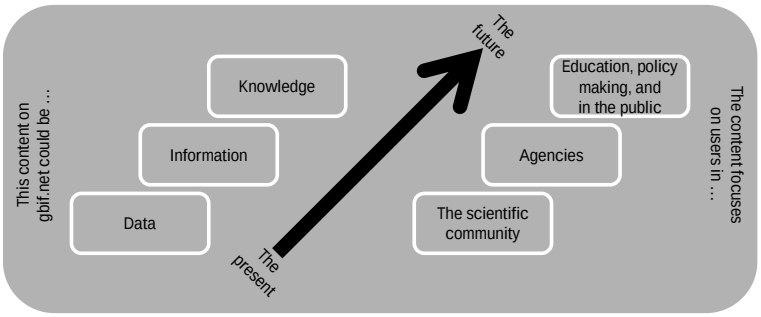


Figure 4.8
The linkages between content and users

Taking gbif.net to the next level – that is, responding to the needs of users other than scientists – will require additional content and functions. This would increase the number of applications and users, but only if the requisite analytical tools, user-specific interfaces, and ancillary specialized information are developed. The Secretariat expects other organizations to provide such tools, but since the success of gbif.net is closely related to the actual use of data, the portal will in the future have to provide such added features. Consequently, the Secretariat will need to take the lead in the development of new tools and information, either on its own or in new strategic partnerships.

The Review Committee believes that the portal will have great potential when the number of records increases substantially and the data are correctly identified through a sound, higher-order classification (families to phyla) and made broadly usable. The potential will increase even more when the links are established to other kinds of data, e.g., genomic, ecological, observational, or geo-referenced data, and the biodiversity literature. Additional functionalities also will increase the potential use of the portal, for example, with a better search interface, various user interfaces, increased user-friendliness, GIS functionalities, and access to analytical tools that are well supported. Moreover, the portal's current anglophone bias will have to change. Section 4.6.1 elaborates these very specific suggestions for future improvements on gbif.net.

A major problem has been and perhaps will continue to be that the prototype does not provide a good description or control of the quality and extent of data. The Review Committee, as well as many respondents, has had serious doubts about the quality of the data, since this is now solely the responsibility of the numerous independent providers. This specific issue is discussed in section 3.2 on the DADI Programme.

Despite the incompleteness of the gbif.net prototype, the initial content and functionalities there clearly support the concept that GBIF is feasible and that providers are willing to provide data.

4.4 The knowledge of GBIF among users

The following assessment of GBIF's "profile and uptake" with the specific user groups is based on the Secretariat's self-assessment (largely prospective) and on the responses to the various questionnaires. The assessment is based on the knowledge and perception of GBIF among the following user segments:

- The scientific community;
- The educational community;
- Policy makers and implementers;
- Commercial users; and
- Users in the general public.

Except for the commercial users, these segments of users were identified in the Content of Review document that forms the basis for this review. The knowledge and perception of GBIF among these segments are described in the rest of this section.

4.4.1 The scientific community

As an organization born in the OECD Megascience Forum, GBIF's primary users are the members of the scientific community in several disciplines, such as systematics, ecology, conservation biology, and bioinformatics.

The Secretariat ...

According to the Secretariat, researchers in the fields of biogeography and environmental prediction are not only aware of GBIF, but are working with the organization. Many systematists are aware of GBIF as well, but are waiting to use it until the quantity of data available through GBIF is much greater than at present. Informatics experts in the ecological and molecular areas are aware of GBIF and are reputed to be eager to interact with it.

The GBIF community ...

The comments from the respondents in the GBIF community also suggested that the use of the portal so far has been limited due to the relatively small amount of data, which might explain why the knowledge of GBIF is not yet very widespread in the life sciences. The portal and the vision of GBIF have – at least in the developed countries – been received well with high, yet critical, expectations. It seems that GBIF and its portal are best known

among scientists in systematics and bioinformatics, but that these scientists also tend to be more providers than users. Some respondents noted that GBIF is not fully understood in the scientific communities in general and that there is a need to contact users outside the systematics community (e.g., in ecology, genetics, chemistry, and pharmacology) to help them understand the vision of GBIF. The few comments received from scientists in developing countries suggested that the knowledge and perception of GBIF is limited there, which might be explained partly by problems with Internet connections.

Based on the interviews with Governing Board members and on their responses to the review questionnaire, most found that the knowledge of GBIF among the scientific user base was relatively high, although important caveats were noted. The perception of GBIF in the scientific community was also deemed to be generally favorable.

The users …

The respondents from the user survey reflected on the use of gbif.net in the scientific community, thereby presenting future expectations to be met by GBIF to increase knowledge and perception among these users. In addition to enhancing access to and exchange of biodiversity data and thus opening less-known collections or observations, several users saw gbif.net as a possible reference source in which scientist are able to find information on "who is also dealing with these species," which museums keep samples of their favorite species, presenting "high quality citable information on world biodiversity," and creating links to other scientists in specific groups and to methodologies, software, etc. These expectations exceeded the planned taxonomic reference catalog.

The comments from users also indicated that the knowledge of GBIF is well-known among scientists in systematics and biogeography, whereas conservation and ecology and basically all research in biology and medicine could benefit from GBIF. As one of the expert users argued:

> *"Unfortunately biosystematic information has been dispersed and there has not been a single universal comprehensive summary of it in over 250 years. Hence, biological research has been less that maximally efficient. So, even a biosystematist wants the GBIF vision to see beyond their group (taxon). Other biologists need a view of all groups and to the extent that a scientist or medical researcher studies life from a comparative view, they will want a GBIF vision."*

The experts …

Among the experts who responded to our questionnaire, more than thirty commented on the knowledge and perception of GBIF in scientific communities. Three out of four found that the knowledge of GBIF was already generally high, or mixed, depending on the community in question. A similar number found that the perception of GBIF was already rather good or more positively expected to see better results coming from GBIF. Only one out of four was hesitant about GBIF, but there were no apparent similarities between the backgrounds of these experts. One expert suggested that awareness in the applied conservation community is greater than in the scientific community, perhaps driven by the original expectation that GBIF might infuse large amounts of cash into the system.

The expert respondents indicated that scientists do recognize the importance of GBIF, though the number of users so far is small. At the same time, there is some degree of scepticism that GBIF will achieve its aims, and concerns that the data are not always valid. So, even though all but one would agree with the need for GBIF, some also have a wait-and-see attitude.

Clearly, GBIF is fairly well known among natural history collections and institutions with the ability to contribute data to GBIF – indeed, some already do. One expert explicitly recommended that GBIF continue an outreach program in order to enhance knowledge among many organizations that do not yet know about GBIF, as discussed earlier in this chapter, and among scientific data users at the more basic level.

4.4.2 Users in education

It is mentioned repeatedly that gbif.net in the future may be tremendously useful for educational users.

The secretariat ...

The Secretariat has noted that when software developers create user interfaces to the GBIF data portal that are specifically aimed at this user group, educational use will expand tremendously.[16] The Secretariat already has gotten requests for information from students at all levels via the "contact us" link on the portal. The Secretariat believes that GBIF data will significantly enhance online learning and be used for CD educational tools. Although the time has not yet come for targeting educational users, the Secretariat believes that GBIF is well-positioned to do so with its connections to the CBD's Expert Center for Taxonomic Identification and to the Global Taxonomic Inventory.

The GBIF community ...

Governing Board members collectively agreed (45 of them commented on this topic) that the "profile and uptake" among educational users was still very low, but that the future potential for educational applications is great. A few members expressed some doubts that GBIF should address this segment of users.

Governing Board members generally agreed as well that serving the educational users will require completely new features on gbif.net, since the portal has too much emphasis on primary data and too little emphasis on making the data an effective tool for learning and the creation of new knowledge. Features suggested for educational use include improving the presentation of data and providing more interpreted and synthetic products. In this regard, the introduction of the species bank is likely to increase the use of gbif.net. Other improvements suggested include the development of a better search function; additional tools to select, classify, and visualize data; additional information about species, such as images, sounds, and descriptive data; and addition of other types of data and information, such as

[16] Examples of the type of software developers the GBIF Secretariat refers to here can be found at: http:// www.eti.uva.nl/; http://www.globio.org/; http://www.bioednet.org/; and http://www.davidrumsey.com.

historical publications and data from expeditions. Furthermore, gbif.net will need to provide different views of the data in the form of summaries, tables, graphs, interpretation of the data, and modelling. All of these functions should be presented at various levels of complexity, according to the educational level of the students concerned.

The users …

The respondents from the user survey reflected on the use of gbif.net to users in education as well. Their comments indicated that they believe this segment does not yet have much real knowledge of GBIF, though nearly one fourth of the respondents actually have an affiliation to education, either as a scientist or as a student.

So far, the portal is too "technical" for broad educational purposes. Already, gbif.net "can and should be used for student research" although the material does not yet support classroom activities as such. This would require much more digested information and ready-to-use material. As one respondent noted, this implies that gbif.net "should provide data and literature," thereby creating a "source of high-quality, citable information on world biodiversity."

The most important contribution from GBIF to the educational community at all levels will be the development of gbif.net into "a source of accurate and widely recognized taxonomic data." The usefulness of gbif.net for the more sophisticated educational user could be:

- Learning how to access biodiversity data and using them;
- Learning about interconnectedness – the big picture in ecology;
- Providing a taxonomic reference database and basic instruction in many domains;
- An easy view of what data are available;
- Gaining information on organisms needed in teaching; and
- Getting a good overview of the distribution of species.

The experts ...

Finally, the expert respondents – 21 commented on this topic – generally agreed that the knowledge and perception of GBIF in the educational community is rather poor. Nevertheless, access to the GBIF data sets by students at the university level is expected to be very positive by some, especially when further improvements on gbif.net are made and links to exercizes are provided.

4.4.3 Users in policy making or policy implementation

This segment covers a rather diverse group of politicians, officials, and civil servants in government agencies and local administration, and experts in NGOs.

The secretariat ...

The Secretariat believes that this user segment, in GBIF Participant countries/economies, is aware of GBIF but does as yet not fully understand how to access and analyze GBIF data and put them to use.[17]

The GBIF community ...

Nearly sixty respondents from the GBIF community commented on this and most of them considered the policy community to have a limited knowledge of GBIF to date and little basis for understanding its value to it. Similarly, however, there is a strong expectation that the GBIF network will have significant policy relevance and uptake in the future. The awareness of GBIF apparently is notably higher in the policy communities working on environmental issues and international conventions. The actual use of gibf.net, however, was limited since the presentation of data on the portal does not address the needs of the users in this segment for various reasons:

- Lack of data, especially for the regional level;
- Lack of training or explanation;
- An anglophone bias is a barrier for a lot of users – not only policy makers and implementers – in many participant countries and economies;
- Lack of more sophisticated functions, such as spatial distribution and analysis tools; and
- Inability to connect – at least not yet – the users' own activities with those of GBIF.

Generally, most policy makers and implementers have a lot to do and not much time. According to one Governing Board respondent, what they need from GBIF is:

> *"a reliable source where they make a query on a species or a site [and] get a clear and not too complicated summary, with some nice tables, graphs, maps and pictures. They want to be able to answer easy questions, which species are there, is there a protected area, what impact will an "activity" have there, and the access to this information needs to be quick and easy." (Voting Participant)*

The users ...

The potential of GBIF in political decision making globally, nationally, and locally is considered very high. Some respondents apparently also were concerned about this since policy makers "are looking for simple answers, and hopefully GBIF won't give them ways to avoid uncertainties and complexity." However, most of the respondents did not really consider gbif.net as a tool for policy makers, but as a tool for making policies. It will

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[17] The Secretariat has provided a few examples on the GBIF Web site of how the policy user segment can employ GBIF data: A presentation by Jorge Soberón, entitled "The National Biodiversity Information System of Mexico," and "A new biogeographic regionalisation for Tasmania," by David Peters and Richard Thackway, provide some examples. Achieving the Australian National Objectives and Targets for Biodiversity Conservation 2001-2005 can be significantly assisted by GBIF data.

be mainly scientists who will be able to use gbif.net to produce scientific information and analysis useful for policy makers and implementers for their decisions. Another respondent thought that "this group of people needs to be made aware of global diversity and their exposure to GBIF would be a great asset."

Many of the users showed very explicit expectations in the possible uses of GBIF in policy making and implementation, for example:

- Providing understanding about the vision of GBIF and thereby encouraging and financing biodiversity or conservation-related efforts nationally;
- The ability to identify other bio-regions and conservation management plans that inspire planning in other regions;
- Being a source of high-quality citable information on the status of world biodiversity in marine, land, and freshwater environments;
- Being able to provide maps and analyses for regions and being able to overlay protected area networks and identify the need for new areas or to prioritize protected areas;
- Detecting the presence or absence of flora and fauna; and
- Providing specific references to minimize confusion in laws regarding biodiversity and information to aid in drafting such laws and programs.

One respondent summarized the knowledge and perception of GBIF like this:

> *"A good basis, but I doubt that many policy makers are using it as yet. Policy makers work in a country/region, rather than globally. As more data becomes available, better and more refined searches can be conducted (spatial etc.) and more associated (habitat/ecosystem etc.) data becomes available over GBIF the potential is enormous…. [T]he quality (and perceived quality as much as actual quality) and good documentation of quality is an absolute essential in this field.*

The experts …

According to nearly all the experts, the knowledge of GBIF is generally low or limited to very few of the relevant policy makers or implementers. As one explained:

> *"The sort of data (specimen and species level data) is not of relevance for policy makers, since they depend on meta data or analysis. This is to my knowledge not provided on GBIF, and in fact should not be, since this is the domain of specialized institutions. GBIF then could – if well coordinated with others such as the Clearing House Mechanism at the Convention of Biological Diversity – provide access to such analysis."*

Another expert had the impression "that policy makers and implementers see GBIF as the 'one-stop shop' to answer all their biodiversity related questions. But GBIF is still a very long way from reaching that point." The

question raised by the expert – as well as by others – is exactly how far GBIF should go in digesting data and presenting them on the portal. We address this further below.

4.4.4 Commercial users

Unfortunately, none of the respondents to our questionnaires have had the opportunity to comment on the "profile and uptake" among this specific segment of users.

The secretariat ...

The Secretariat did mention that corporations in the biotechnology, pharmaceutical, and agriculture sectors might be able to benefit from GBIF data when the planned interoperability with online molecular and ecological data is accomplished. This activity is planned under the 2005-2006 Work Programme.[18]

The GBIF community ...

Our interviews with members of the GBIF community also indicated that industry may have some interest in molecular biology, biomedical applications, and invasive species work. Although this might be a source of additional funding for GBIF – or perhaps also a source of data or other sort of content on the portal – a closer linkage with industry could be perceived as a problem by developing countries, which are defensive about giving away indigenous or traditional knowledge without compensation. This IPR-related issue is also noted in section 2.3 above.

The users ...

It also was pointed out by one of the users, who has a legal background, that GBIF should involve industry because …

> *"… they are clearly very interested in the type of information available via GBIF and will have the technology (unlike much of the ideal target audience in the developing world) to access the images and data rapidly and efficiently. The concept of GBIF is excellent. However, there needs to be considerably more thought as to the practicalities of its execution – unless it wishes to be viewed down the line as the tool of bio-pirates."*

The experts ...

None of the experts had significant comments on the "profile and uptake" among commercial users of GBIF.

4.4.5 The general public

Our survey among users of gbif.net suggests that approximately one-tenth of the visitors consider themselves as being in the general public segment of

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[18] Lene Lange of Novozymes AS presented the potential commercial use of GBIF-like data at the Science Symposium held in conjunction with the 8th Governing Board meeting. The presentation entitled, "The Importance of Biodiversity Data to Discovery and Technical Applications," is available on gbif.org.

users. Although the number of respondents was rather limited, the responses to the questionnaire did indicate that the general public visit gbif.net.

The secretariat ...

The Secretariat in its self-assessment noted that members of the general public who have used Internet search engines (e.g., Google) to look for "biodiversity information" or "biodiversity data" have readily encountered GBIF, because links to GBIF's data portal appear first in both cases.[19] However, the Secretariat does not yet know exactly how the general public may be using the data.

An unexpected mention of GBIF appeared in a recent issue of a Danish comic book. GBIF was thinly disguised in one of the stories, as the images below illustrate.

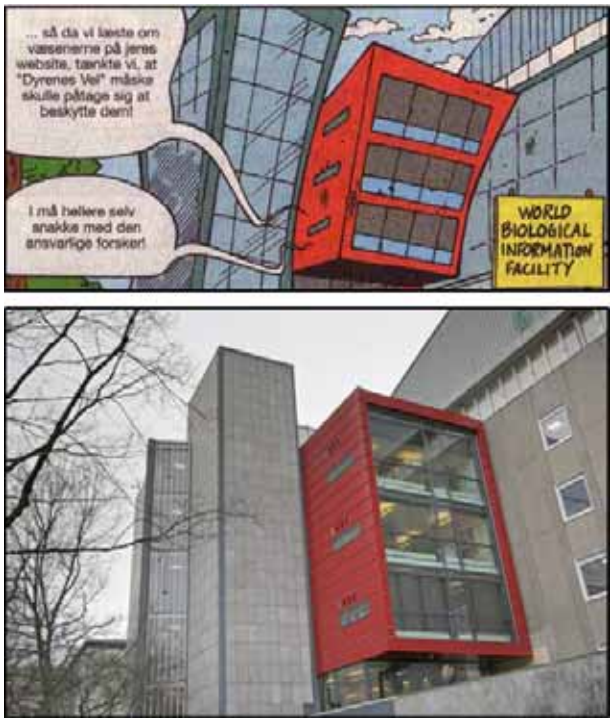

Figure 4.9
Above: The "World Biodiversity Information Facility" from the Danish Donald Duck Magazine, Jumbobog No. 287.

Below: The real GBIFSecretariat, at the Zoological Museum of the University of Copenhagen

Upper drawing: Egmont Press, representative of Disney in Denmark, copyright 2004.

The GBIF community ...

Governing Board members found the general public to have the least knowledge of GBIF or the data on its prototype portal. Nearly sixty members commented on this issue and only one thought the general public has some knowledge of GBIF.

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[19] When searching on Google for 'biodiversity information,' GBIF is the first link out of 161,000, and when searching for 'biodiversity data' GBIF is also the first link out of 42,400. Google provides 7.8 million links when searching for 'Biodiversity' and GBIF is among the first twenty links. These figures were obtained on 7 December 2004.

> *"Judging from other experiences such as FishBase and the Botanical conservatories sites, the public wants to know more about what exists where they live, and the offer of GBIF type information (expanded with maps, photos, etc) provokes an incredible increase of demand" (Voting Participant)*

> *"The general public generally want "theme" based web resources based around topics of interest. Few want all specimens of a given taxon, they would rather browse maps and pictures and be "spoon-fed" rather than having to go and get it themselves." (Scientific Subcommittee member)*

As these two quotes suggest, gbif.net can and will be useful for the general public – that is, mainly the better informed citizen – if additional features are added to the portal, such as:

- Providing species-level information and more common names at the local or regional level;
- Developing species pages (perhaps through the Encyclopedia of Life, which is not a GBIF initiative, but one with which GBIF should perhaps form a partnership);
- Providing access in several languages, which will be highly needed;
- Using common (vernacular) names;
- Providing graphs, tables, maps, and maybe something "game like;"
- Providing photos and other visualisation functions; and
- Making searches easier.

Several members nonetheless emphasized that GBIF has plenty to do for the other user segments. Furthermore, it was noted that specialists in explaining science to the public are needed if GBIF is to try to address this broad segment of users.

The users ...

Not surprisingly, most of the respondents to the user survey share the view that GBIF is not a publicly targeted endeavor – at least not at present – although many of the users have ideas for improvements to gbif.net that will encourage the public to use the portal.

The overall vision seems clear no matter which segments of users are in focus, at least to one of the respondents:

> *"For all the users, GBIF promises a single authoritative portal for ALL biosystematic information. One place where every one who has 1) a scientific name of an organism can find whether it is correct or not, and if not, what is the correct name, then 2) link to basic information, like where does the organism occur in time and space. For teachers, students and general public, a basic encyclopaedia of life."*

Ideas for raising GBIF's profile among the public included information for groups working on biodiversity grass roots issues or – as suggested by an American user – an advertising campaign in *Discover, Mensa, Scientific American, Games, Psychology Today*, or other magazines like that, to bring curious visitors to come explore gbif.net. Improvements of gbif.net content and features for the general user would include the addition of common names, images, literature, and making systematics more accessible. Although gbif.net may not evolve into a facility for the public at large, even a scientific infrastructure can catch the attention of users outside the immediate target group.

The experts ...

Finally, nearly twenty experts reflected on GBIF's "profile and uptake" among users in the general public and every one of them thought that the knowledge of GBIF is very low. Furthermore, none of them expected GBIF to have any real potential for this segment of users.

4.4.6 Conclusions

Although we are not be able to provide a comprehensive overview of the knowledge of GBIF among its user groups globally, the information and input we obtained from independent experts, a small sample of actual users, and of course the GBIF community itself has provided an indication of such knowledge. Generally, it appears that the knowledge of GBIF among the principal groups of users is highly fragmented. Our data indicate that:

- Knowledge about GBIF by *users in the scientific community* is quite high and increasing in the systematic, biogeographic, and bioinformatic communities, particularly in the developed countries. In other areas of the life sciences, e.g., ecology, genetics, chemistry, and biotech, the knowledge of GBIF is slowly improving.
- Knowledge about GBIF by *users in education* is low and will be as long as there are no tools or interfaces focused on educational applications on gbif.net. The potential of GBIF in this group seems to be great, but also dependent on specific initiatives for developing the requisite tools and interfaces.
- Knowledge about GBIF by *users in policymaking or policy implementation* in the participant countries is moderate and uneven. Many government institutions are involved in GBIF, but the potential use of the GBIF network for such applications is not yet clear to many potential users in other government agencies. The influence of GBIF on policy making and implementation will depend on the interpretations and analyses provided by scientists, consultants, and others rather than on GBIF itself.
- Knowledge about GBIF by *commercial users* is very low. The potential of GBIF among the commercial users is somewhat controversial, but also could be significant, especially if data from gbif.net are made effectively interoperable with molecular and ecological data.
- Knowledge about GBIF by *users in the general public* is very low as well. The potential use of gbif.net by the public will depend on the applications facilitated by the portal and by its ease of use.

Overall, the knowledge of GBIF is quite high and increasing among its primary audience in the scientific community, but still quite low among its secondary audiences, including the broader scientific community. The Review Committee finds it acceptable that GBIF is not very widely known beyond its core scientific base, since the portal is still a prototype. Nonetheless, it indicates the need for much more vigorous outreach activities in the future. It also underscores the need for more demonstration projects that show the potential of gbif.net and the various applications of the data accessible from there. More important, it also emphasizes the need for developing features and interfaces targeted to the specific user groups in order to reach them properly. We find that GBIF needs to focus on a broader set of users and applications to demonstrate its relevance. Focusing on applications and examples that are compelling and have high impact will increase GBIF's profile and uptake – especially if the effort is converging with educational needs and with the needs of the conservation community along with scientific needs. This will require intensive development of gbif.net, including translation of content into languages other than English and improving the search and visualization functions with maps and photos.

4.5 Visibility and outreach

This section deals initially with the public visibility of GBIF and then with its outreach activities, including the funding of demonstration projects.

4.5.1 Visibility

With regard to the media, GBIF has achieved some recognition in the specialized and more general anglophone scientific press such as *Science* (seven articles), *BioScience* (one article), *New Scientist* (two articles), and *Applied Genetic News* (two articles), among others. GBIF has also been cited in non-scientific media, such as newspapers or radio, but we were only able to find such references in Denmark.

During the course of our review, several people mentioned to us that they have great expectations to see the first articles using GBIF data printed in the most important peer-reviewed scientific journals.

The distribution of articles and other references in the media at the end of August 2004 is presented in the figure below.

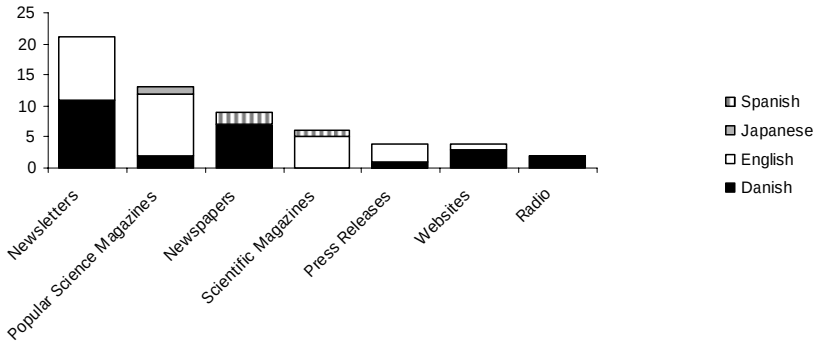

Figure 4.10
GBIF in the press by end of August 2004

Source: GBIF in the press list by the Secretariat (end of August 2004)

At that point, GBIF was mentioned in nearly sixty instances – mostly written in Danish and English. Only one article was prepared in Japanese and three in Spanish. Not one article was in French. Most of the information about GBIF appeared in various newsletters.

This is understandable and appropriate, however, since it is still too early for the organization to be broadly promoted, given the status of its prototype portal. Nevertheless, a truly global dissemination of GBIF will require a much more multi-linguistic and widespread approach.

4.5.2 Outreach

This section deals with GBIF's outreach to the various segments of users from the perspectives of the Secretariat, the GBIF community, and the experts responding to our questionnaire.

The secretariat ...

According to the Secretariat, specific, targeted outreach has been made – and is ongoing – to the scientific community and to policy makers albeit this is mainly for building support and funding. The time has not yet come for targeting educational users though it is getting much closer.

GBIF's efforts for outreach to users are restricted thus far. It is difficult for GBIF to demonstrate the usefulness of the portal because there are no user interfaces and analytical tools that draw on GBIF data and that are geared to specific user groups. In developing those interfaces, GBIF should consult with some representatives from these different user groups to interact and perhaps even develop expansions to the model to better suit their specific needs and uses.

According to the Secretariat, it will be very helpful when appropriate organizations and companies begin to develop such interfaces and tools. GBIF's contacts with such organizations and companies, however, still need to be developed.

The GBIF community ...

Among the members of the GBIF community there were many positive comments on the outreach efforts of the Secretariat. Some of the comments noted that the portal now demonstrates the proof of concept and that GBIF is succeeding in connecting free biodiversity data from major institutes around the world through one portal. This is a precondition for even considering outreach to users. Also, it was considered good that GBIF staff and other GBIF people are attending conferences, congresses, seminars, and international events where they can spread the word about GBIF.

But there also was some concern in the GBIF community about outreach, mainly in which segments to address. A node manager had the following comments:

> *"GBIF will address this issue – outreach – in due time I think. Currently they mainly address the data providers (which could be said to be the same people as the scientific data users, though!) and should in my opinion strongly rely on outreach to the other groups in collaboration with us node managers,[because] we're closest to the users!"*

Nonetheless, GBIF needs to establish its portal and get better organized before having a big external relations push. The focus should be on the product, rather than on marketing, at this point. This hesitant attitude was shared by quite a few members of the GBIF community and may be explained by the potential risk of losing data providers and end-users by 'launching' prematurely.

Another concern about outreach activities was described as follows:

> *"I know it is probably heresy to say, but this is a tool that will be immensely valuable to science and management but for which the public is likely to have little direct use. To me, the effort expended on selling it to the public is unlikely to do much good and will detract a lot from building the system that scientists and managers need."*

Other respondents also considered it acceptable that GBIF is not overly aggressive in its outreach to non-expert users, but instead focuses on the scientific and other expert users. In turn, the expert users should translate and digest the data for other users. Consequently, the role of the national nodes will be increasingly important in outreach, because they are close to the various users.

A few members of the GBIF community found it a weakness that no survey of potential users was conducted by GBIF previously. This is considered a necessity for developing interfaces to particular user groups and to identifying efficient ways to serve these groups.

Overall, the respondents were split into two viewpoints: those who favor a narrow focus on the scientific users and those who advocate a much broader focus on users, including the general public.

The experts ...

A number of experts who commented on the outreach efforts of GBIF were generally very positive, since GBIF can "provide something nobody else does: bring all the pieces together by developing the interface." Furthermore, it was noted that the development of gbif.net has been participatory and responsive to input from the scientific community. Information is easily available and accessed; the technical basis is good and the organization carries out its affairs with a minimum of bureaucracy. Finally, it's free!

At the same time there also were a few negative remarks from some of the experts. Some considered the GBIF staff to be too small to "meet the increased exponential requirements" and only able to provide "limited technical support due to skeleton staff." Other remarks noted that the portal is still "not deep enough or complete enough to be useful" and also is not well documented.

4.5.3 Demonstration Projects

As the GBIF Executive Secretary pointed out, the idea of having a Demonstration Project was originally proposed at the OCB Scientific Subcommittee meeting, which took place in 2002. The main idea was (and still is) to be able to generate a "proof of concept or prototype" which can show to the international community (and not only the GBIF members) the usefulness of biodiversity data and their applications in science and for practical applications including decision making. If sufficiently compelling, such demonstration projects can help attract new Participants and partner organizations, recruit new data providers and users of the portal, and generally solidify existing support and participation.

The first call made in 2003 attracted 12 proposals. However, as this was the first time GBIF had requested such proposals, many of them were not appropriate, being either too narrow or off the mark. GBIF therefore requested that three of the proposers resubmit revised projects. One of these subsequently withdrew. The winning proposal came from the BIOTA Consortium involving the University of Turku in Finland and the Institute of Research of the Peruvian Amazon. It is important to note that when this project was selected, GBIF had not yet made available any biodiversity data via its prototype data portal, nor were GBIF's data architecture and data standards fully developed. Therefore, the awardees had to do everything from scratch. In the "guided tours" prepared by them, they included both data that they had previously generated in their research projects in Finland

and in the Peruvian Amazon, and generated and integrated some new data sets as well. [20]

The 2003 demo project presented concrete examples of the benefits of sharing and integrating biodiversity data from different sources and for different end users. Among others, the Demo Project tours provide examples of:

- Visualization of specimen and inventory data with map interfaces;
- Assessment of specimen data versus intensity of collection effort;
- Auxiliary maps and tools that interactively determine biogeographic patterns;
- Satellite image mosaics that help in assessing biological field data;
- How species data can be considered in conjunction with other sorts of data (populations, infrastructure, etc.);
- Multi-author data storage solutions to prevent dormancy of data;
- Visualization of biological information with helpful images;
- Online queries and integration of data using DiGIR technologies;
- How to conduct queries of biological literature using spatial criteria; and
- Integration of GBIF-related information into existing portals.

Learning from the previous experiences, two new criteria were added in the 2004 demo project call for tenders. The call was open only to GBIF Participants and the proposers were required to use data provided by the GBIF portal for most of their activities.

Because GBIF's major role is to provide primary biodiversity data, not to analyze these data, GBIF has restricted the amount of money it is spending on demo projects. The goal of GBIF is to focus on providing primary biodiversity data, much as GenBank does for sequence data, and then to let others build value-added products on top of these data. However, the Governing Board has agreed to spend a small amount of money on demonstration projects.

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[20] The GBIF demonstration project from 2003 is located on http://gbifdemo.utu.fi. The project demonstrated five different tours showing the potential use of GBIF-like data:

- Tour 1: Reliability and consistency of neo-tropical species distributions.
- Tour 2: Access to multi-author rainforest tree inventories.
- Tour 3: Interactive visualization of a sub-Arctic, grid-based observation data archive.
- Tour 4: Species data supporting regional planning and integrated management.
- Tour 5: Environmental literature searches on a map interface.

In 2003, GBIF was able to fund one proposal for USD 50K. However, in 2004, GBIF received a large number of excellent proposals. As a consequence, the organization reprogrammed some funds from several other activities in order to fund two proposals. Both projects will develop tools for conservationists and test those tools using GBIF data. One project will create the first publicly available web-enabled analysis tool for understanding species richness. The other focuses on developing a tool to estimate extinction at the population level.

4.5.4 Conclusions

GBIF's outreach activities obviously have been focused mostly on attracting active participants of various sorts: funding organizations, scientific partners, and data providers. So far, there has been some outreach to users in the scientific community and to policy makers (mostly for funding reasons), but outreach to other user groups (e.g., in education or other applications) has been limited. The Review Committee fully supports this prioritization because the portal is still a prototype.

The perceptions of the existing outreach activities are varied, but can be summarized as follows:

- GBIF is still not very active in its outreach to potential users beyond the immediate systematics community, where outreach has had an impact.
- This lack of broad outreach is generally considered acceptable in the short run, since the portal is currently aimed at a highly expert audience. As long as gbif.net lacks user-friendliness and broad applicability, outreach to non-expert users should remain limited.
- The nodes are crucial for further outreach – especially for the broader scientific communities in the participant countries and organizations.
- There is an apparent need for good examples – demonstration projects – showing the full potential and usefulness of GBIF data. In general, demonstration projects have lacked sufficient attention and resources.
- No user group surveys have been conducted (and our questionnaire was very limited). Therefore, it seems that there is only a limited knowledge of the demands for functions among the different groups of users outside the GBIF community. The needs from a nodes perspective have been surveyed, however.

In summary, the Review Committee encourages GBIF to be cautious in its outreach to users due to the near-term deficiencies of gbif.net. We nonetheless expect that preparations for comprehensive outreach activities will be made soon, focusing on users in the scientific communities, education, and policy making.

As discussed at the beginning of this report, GBIF was established as a scientific infrastructure project with a significant societal purpose. This dual purpose imposes a paradoxical pressure on GBIF. The societal purpose necessitates tremendous efforts in providing examples of the potential uses of data and making the data easier to understand and use, which is not the

primary purpose of a scientific infrastructure facility. This dichotomy will inevitably be a continuous topic of discussion in the GBIF community and will force GBIF to constantly maintain the dual focus – especially when prioritizing the scarce resources of the organization.

The Review Committee encourages the funding of demonstration projects and suggests that the number of projects funded be increased in the coming years. We find that the need for good examples of the usefulness of GBIF data exceeds the demonstration projects that have been funded thus far. There is a tremendous need for more diverse and compelling examples of the scientific uses of the data, of applied uses for policy and decision making, and of educational and other uses.

Quality of data

Finally, many respondents have expressed doubts about the quality of the data on the portal. There are, in our opinion, several good reasons for this and section 3.2 of this report deals with this essential question. Solving the data quality problem on gbif.net is complex and essentially dependent on improvements coming from the data providers who control the data. Obviously, this will take many years of standardization and data cleaning, but in the short term we believe that more information on data quality needs to be provided, e.g., by clearly stating where the data originate from (improved citations) and how data providers check the quality of their data.

4.6 Recommendations

4.6.1 gbif.net

Assessing gbif.net has been rather difficult since it is a moving target, constantly changing as more data are added or more features implemented. Some of our early criticism has been superseded by revisions made by the Secretariat in newer versions of the portal in response to the problems we identified. Nevertheless, our discussions and the comments we received from many respondents resulted in many suggestions for improvements to gibf.net.

Content

1. Because having comprehensive biodiversity data on gbif.net is essential for the success of GBIF, the emphasis continuously should be on identifying new data providers and building an ever larger data inventory. No matter how impressive the effort has been over the past year, the amount of data served through the portal is (understandably) still far short of being sufficient. So far, only the low hanging fruits have been picked and it will be increasingly difficult to expand the amount of data. It will require new participants with digitized collections and it will require much greater support of digitization initiatives.

Tools

2. Many respondents wanted analytical tools to be provided through the portal. We strongly support this and note that gbif.org already provides links to several tools developed in the biodiversity community. We encourage GBIF to be involved increasingly in the development of analytical tools that

are integrated with the portal. The integration of such tools is essential for attracting a broad range of users to gbif.net.

User support

3. With a constantly increasing number of users, GBIF will have to establish a user support infrastructure for effectively handling their questions and concerns. A partly centralized solution is necessary, but in the future a more distributed support structure will be needed as well to handle linguistic and other specializations. The best functioning nodes may very well be important for this purpose.

4. More specific content-related recommendations are:

- Implement different profiles or interfaces on gbif.net, depending on the specific segment to which a user belongs.
- Improve search functions by adding:
  - New search criteria or fields, such as dates, spatial coordinates, collector, common name, and others as needed;
  - Higher-order classification;
  - Index for names that may be misspelled;
  - Better overall metadata information;
  - The capability for saving searches; and
  - More complex and iterative search features.
- Improve handling of taxonomic synonyms.
- Implement multi-lingual options.
- Implement a forum for facilitating systematic discussions.
- Add beginner guides, FAQ's, pamphlets, and other user information.

Technical improvements

5. We have identified a number of more technical features that should be developed or improved or changed, although there surely will be others identified through a process of continuous improvement:

- Recognition of previous users, so that signed data user agreements are saved;
- Notification of users when specific types of data are added or when data on a specific taxon are provided;
- Storage of queries or user profiles; and
- Refining of search results.

6. More generally, the Review Committee sees no apparent reason to maintain two separate Web sites – gbif.net and gbif.org. A single, integrated portal will be clearer and less confusing.

4.6.2 Outreach strategy for users

1. At this stage of the evolution of GBIF, it is most important to demonstrate to scientists that GBIF will serve their interests. Other user groups will have to wait until suitable content and interfaces are developed. Nonetheless, it is essential to begin developing an outreach strategy focused on all the users. Outreach efforts need to be very well aligned with the development of the portal, for example, with the evolution of data quality, number of records, and interfaces.

The user outreach strategy should have an analytical foundation that clearly identifies and prioritizes the various user segments and their needs, so that it establishes effective approaches for serving these various constituencies, which are partly or wholly disparate from one another.

2. The Review Committee recommends that an outreach strategy for the scientific community be developed and implemented first, so that the focus is placed solely on the primary users. That way GBIF can concentrate on one type of user interface and get it completed and fully operational as quickly as possible. This will help engage GBIF with new sources of data. Any outreach activity to a specific group of users should rely on a strategy based on:

- A survey of user needs;
- An explicit prioritization of responses to user demands;
- A technically mature and tested user interface on gbif.net; and
- A clear division of responsibility between the Secretariat and the nodes for implementing the strategy.

3. What is not as clear to the Review Committee is the situation when gbif.net is no longer a prototype and more extensive outreach activities to users in the scientific community need to be implemented. This should be considered carefully by GBIF when developing its user outreach strategy. More specific communication activities recommended include:

- Presentations to high-value scientific congresses.
- Publishing informative papers and articles about GBIF like the one that recently appeared in BioScience (54 (6): 485-6).
- Asking people to acknowledge use of GBIF data in their publications, especially in scientific, peer-reviewed articles.
- Lobbying key constituencies and building liaisons with the world-wide museum community.
- Targeting a few major protected areas (like the UNESCO World Heritage Sites) and making special efforts to deliver relevant data to them. This could be a relatively easy effort that would get the GBIF logo before many people and provide a real service. Other high visibility users should be similarly targeted.
- Linking up with some special initiatives.

- Continuing efforts to visit high-value institutions by GBIF officials or its local representatives.
- Multiple languages should be used whenever possible.

4. The nodes should play an especially crucial role for GBIF's outreach to users. The nodes represent the main link between GBIF and the different user communities and a user outreach strategy will need to clarify their functions. The nodes can provide one of GBIF's main goals to encourage a greater level of in-country participation in GBIF and coordination with local user groups. We realize that not all nodes are in a position to deal effectively with this or have the resources to do so, but nevertheless GBIF's strategy must clarify how the nodes can support this in the future.

When developing its user outreach strategy, GBIF needs to avoid some common errors, such as:

- Excessive reliance on one-way communication, such as large-scale briefings, newsletters, and other forms of written communication;
- Reliance on mass media;
- A belief that telling the message once or twice is enough;
- Poor categorization of users with legitimately different interests, concerns, and needs;
- Mis-timing of communications (e.g., too late or too early, too much or too little); and
- Separation of the outreach process from the overall GBIF initiative, which produces fragmentation.

4.6.3 Raising visibility

1. The Secretariat has suggested in its self-assessment that a more extensive marketing of GBIF is being initiated. Based on the facts presented to us – mainly the undeveloped nature of gbif.net in its functionalities, the lack of documentation, and quality of the data – the Review Committee cannot recommend that more extensive marketing of GBIF is currently warranted. This is because the main product of GBIF – gbif.net – is not yet ready for broad advertising on mass media. Targeted advertising eventually could be important, but it would be costly and should not be implemented until gbif.net is sufficiently mature.

2. However, a more focused advertising program for scientific communities or societies would be less costly and could be more effective. Later, when GBIF is ready to approach other user groups such as educational users, a focused campaign for teachers at all educational levels might be necessary, but having segmented interfaces on gbif.net will be a prerequisite for any advertising beyond the core scientific user groups. The nodes will have to assist the Secretariat in this by translating articles about GBIF prepared by the Secretariat into their native languages and providing guidance to whatever magazines and journals will be relevant.

4.6.4 Demonstration projects

An essential component of GBIF's outreach to users – as well as to providers, participants, and funding sources – is demonstrating the possible use of data provided by the GBIF network. The Review Committee strongly supports demonstration projects as a means of presenting the vision of GBIF to providers, users, partners, and sources of funding. Nonetheless, more effort should be put into increasing the number and scope of such projects so that they address different scientific and applications communities to help funding agencies and other stakeholders better understand the value of GBIF.

The experts, users, and the GBIF community itself all have explained to us that it is definitely time to contact and build partnerships with intermediaries who will enhance the primary data to better serve the different categories of users. There must be tangible evidence that it is feasible and can provide useful information for the end-users. Consequently, the Review Committee recommends that more effort be put into planning and funding demonstration projects.

5. Governance and Management

5.1 Introduction

The key question about GBIF's governance and funding put forward in the Content of Review document is:

1. Have the present organizational structure and funding been sufficient for GBIF to achieve its goals?

In pursuing its answers to this question the Review Committee also was requested to examine the following sub-questions:

a. Governance Structure: do the Rules of Procedure serve GBIF well? Should GBIF continue with two kinds of Participants?

c. Legal Basis: GBIF is an independent organization, based on a non-binding, voluntary MOU. Is this basis sufficient and appropriate?

d. Operations of the Secretariat and the Governing Board: are they appropriate and efficient?

e. Voting Participation by Intergovernmental, Non-governmental and Other Organizations: the Rules of Procedure do not currently allow these organizations to be Voting Participants, and state that the possibility of offering Voting Participation to these entities should be considered in the third-year review.

j. Financial Mechanisms: should the Financial Contributions for Voting Participants and procedure to handle those (Annex I of the MOU) be changed?

k. Additional Funding: has sufficient and appropriate progress been made by the Participants in increasing their in-country or

intra-organizational investments in biodiversity information infrastructure in support of GBIF, as the Memorandum of Understanding encourages them to do?"

Section 5.2 explains and analyzes the participation in GBIF. Section 5.3 focuses on governance issues specific to the Memorandum of Understanding (MoU) and the Rules of Procedure of the Governing Board (RoP), and the functioning of the Governing Board. Section 5.4 on Funding covers topics such as the GBIF financial mechanism and the level of funding. The final section addresses the operation and management of GBIF.

The analysis is based on stakeholder opinions from the GBIF community and from independent experts, on intensive study of key documents, and on a comparison with other organizations. The Review Committee was not able to find any single organization to compare GBIF with and thus decided to compare it with a number of organizations that share some characteristics with GBIF, although they may differ in various functions such as purpose, funding, or governance structure. Appendix H presents these comparative aspects of governance.

5.2 Participation in GBIF

According to GBIF's MoU (§1.4) the definition of a Participant is:

A country, economy, inter-governmental organization[21] or other organization, or an entity designated by a country, economy, inter-governmental organization or other organization, that has signed this MOU and has expressed its intention to observe the provisions herein. A Participant may designate an entity to take part in the operation of GBIF and to act for the Participant in such matters as the Participant chooses to delegate to it.

Furthermore, the §4.3 of the MoU states that the Governing Board should consist of one representative from each Participant and that there are two modes of participation: (1) Voting Participants, for Participants that have decided to make an annual financial contribution, and (2) Associate Participants, for those entities that have not decided to make a required financial contribution, but want to take part in the deliberations of the Governing Board without the ability to vote.

The RoP document describes more thoroughly the possibilities of participation and the subsequent rights and obligations. The RoP (§3.1) and the MoU (§4.3) make voting rights dependent on providing a financial

[21] An inter-governmental organization is one that is established by three or more governments, that is based on a written agreement (treaty, charter, memorandum, etc.), and has permanent representation such as a Secretariat. Source: www.uia.org.

contribution. Article 3.2 of the RoP, however, states that inter-governmental, non-governmental and other organizations cannot apply for Voting Participant status until the 3rd-Year Review has considered whether voting rights should be given to entities other than countries. De facto, the following categories of participation are attainable at present:

- *Voting participation*, which is solely applicable for countries that are financially contributing to GBIF as regulated by the financial mechanism in Annex I of the MoU.
- *Associate participation for countries and economies*, which does not provide the Participants with voting rights and does not require financial contributions. However, these Associate Participants can change status to Voting Participant by sending an official letter to GBIF agreeing to pay a financial contribution (RoP: §3.3.1).
- *Associate participation for inter-governmental organizations, or other organizations*, which does not provide the Participants with voting rights and does not require financial contributions. At present, these Associate Participants cannot change status to Voting Participant (due to RoP: §3.2), although the RoP (§3.4) does contemplate this possibility if a so-called Ad Hoc Membership Committee finds a petition to be acceptable and fair, and an appropriate financial contribution is negotiated (MoU: §4.4).

In addition to these categories of participation, the RoP (§8.1) considers the possibility of giving institutions an Institutional Affiliation to GBIF:

> *8.1 Relevant institutions that deal with biodiversity data, including universities and university departments, governmental research institutes, agencies, foundations, private companies and national organizations, can become affiliated to GBIF. The cost of affiliation will be decided by the Governing Board.*

Even though this sort of affiliation requires some sort of financial contribution, the Affiliated Institutions cannot become Associate or Voting Participants and are not entitled to participate in Governing Board affairs unless invited to do so. At present, no institutions have achieved Institutional Affiliation and, to our knowledge, no institutions have petitioned for it.

5.2.1 Participants – who, where, when …

As of 7 December 2004, GBIF had 70 Participants: 25 Voting Participants, 17 Associate Participants from countries and economies, and 28 Associate Participants from a wide range of governmental and non-governmental international organizations.

As illustrated in the map below, Participants from countries and economies are spread all over the world, although there is still a preponderance of developed countries. GBIF has a large task in gaining more Participants from South America, Asia, Africa, and the Middle East—especially the

mega-diverse ones. Countries like Brazil, China, Russia, and Italy are obvious candidates for joining GBIF.

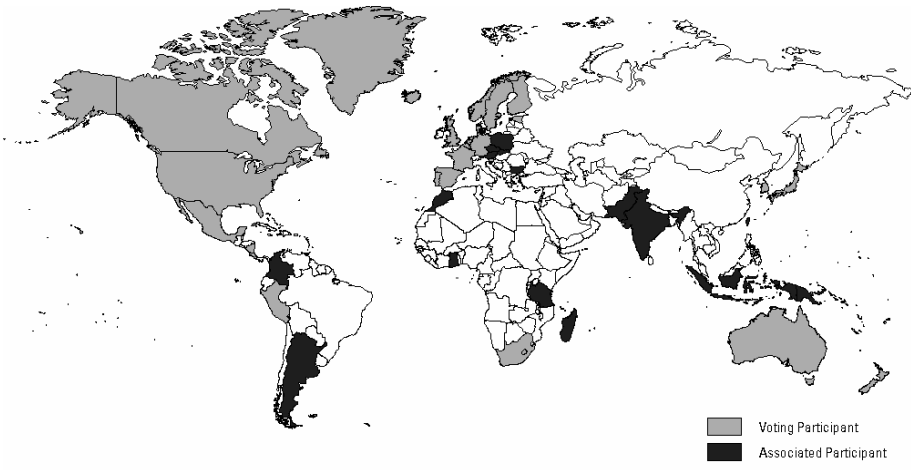
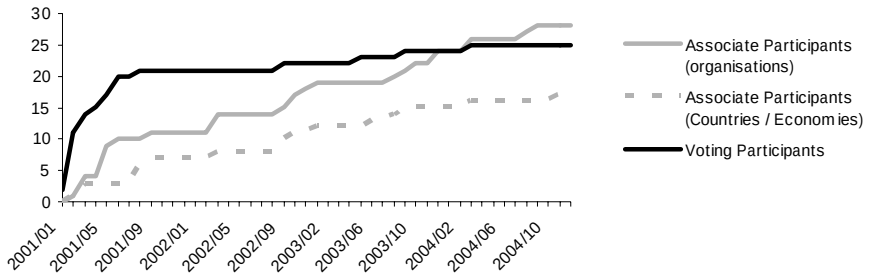


Figure 5.1
The global distribution of GBIF Participants

So far, the voting rights of GBIF reside heavily in the North, with its relatively poor biological diversity and rich systematics collections. Conversely, the countries in the South, with rich biodiversity and generally less extensive collections, seem to be voluntarily excluding themselves from the formal rights of voting in Governing Board affairs. Annex B contains a complete list of GBIF Participants as of the end of 2004.

The first countries and organizations joined GBIF in the beginning of 2001, when the countries in support of GBIF were able to guarantee a total basic contribution of 2 million USD. As illustrated in the figure below, GBIF had 21 voting and financially contributing Participants by the end of the first year. Only four additional countries have joined the category of Voting Participants since that time, indicating a serious stagnation in financial contributors to GBIF. In contrast to this, the number of Associate Participant countries, economies, and organizations has increased steadily.



Source: gbif.org (December 2004)

Figure 5.2
The expansion of GBIF Participants

The Review Committee is uncomfortable with this apparent inability to add financially contributing countries, coupled with the steady increase in non-contributing countries and organizations, since the total number of participants is a cost driver for GBIF. We expect that the increasing number of Associate Participants will lead to further pressures on GBIF's finances unless the numbers of Voting Participants are increased as well, or the mechanism of funding is altered, or both.

5.2.2 Motives for participation in GBIF

In our questionnaire to the Governing Board, the respondents were encouraged to describe the reasons why the Participant they represented decided to join GBIF. Many different reasons were mentioned. However, all of them can be reduced to the following five main ones:

- *Increasing dissemination of data from their own collections* was the most important reason for participating in GBIF. Many emphasized that their country, organization, or institution possess knowledge, taxonomic data, specimen data, or observational data, which they believe are usable by other institutions or in other contexts. Being part of GBIF can provide them with standards, which will facilitate the dissemination of their data. Another aspect of this increased dissemination is the expectation that GBIF will lead to an increase in applied uses of biodiversity data.

- *Gaining access to the GBIF network* and thus to data in collections in other institutions or countries was also given as a vital reason for participating in GBIF activities. Although access to the network and the data is open to anyone in the world, these respondents apparently believed there might be some additional opportunities for access by GBIF members.

- Several respondents – mainly organizations – mentioned that their objectives are aligned with the objectives of GBIF. Consequently, a major reason for participating in GBIF is to *exert influence* on the activities of GBIF.

- *Repatriation of data* from collections in developed countries to countries of origin was also given as a reason for joining GBIF.

- Finally, a few respondents mentioned the future *Catalogue of Life* as an essential reason for joining GBIF. Building an authoritative taxonomic index is considered a globally important task that is only achievable through global cooperation and is thus dependent on many countries and organizations participating in GBIF.

The figure below summarizes the reasons mentioned by the nearly forty respondents for participating in GBIF. The two main reasons – disseminating their own data and gaining access to data in other countries or collections – are obviously closely related to each other and indicate strong support of the facility.

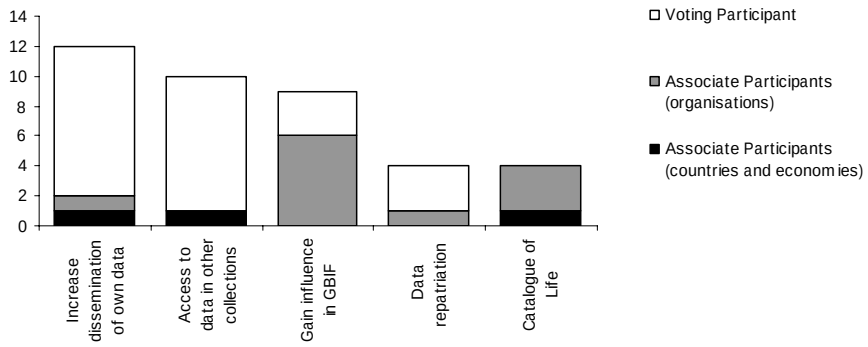


Figure 5.3
Motives for becoming Participants of GBIF

Source: Survey in the GBIF community (N=39)

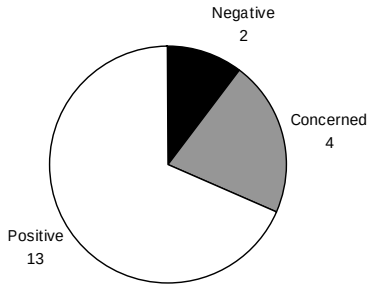
The respondents from developing countries emphasized the access to data in other collections in other countries as the main reason for participating in GBIF, along with gaining more influence.

5.2.3 The categories of participation – opinions

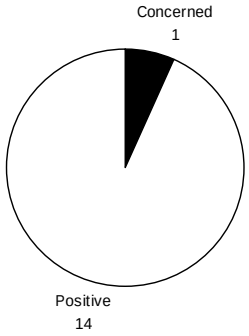
As we mentioned above, GBIF distinguishes between Voting Participants (also the financial contributors), Associate Participant nations and economies (no financial contribution and no voting rights), and Associate Participant organizations (no financial contribution and no voting rights). We asked the Secretariat and the GBIF community about their opinions on the kinds of Participants present in GBIF today, especially focusing on the following distinctions:

- The differences in rights and contributions between Voting Participants and Associate Participants;
- The presence of both nations and organizations as Participants and the interaction between them;
- The current link between the right of voting and the financial contribution; and
- The potential consequences of an increasing number of Participant nations and Participant organizations.

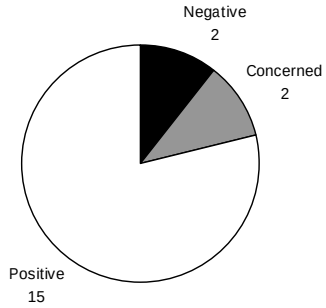
The figures below clearly indicate overall positive opinions regarding the present categories of participation in GBIF among the nearly twenty respondents who commented on this topic in the questionnaire. Our interviews in Oaxaca and Wellington also supported this impression.



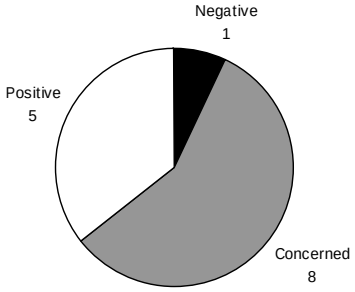
The difference in rights and contributions between Voting Participants and Associate Participants



The presence of both nations and organizations as Participants and the interaction between them



The present link between the right of voting and the financial contribution



The potential consequences of an increasing number of Participant nations and Participant organizations

Figure 5.4
Opinions on the categories of participation

Nevertheless, many respondents did express some concerns about the categories of participation, which we elaborate on in the rest of this section.

First, we asked the GBIF community what the specific considerations were for the Participant country they represent for choosing either Voting Participant or Associate Participant status (obviously, organizations and economies have not had any other alternative than being Associate Participants, but countries can choose). Apparently, most of the Voting Participants did not really consider any other status. The figure below clearly indicates this. The essence of the comments from most of the respondents is that there was really no political alternative, although the reasons given varied somewhat. Some emphasized that being a Voting Participant is an obvious consequence of being among the founding countries, or being – or wanting to be – scientifically leading in this field, or having major interests in biodiversity. Being a Voting Participant is necessary if a country "desires to influence and demonstrate leadership," as one puts it. A respondent from a developed country stated that "it is obvious that one has to pay for GBIF, and the philosophy of GBIF was that developed countries should support most of the GBIF costs in order to make it possible for developing countries to participate and to help for the repatriation of biodiversity data to developing countries."

Having influence in GBIF thus was an implicit motive for some respondents, whereas other respondents were more explicit about this. One respondent stated that the "stakes … are high, and we wanted to be sure that we could participate fully in steering the direction in which GBIF was going to go."

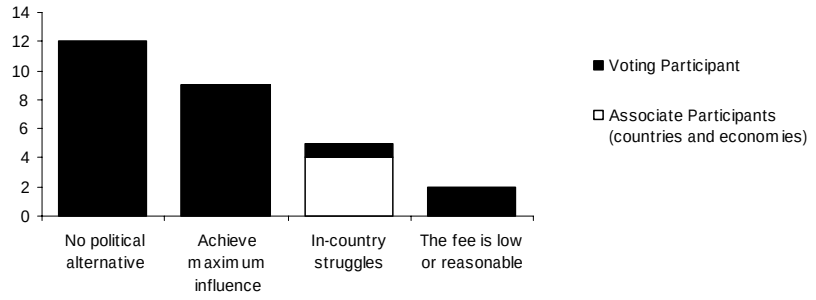


Figure 5.5
Motives for choosing category of participation

Source: Survey in GBIF community (N=28)

A few respondents mentioned internal problems as the reason why their countries are not Voting Participants. The main internal problem is getting funding secured, mainly because the funding comes from several sources in most countries. This is the reason why some countries have not been able to contribute financially to GBIF and it is potentially also the reason why some countries might not be able to secure funding in the next term.

The difference between Voting and Associate Participants, however, is not very obvious in the practical governance of GBIF because "the Governing Board should strive to work by consensus whenever possible" (MoU: §4.5.b) and because voting is used only where required, such as for the elections of officers and adoption of budgets and the Work Programme. As one respondent representing a Voting Participant put it: "Voting is not taken all that often, most activities are open to all members and the real influence in GBIF is had by hard work, irrespective of voting status." Much of the input we have received from interviews supported the notion that influence in GBIF is not solely reduced to a matter of formal rights, but is strongly based on scientific legitimacy and the ability to participate in the deliberations of the Governing Board and the committees. A few respondents also mentioned that the difference between Voting and Associate Participants is insignificant and not enough to attract Participants to contribute financially.

Most respondents also accept and support the fact that those who contribute financially also have more say in Governing Board matters. It is especially clear for nearly all respondents that organizations should not have voting rights.

Another problem that was mentioned is that the European countries apparently vote as a block, which neutralizes the voting of non-European

Participants, as several non-European respondents seem to have noticed. Giving voting rights to everyone – as one respondent suggests – could ameliorate the voting block problem somewhat.

Opinions on presence of both nations and organizations as Participants

A second aspect of the categories of participation is the presence of both nations and organizations as Participants and the interaction between them. The MoU (§2.1) states that:

> *"GBIF is an open-ended international co-ordinating body set up with the overall aim of furthering technical and scientific efforts to develop a global digitised information facility for biodiversity data."*

Open-ended means open for Participants – whether nations or international organizations – holding and being prepared to share biodiversity data. Although our inquiries indicated some tension between organizational and national participants, it also was obvious to everyone that implementing the vision of GBIF requires data and knowledge held by nations as well as by international organizations. A respondent representing a Voting Participant illustrated this point by emphasizing that "the organizations can be of great help to GBIF by their knowledge of how to solve similar problems (e.g., catalogue of names, IPR issues, etc.). This can be as important as a money contribution."

Figure 5.4 above clearly shows strong support of the presence of both nations and international organizations in GBIF. However, a few respondents mentioned that the organizations' agendas may differ from the agendas of nations and that the organizations from time to time can be "pushy" in discussions at Governing Board meetings.

Opinions on the link between the right of voting and the financial contribution

At present, each Voting Participant has one vote completely independent of the size of the financial contribution. Earlier discussions on voting, for example about weighted voting, have not led to alternative models of voting that have been sufficiently convincing. Moreover, as Figure 5.5 above indicates, the existing model is supported by many respondents. The following quotes also support this:

> *"Non-voting participants can have a strong input, which is good, but that only financial contributors (generally nations) have a voting right, assures that GBIF actions have a chance to be implemented."* (Respondent from major contributor, edited for clarity)

> *"GBIF needs resources. Some countries can pay more than others. It is only fair that those countries have a stronger saying on what goes on. I do not think we need to change things."* (Respondent from a developing country)

Opinions on the potential consequences of an increasing number of Participants

There are different opinions about whether GBIF should or should not strive to increase the number of participants, although the reasons vary:

- The *positive* respondents emphasized that GBIF is a truly global endeavor. Consequently, an increase in Participants – mainly countries – will add legitimacy to GBIF and improve its status as a worldwide organization. Any financial consequences should be addressed independently, as a respondent from a developing country noted.
- The *negative* respondents argued rationally as well. As a respondent from a major contributor stated: GBIF "is not the CBD. It does not need universal membership – and in fact this would be deleterious. It needs members who have data and want to and are in a condition to contribute." Because the raison d'être of GBIF is to guarantee that everyone else will have access to the data and tools on the network, formal participation per se is not important.
- The *concerned* respondents were more preoccupied with the governmental consequences of an increased number of Participants, regardless of their category. One possible consequence mentioned was "inappropriate skewing of decisions towards goals (capacity building) that will take away from the key needs (data and tools)," since more and more interests will need to be taken into account. This is considered a threat because it may blur the long-term vision of GBIF. Another possible consequence is that the power will have to shift from the Governing Board to the Executive Committee, which might require a redefinition of the Executive Committee and its composition, tasks, and responsibility.

In addition, as shown in figure 5.2, the increase in Participants is mainly caused by more and more Associate Participant nations and organizations joining GBIF. This development poses a risk to GBIF's financial strength since these Participants imply certain costs although GBIF does not gain any contribution from them. The GBIF community is well aware of this development, but "much of this could be ameliorated with other funding sources," as a major contributor stated in the Governing Board questionnaire.

5.2.4 Conclusions

The Review Committee recognizes the value of the current categories of Participants in GBIF. The categories – Voting and Associate participation – are well adopted by the GBIF community and also widely accepted. However, the information and opinions presented by the GBIF community raise some concerns in the Review Committee.

Categories of participants

The MoU and RoP of GBIF differentiate between various categories of relations to GBIF: voting participation for countries contributing financially to GBIF, associate participation for non-contributing countries, economies and international organizations, and finally institutional affiliation, which does not provide access to the Governing Board. The Review Committee finds that these categories are essential and relevant, but too exclusive if GBIF is to be a truly open-ended organization. In addition to those, we find that the segment of Associate Participant organizations is rather blurred. We believe that the rights, roles, and relations of the following entities need to

be defined more clearly: countries and economies, inter-governmental organizations, non-governmental organizations, international scientific societies, national scientific societies, commercial organizations and companies, national scientific institutions, and individuals.

One of the questions put forward to the Review Committee is whether GBIF should continue with two kinds of Participants or not. We conclude that the two existing kinds of participation are not sufficient to cover the relevant stakeholders of GBIF and it will be necessary to formally recognize other sorts of participation.

The increase of non-contributing countries and organizations

The committee also is uncomfortable with the stagnation of dues-paying Voting Participant countries coupled with a steady increase in Associate Participant countries and organizations that do not pay dues (although many do provide some in-kind support), since the number of Associate Participants is a cost driver for GBIF. We revisit this important topic in Section 5.3.7, but since the number of potential countries that can provide high contributions is decreasing, GBIF obviously has to find additional sources of funding if enhancements to GBIF's capabilities can be made.

Motives for participating and for choosing a category

The motives for joining GBIF appear to support the concept of the facility strongly – to disseminate digitized data from their own collections and to gain access to data in collections in other countries or organizations. It seems to us that the main reason why some countries have chosen the Associate Participant status, rather than Voting Participant, is that they have experienced problems in building support for GBIF at the national level and in locating the sources of funding. This is apparently a problem, although the basic contribution for many of these countries is rather low.

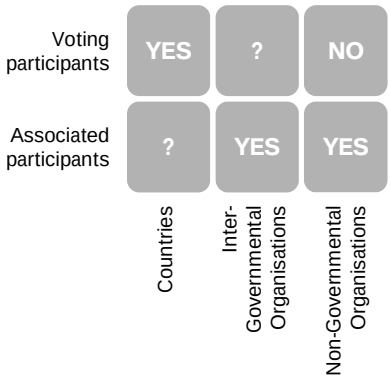


Figure 5.6
Opinions on categories of participation

Opinions on the categories of participants

It is clear to us that the GBIF community generally accepts and supports (1) the distinction between Voting and Associate Participant status, notably that only contributing countries have voting rights, 2) the presence of both countries and international organizations as a prerequisite for implementing the vision of GBIF, and (3) the current link between the payment of dues and voting. However, the difference between Voting and Associate

Participant status appears to be rather insignificant, because most decisions are taken by consensus. As illustrated in the figure above, the GBIF community clearly accepts that countries can be Voting Participants and that non-governmental organizations can be Associate, but not Voting, Participants. It is not clear, however, if countries should continue to be able to maintain their status as an Associate Participant indefinitely, or if inter-governmental organizations should be able to become Voting Participants.

The countries that currently stay in the Associate Participant category apparently do so because the incentives for countries to shift their status from Associate to Voting Participant are weak. This creates a free rider effect, particularly for OECD countries.

A number of developing countries have chosen not to become Voting Participants - even though the contribution is very low - and thereby forgoing the same rights as most developed countries. The Review Committee finds this disadvantageous to them, since it (voluntarily) keeps these countries from full decision-making and governance status.

Voting rights to organizations

According to the MoU, inter-governmental organizations can achieve voting rights if they contribute financially to GBIF. However, the RoP do not allow this presently. One question presented explicitly to the Review Committee is whether the RoP should allow inter-governmental, non-governmental, and other organizations to be Voting Participants. In our opinion – and most of the people we have interviewed agree with this – non-governmental and other organizations should not be allowed to gain such status, whereas inter-governmental organizations should be.

The status of inter-governmental organizations in GBIF was discussed intensively in the Interim Steering Committee of GBIF, where two essential reservations were raised: the possibility of a country having more than one vote if it is a Participant and is also a member of an inter-governmental Participant, and the difficulty of setting the level of contributions to GBIF since inter-governmental organizations do not have GDPs. Generally, the Review Committee acknowledges these reservations, but most significantly the committee finds that the segment of inter-governmental organizations has great potential as contributors that cannot be disregarded in the future funding of GBIF.

More specifically with regard to the first concern expressed above, the inter-governmental organizations may only be granted one vote like any other Voting Participant. Consequently, the countries that are members of an inter-governmental organization Participant of GBIF will only have an insignificant advantage compared to countries that are not members of that inter-governmental organization.

The second reservation is already dealt with in the RoP and the MoU, which suggest that the financial contribution from inter-governmental organizations can be negotiated with the GBIF Executive Secretary in order to settle on a fair and appropriate level.

More and more Participants

The legitimacy of GBIF is based on having truly global support, as well as on a highly usable portal. Thus, bringing more Participants into the GBIF

community is vital for the organization. It does stress the finances and the governance of GBIF, however, and consequently forces GBIF to seek other sources of funding and to restructure its governance. Nevertheless, the Review Committee would like to emphasize that seeking new sources of funding and restructuring its governance will be necessary for GBIF regardless of whether there is an increased number of Participants. This is needed because GBIF is changing organizationally from a developing mode to an operational status.

5.2.5 Recommendations

1. We believe it is in GBIF's interest to build as many and as varied relationships as possible in order to be a truly open-ended organization, as stipulated in the MoU. In order to expand its relations beyond the existing ones we recommend that GBIF distinguish between the following different relationships and entities:

- *Voting Participants.* The countries, economies, and inter-governmental organizations that provide the basic contributions to GBIF and have the right to exercise one vote. We recommend that inter-governmental organizations be added as potential Voting Participants.
- *Observer Participants.* A new, time-limited category of participation for countries, economies, and inter-governmental organizations preparing to become Voting Participants. We recommend that GBIF set a deadline for conversion from Observer to Voting Participant, perhaps at three years.
- *Associate Participants.* Non-governmental international organizations, and international societies. These entities cannot become Voting Participants, but can achieve representation on the Governing Board. This category of non-voting Participant is also used by the European Science Foundation (ESF), the Consultative Group on International Agricultural Research (CGIAR) and CERN.
- *Affiliate Participants.* Entities such as national governmental and non-governmental institutions, national societies, and commercial organizations and companies that have a legitimate interest in GBIF. Affiliation does not allow representation on the Governing Board, but provides access to participate in the scientific and technical discussions in GBIF (see the recommendation on changes in governance structure below). The ESF, CERN, and CGIAR also use a similar affiliation status for organizations or institutions in Participant or other countries.
- *Data providers.* Entities in possession of biodiversity data that meet the requirements of GBIF and that either can be or already are being provided to the GBIF network.
- *Donors.* Entities providing supplementary funding or donations to GBIF.
- *Partners.* Professional entities that share the interests of GBIF and that may enter into formal cooperative relationships with GBIF.

- *Friends of GBIF*. Scientists and other individuals with an interest in GBIF. These individuals may join activities or programs established by GBIF for this category, such as user groups.

The links between these relations and entities are illustrated in the table below.

Relation … \ Entity …	Countries and economies	Inter-governmental organizations	International NGOs	International scientific societies	National NGOs and scientific societies	Commercial organizations and companies	National governmental institutions	Individuals
Voting Participants	Yes	Yes	No	No	No	No	No	No
Observer Participants	Yes	Yes	No	No	No	No	No	No
Associate Participants	No	No	Yes	Yes	No	No	No	No
Affiliate Participants	No	No	No	No	Yes	Yes	Yes	No
Data providers	Yes	Yes	Yes	No	Yes (NGOs)	Yes	Yes	No
Donors	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Partners	No	Yes	Yes	Yes	Yes	Yes	Yes	No
Friends	No	No	No	No	No	No	No	Yes

Table 5.1
The interconnection between relations and entities

2. An entity may have – and some should have – several relationships to GBIF, such as Voting Participant, data provider, and donor. The reason why we recommend focus on the various relations and entities is to make sure that each of them is characterized properly and that consequently GBIF develops a separate outreach strategy for each. It also is important for GBIF to be able to have a formal affiliation to governmental or non-governmental institutions in non-Participant countries in order to promote in-country activities and support for GBIF goals, with a view to developing future national participation in GBIF.

3. Finally, GBIF should consider adopting a simpler, more general MoU to be signed by all Participants, as discussed further in our recommendations on the documents of regulation below, as well as more specific agreements targeted at each of the entities and suggested categories of relationships to GBIF.

5.3 Governance

As mentioned at the beginning of this chapter, the Review Committee was expected to respond to some specific questions regarding governance. Somewhat interpreted, the questions posed to us were as follows:

1. Has the present governance been sufficient for GBIF to achieve its goals?

b. Do the Rules of Procedure serve GBIF well?

c. Is the non-binding, voluntary MoU sufficient and appropriate?

d. Are the operations of the Governing Board appropriate and efficient?

Our approach to governance is initially focused on the formal aspects of governance as it is presented mainly in the MoU and the RoP, followed by the more tangible aspect of governance – that is, the actual functioning of the Governing Board – as it is perceived by the GBIF community. Finally, we examine the commitment to GBIF's objectives by the Participants in their local environments. However, the first section deals with the goals of GBIF and, in particular, how operational they are.

5.3.1 The goals of GBIF

This section focuses on the goals of GBIF as an instrument of governance, and particularly on their clarity and how operational and traceable they are in GBIF's activities. The goals of GBIF as stated in the MoU are extracted in the table below.

1. Purpose The purpose of GBIF is to promote, co-ordinate, design and implement the compilation, linking, standardisation, digitisation and global dissemination of the world's biodiversity data, within an appropriate framework for property rights and due attribution. GBIF will work in close co-operation with established programmes and organizations that compile, maintain and use biological information resources. The Participants, working through GBIF, will establish and support a distributed information system that will enable users to access and utilise considerable quantities of existing and new biodiversity data.
2. Goals of GBIF It is the intention of the Participants that GBIF: a. be shared and distributed, while encouraging co-operation and coherence; b. be global in scale, though implemented nationally and regionally; c. be accessible by individuals anywhere in the world, offering potential benefits to all, while being funded primarily by those that have the greatest financial capabilities; d. promote standards and software tools designed to facilitate their adaptation into multiple languages, character sets and computer encodings; e. serve to disseminate technological capacity by drawing on and making widely available scientific and technical information; and f. make biodiversity data universally available, while fully acknowledging the contribution made by those gathering and furnishing these data.

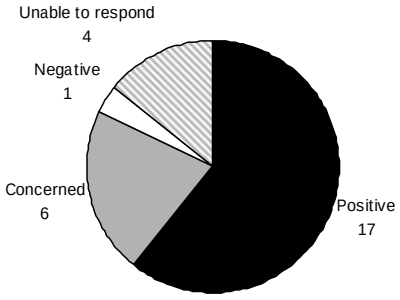
3. Involvement of the Participants
Each Participant should seek to: a. participate actively in the formulation and implementation of the GBIF Work Programme; b. promote the sharing of biodiversity data in GBIF under a common set of standards; c. form a node or nodes, accessible via GBIF, that will provide access to biodiversity data; d. as appropriate, make other investments in biodiversity information infrastructure in support of GBIF; and e. contribute to training and capacity development for promoting global access to biodiversity data

Table 5.2
The objectives of GBIF
(MoU: §3)

According to the Secretariat, the goals of GBIF mentioned in the MoU (especially in §3.2) have been sufficiently clear to identify the key characteristics of GBIF without being too prescriptive. The Strategic Plan adopted in 2003 by the Governing Board – which is an update of the Business Plan developed by the Interim Steering Committee – spells out in more detail the goals mentioned in the MoU. In addition to this, the major Work Programme components are more specific and have been developed within the goals stated in the MoU and the Strategic Plan.

The Secretariat has expressed the view that the established goals are appropriate, although the goals in a new MoU might be moderately revised and updated. One such revision might include stronger guidance from end user needs for the development of GBIF, with which the Review Committee fully agrees.

Turning to the rest of the GBIF community, we see the same positive perception of the goals presented in the MoU, as illustrated in the figure below.



Source: Survey to GBIF community (N=28)

Figure 5.7
The goals of GBIF - in the opinion of the GBIF community

Some words of caution did arise nonetheless from the community, such as:

- A warning about expanding the goals too much too early.
- Suggestions to use practical goals – e.g., how many collection records can be digitized – that are more oriented to results and not so much oriented to process as the existing goals are.

- A warning that some of the existing goals may be too ambiguous, which can leave different interpretations open for the Participants. An example is §3.2.f about making biodiversity data universally available, which allows for various political and commercial interpretations, and which potentially can be a constraint on GBIF's progress.
- A suggestion to place more focus on the GBIF Strategic Plan as the most important instrument in bridging the gap between the goals in the MoU, which seldom change, and the ever-changing Work Programme.
- Increasing the clarity of the Participants' obligations.
- Putting more emphasis on the developing countries.

However, the most important short-term goal is to make "the database federation," as one respondent from a major Participant put it.

The Review Committee fully supports the hierarchical structure of goals that is provided by the MoU at the high policy level, then the Strategic Plan, and by the Work Programmes at the implementation level. The MoU is properly a visionary document, not an operational document. More operational goals and targets – as well as rules and regulations – are also properly a matter for subsidiary documents. Consequently, any future revision of the goals in the MoU should maintain the high level approach and place a premium on continuity, and not become involved in specific operational and implementation aspects.

5.3.2 The formal basis for governance – the MoU and the RoP

The formal governance of GBIF is based on two essential and interlinked documents:

- The Memorandum of Understanding, which is signed by every Voting and Associate Participant. The MoU is non-binding and voluntary, and subject to the laws and regulations of each Participant. It is thus considered to have a weak legal basis.
- The Rules of Procedure, which refer to the MoU on key issues such as Governing Board structure, meeting structure, the requirements for Voting Participants, voting procedures if consensus cannot be reached, intersessional decision-making, committee structure, and institutional affiliation.

Both documents are reproduced in full in Appendixes B and C.

Before turning to the details of the MoU and the RoP, we address the essential question of whether it is appropriate to base GBIF on an agreement such as an MoU. The Interim Steering Committee that prepared the formation of GBIF engaged in considerable debate about establishing GBIF on the basis of an MoU or a treaty. By choosing an MoU, it was possible to implement GBIF much faster than if a treaty were used, because many countries would take years to ratify a treaty. Moreover, some countries would have refused to enter into a treaty organization for this purpose. The

Interim Steering Committee also debated how specific the MoU should be. The consensus was that it should be rather general and more visionary, as noted above, and that a set of Rules of Procedure would spell out the internal workings of the organization. More fundamentally, an MoU emphasizes that GBIF at its core is a scientific project based on voluntary participation by countries and organizations, rather than a political body.

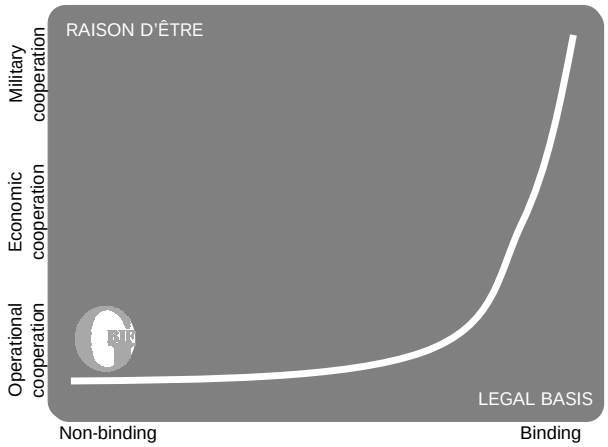


Figure 5.8
The relation between the raison d'être of an international organization and its legal basis[22]

The figure above illustrates that GBIF is considered an international organization aimed at operational cooperation among its Participants. This sort of cooperation is usually considered 'low politics', since it requires a modest level of commitment from each participant, compared to other international organizations involved in 'high politics', such as the United Nations, the European Union, or the North Atlantic Treaty Organization.

Some of the strengths of the MoU mentioned by the GBIF community are:

- The flexibility of the MoU has facilitated the potential for continuous development of the RoP.
- The MoU included provisions on almost all the strategic issues that needed to be considered when GBIF was created.
- The MoU has proven to be useful as a template for the development of an in-country MoU between agencies and institutions.
- The 'non-legally binding' character of the MoU made it possible for GBIF to become operational more rapidly.
- The MoU is generally clear and simple, and a comprehensive document that has provided good guidance.

[22] Developed from Poul Ole Schultz. 2003. Internationale Organisationer – Staternes Redskaber (International Organizations – the Tools of Nations). Columbus.

- Many Participants on the Governing Board have real ownership of the MoU because they were involved in creating it.
- The fact that the MoU is an inter-governmental agreement – without being legally binding – is considered a strength since it brings nations together and moves the GBIF agenda forward with implicit political support. At the same time, the MoU is oriented toward scientific cooperation and is not considered to be overtly political.

It is apparent to us that some of the satisfaction with the existing MoU among the GBIF community is based on the fact that it took quite a lot of time and effort to develop it. Participant representatives generally indicated that they wish to avoid a protracted process for negotiating the second MoU, and thus not to make major changes if possible. Nevertheless, the GBIF community did mention a few weaknesses of the MoU:

- Several respondents emphasized that the non-binding character of the MoU poses a severe weakness or risk for GBIF, because it can make the national fundraising more difficult. It also implies that a Participant can quit GBIF at any time or cancel its financial contribution. This status also places some doubt on the willingness of Participants to continue over the long term. Nevertheless, no one advocates a change of the legal status of GBIF.
- The MoU is signed by countries as well as various sorts of organizations. Consequently, parts of the MoU – e.g., the Annex – are irrelevant for some of the Participants.
- The ambitious goals set out in the MoU are not commensurate with the relatively small basic contributions agreed to in the MoU.
- The MoU does not guarantee financial stability for GBIF, an important issue to which we return in section 5.3.7.

In addition to the perceived weaknesses of the MoU, the Review Committee finds that a further clarification of the categories of participation in GBIF is necessary, as stated in section 5.2.

Some of the strengths of the RoP that were mentioned by the GBIF community respondents are:

- The RoP describe how intersessional decision making is done, which allows GBIF to operate more efficiently and flexibly.
- The RoP establish the principles for operations and are quite comprehensive, providing good guidance for GBIF.

However, representatives of the GBIF community also mentioned a few weaknesses of the RoP:

- The RoP still lack a section on voting for economies and Associate Participants – if this becomes relevant.
- Quite a few respondents considered the election process to be overly bureaucratic, leading to unnecessarily drawn-out voting processes for chairs and vice chairs.

- The RoP now need a thorough review, taking into consideration the first few years of GBIF's governance, in order to achieve optimal clarity and efficiency.

The Review Committee's own assessment of these two essential documents supports most of the strengths and weaknesses noted by the GBIF community. In our opinion, it has been a strength for GBIF that the MoU is a non-binding agreement. The relative rapidity with which countries signed the MoU and initiated GBIF is undoubtedly explained by its non-binding status. The Review Committee finds that there are no arguments at this time for elevating GBIF's legal basis from a non-binding to a binding agreement for various reasons:

- The GIF community is basically pleased with and generally supports the existing MoU;
- Some major countries have major objections to a stronger, more binding legal basis and we believe that most of the GBIF Participants will not be able to gain the sufficient support in their countries for a stronger commitment;
- A more binding agreement will still not guarantee secure funding; and
- GBIF is not a "high-politics" organization and is not supposed to make decisions that require strong national obligations toward other countries.

Nevertheless, we believe that some changes are needed in the MoU and the RoP, such as categories of Participant and of other relationships, as we recommend in the previous section.

5.3.3 The system of governance

Figure 5.9 illustrates GBIF's system of governance, which can be seen as composed of two interconnected systems:

- *The political system*, focused on governmental, strategic, financial, and managerial questions. The political system comprises primarily the Governing Board, the Executive Committee, and the Budget Committee.
- *The implementation system*, oriented towards the scientific and technological implementation of GBIF's activities. The implementation system comprises the Nodes Committee, the Science Committee and its four Scientific Subcommittees.

In this chapter we focus solely on the political system, whereas our assessment of the implementation system is presented in chapter 3. The Secretariat, of course, supports both systems.

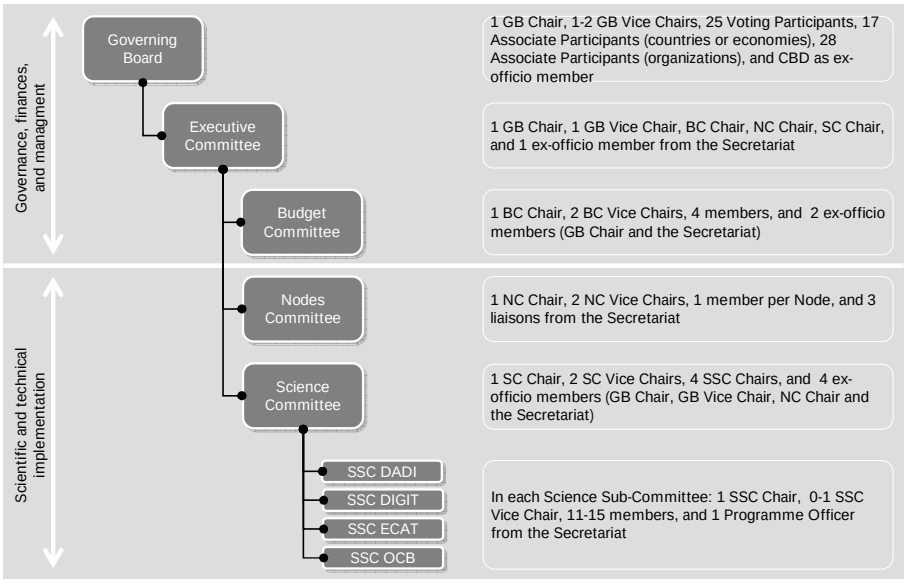


Figure 5.9
The governance system of GBIF

The tasks and functioning of the *Governing Board* are described in §4 of the MoU – mainly the responsibilities of the Governing Board and the basic principles of voting – and in the RoP article I on structure, article II on meetings, and article IV on voting.

According to the RoP article V, the *Executive Committee* is authorized to take decisions on issues of limited scope intersessionally if the issues need resolution before the next meeting of the Governing Board.

The purpose of the three standing committees is described in article VI of the RoP and in more detail in the terms of reference for each Committee. The RoP states that the goals of the standing committees are:

> *"The Science Committee is an advisory committee that will oversee the development and progress of the GBIF work programme and make recommendations to the Governing Board and the Secretariat.*
>
> *The Budget Committee will provide advice to the Governing Board on financial issues pertaining to the operations and directions of GBIF and will oversee the audit of the annual accounts submitted to the Governing Board by the selected auditors company.*
>
> *The Participant Node Managers Committee will serve as a forum for sharing information about the status and best practices of Participants' nodes, and will make recommendations to the Governing Board, Science Committee and the Secretariat concerning relevant issues for the nodes."*

GBIF's interconnected political and implementation governance systems may be seen from a theoretical perspective as based on very different sets of logic[23], which are summarized in the box below.

	The implementation system	The political system
Objective	• Producing coordinated action	• Legitimacy is based on its ability to reflect inconsistencies in its context
Structure	• Unity • System is based on normative compliance • Avoidance – conflicts are solved by hierarchy • Strong organizational ideology	• System is based on normative conflicts • Multiple ideologies present in the system
Processes	• Decisionmaking often unnecessary • Actions consistent with ideology and norms • Specialised • Oriented toward results more than solving problems • Members have great confidence in the system • Limitied rationality	• The system is 'intellectual' because it embrace several ideologies, it tends to follow norms of rational decision-making, and it is more oriented towards problems than results • Generalized • Scepticism is encouraged
Output	• Action	• Talk, in the broad sense of the spoken and written word produced for external and internal purposes • Decisions • Allocation of money for implementation of decisions

Figure 5.10
The political system and the implementation system meet (theoretical approach based on work by Nils Brunsson)

Every organization is dependent on the output from both the political and the implementation system. This is as true for GBIF as it is for any other organization. Since the logic of the two systems is clearly incongruent, every organization has to find ways to handle this obvious dilemma. This contribution from organizational theory has been useful for us to understand some of the criticisms made by the GBIF community about the Governing Board being "too political" or "too bureaucratic" or "too scientific." We address this in the next section, where we take a closer look at the actual functioning of the Governing Board, as conceived by the GBIF community.

5.3.4 The functioning of the governance system

In this section we examine the GBIF community's opinions on the functioning of the Governing Board, especially focusing on its ability to:

- Encourage co-operation and coherence;

[23] This analysis is based on the organizational thinking presented in Nils Brunsson (1989), The Organization of Hypocrisy: Talk, decisions and actions in organizations, John Wiley & Sons, Chichester.

- Reach decisions by consensus;
- Operate efficiently; and
- Handle tensions, problems, or questions related to groups or individuals.

As depicted in the figure below, the GBIF community is largely satisfied with the functioning of the Governing Board with respect to these four specific topics.

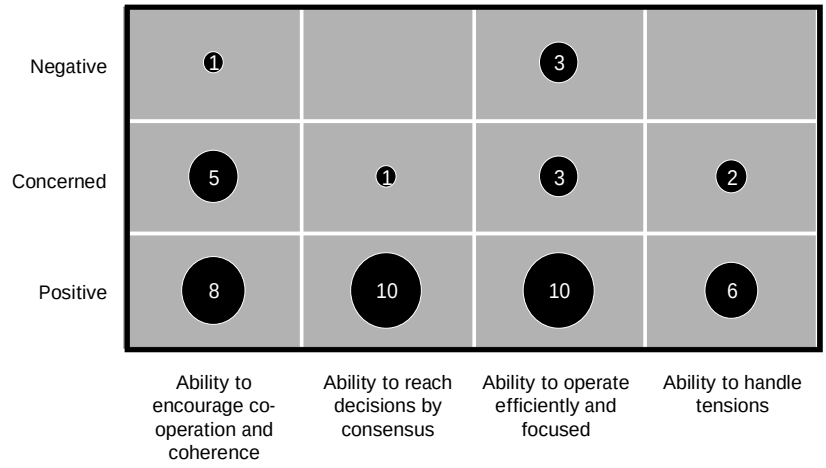


Figure 5.11
The opinions on the functioning of the Governing Board

Source: Survey among GBIF people

A number of interesting comments also were made by members of the GBIF community in response to our questionnaire, as discussed further below.

Encourage co-operation and coherence?

Concerning the Governing Board's ability to encourage cooperation and coherence, several respondents noted that only a few Governing Board members really participate in debates. There also are participants – some of them major contributors – who are not pleased with the anglophone bias of the Governing Board's affairs. Although it is understandable that English is the official language in GBIF meetings and its activities, as one of those respondents put it, "if GBIF would like to get more participation and deeper discussions, it needs procedures using multi-languages."

In our view, as GBIF expands, the principal forum for discussion will not be in the Governing Board itself, but in the smaller working groups where the exchange of opinions can take place more freely, less formally, and more comfortably for those not speaking English fluently. In GBIF's early years, when the number of participants was smaller, the Governing Board could serve as a forum for broader negotiation and discussion. However, we find that with the expansion of Voting and Associate Participants that the Governing Board instead will have to become more focused on making decisions. In this regard, we very much agree that the Governing Board's "capacity to function well will depend on its ability to structure side

activities around the meetings (e.g., science meetings, etc.) and by keeping the meetings tight," as one Voting Participant respondent noted.

We also find that the many developing countries already involved in GBIF lack the full means of participation and influence in GBIF – albeit self chosen – because they are not Voting Participants. This is a barrier for cooperation if the countries have diverse status and power is not distributed symmetrically.

The ability to reach decisions by consensus

To balance the fact that not all Participants have the right to vote, the MoU emphasizes that the Governing Board should strive to reach decision by consensus. The comments presented to us suggest that the culture of making decisions by consensus is "well-developed" and that "gaining consensus is usually not a problem" and that it is has become a "welcomed tradition." However, it is also mentioned that decision making by consensus will become more difficult and unmanageable as the number of Participants (presumably) increases.

The ability to operate efficiently and focused

Significant parts of the Governing Board's agenda involve formalities such as reporting and elections. The GBIF respondents generally viewed the Governing Board to be well-run and improving since the organization's inception. However, a few concerns also were noted:

- Related to the other criticisms of voting procedures we already have mentioned, several respondents considered the *voting routines* to be "inefficient and complicated."
- As one respondent commented, the *atmosphere* is "rather stilted with very little in the way of free form discussion." A related issue raised by another was that "native English speaking individuals monopolize the discussions with quick and smart replies discouraging and, to a certain extent, making it practically impossible for other participants to intervene considering the limited amount of time."
- Regarding *procedures*, a few mentioned that – despite an obviously competent chair – more attention should be given to both content and process during the meetings, so that the decisions taken are clear and unambiguous and items are presented thoroughly, efficiently, and not overly procedurally. More to the point, several respondents to our questionnaire and in our interviews complained that two annual meetings of the Governing Board are becoming unnecessary, and are costly and inefficient.

The ability to handle tensions, problems, or questions

The Governing Board is obviously a rather heterogeneous group in terms of culture, institutional priorities, and personal interests. Just by looking at the institutional affiliations of the Heads of Delegations at the Governing Board meeting in Mexico provides an indication of this heterogeneity.

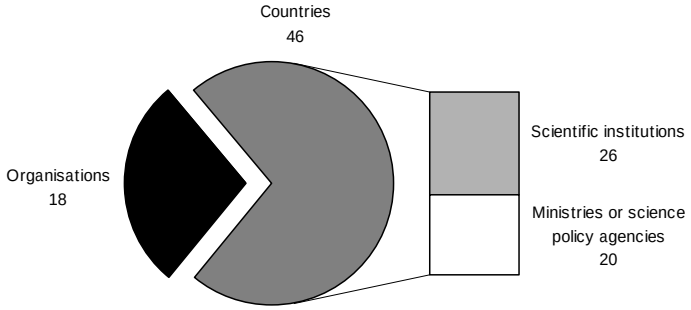


Figure 5.12
The background for the head of delegations at the Governing Board meeting in Mexico 2004

Source: gbif.net - list of delegates to the GB meeting in Mexico 2004

In this diversity of representatives, several potential lines of tension are present. One involves the discrepancy between the developed and developing countries and their expectations of GBIF. For example, there is generally a demand for more capacity building assistance from GBIF by the developing countries, whereas the more developed countries express concerns about whether further increases in such assistance is money well spent in comparison to other GBIF program priorities. Moreover, the differences of interests between non-governmental organizations and countries imply some tension, e.g., in their perception of the raison d'être of GBIF. And, as mentioned several times earlier, there is a tension between native English-speaking representatives and others who do not fully master the English language.

Of course, these and other tensions will not disappear – some might even become more pronounced – and will have to be addressed. At the same time, the GBIF respondents suggest that although tensions do exist, they are not being ignored.

More science ...

A few respondents noted that the content of the Governing Board meetings is ready to be changed, now that many procedural issues are settled. Some respondents envision the Governing Board as a scientific body, discussing mainly issues of substance and content, rather than political formalities. There are concerns about the governance of GBIF since the Governing Board is a mix of scientists and bureaucrats. The mix is counterproductive, as one respondent put it, and suggested that there be a board of bureaucrats and a board for scientists.

In our view, GBIF will need a simpler organization in order to shift focus from governance to science, perhaps by dividing—but not segregating—GBIF's governance structure more explicitly according to business and science. The business part could be dealt with by the Governing Board, maybe only by countries, and the science part could still be very open and involve the organizations as well.

Opinions on the nature of interactions among the GBIF community

As shown in the figure below, the GBIF community uses many superlatives when describing the interactions between various groups of GBIF, despite some of the more specific concerns expressed above.

Figure 5.13
Opinions on the interactions among the various parts of the GBIF community

The experts' opinions on governance

The responses of the independent experts to their questionnaire provided some additional insights, based on an external view of the organization. As strengths, the experts noted that GBIF's governance is based on "a classic and robust schema," that seems "fairly democratic and representative." They also commented that GBIF is based on "broad participation" and "designed for inclusiveness and engagement from the broadest array of parties." One expert stated that:

> *"GBIF's organizational structure offers open participation by interested organizations, but limits voting to funding participants. This is a model that has been chosen by other international organizations and seems to be a sensible organizational structure. Rotating members from all participating organizations can chair and participate in the various committees, so the input perspective is wide."*

Another expert noted that GBIF "is supported by governments and is stable" to operate, though the funding seems "a bit fragile in a time of budget cuts around the world."

However, a few words of caution were also provided by some of the experts, such as a warning about the tendency "to become over bureaucratized." Another expert perceived GBIF "to be dominated by scientists and not enough policy maker input."

A couple of the external experts discussed the relationship of funding to decision making, and to participation in GBIF more generally. One found that "ideally, a country's ability to participate in GBIF would not be a function of their ability to be a financial contributor," and suggested that the UN be asked to contribute for such countries. Another expert expressed the view that:

> *"The actual model, while relevant, doesn't allow a separation between the funding and the decision making process. Therefore the risk is that the work programme is driven by donors. While this happens in most international organization, it would be relevant to think about a better way to separate them. For example, a board composed of 12 members (not only from donor agencies) could be established to agree on the work programmes."*

Finally, another potential weakness that was brought up is "a certain, high degree of dependence on data providers, which at the same time can be tricky." This dependence makes GBIF seemingly deeply "institution-based" despite the fact that funding is based on national contributions. This point is supported by another expert, who noted that "the voting representatives of national governments are not closely related to, nor necessarily serving the interests of, the data providers." A third expert put it slightly differently, who feared that a mismatch of interests may lead to dominance in the GBIF Governing Board by the governmental bureaucracy.

5.3.5 The Participants' commitment to GBIF

GBIF must be a collaborative mega-science endeavor because not one country or one organization would be able to achieve GBIF's goals. Consequently, the organization is extremely dependent on each Participant's commitment and ability to implement decisions made in the Governing Board, and to fulfil the following obligations according to §3.3 of the MoU:

> *Each Participant should seek to:*
> *a. participate actively in the formulation and implementation of the GBIF Work Programme;*
> *b. promote the sharing of biodiversity data in GBIF under a common set of standards;*
> *c. form a node or nodes, accessible via GBIF, that will provide access to biodiversity data;*
> *d. as appropriate, make other investments in biodiversity information infrastructure in support of GBIF; and*
> *e. contribute to training and capacity development for promoting global access to biodiversity data.*

One way of illustrating the Participants' commitments is to see how many are actually providing data to gbif.net. This is shown below.

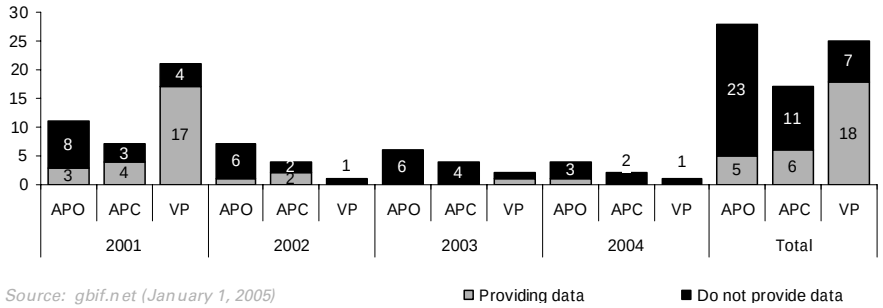


Figure 5.14
Commitment from Participants - illustrated by the number of Participants providing data to gbif.net in January 2005 sorted by category and the year they joined GBIF.

APO – Associate Participant Organization; APC – Associate Participant Country; VP – Voting Participant

40% of the Participants – primarily the Voting Participants – provide data to the portal. Looking at this indicator in isolation, there is still room for improvement, although we understand the Participants who joined GBIF most recently may have to secure in-country or intra-organizational support and infrastructure before being able to provide data. As one GBIF respondent also pointed out: "the task to get sufficient support for a national node starting from nothing is a daunting task and may be beyond some GBIF board members."

The MoU, however, is not very explicit about the nodes. National Participants may believe that paying dues to GBIF is their main responsibility, but establishing node(s) and digitizing their existing info resources are equally important. This appears to be a problem in OECD countries, not just in less developed ones.

Approximately half of the respondents from the GBIF community think the Participants' commitment to GBIF and the ability to implement GBIF goals is high; the other half finds it rather uneven. The GBIF community members mentioned several reasons why the commitment is uneven:

> *"Governmental coordination is not easy and in some places the people at the table do not have the ability to convene meetings either within their governments or with civil society effectively. Given the nature and structure of GBIF this will simply be a constant condition."*

> *"The participants are strong advocates of GBIF, but they tend to act independently and move at their own pace."*

> *"The ability to implement decisions is not in government but in organizations and scientific community in the nations."*

"It is not immediately clear just what influence [representatives] have with their home countries or institutions."

A completely different reason that was mentioned is that there is a turnover of persons representing the participants in many delegations, which may lead to a lack of continuity or inefficiency in the follow-up and decision-making processes. More specific issues concerning the Participants' commitments to GBIF are discussed in chapter 3.

5.3.6 Conclusions

Conclusions about GBIF's governance structure

GBIF's governance system has been sufficient thus far to achieve the organization's goals. There are basically two ways to go with the governance structure: (1) keep the existing governance structure, in which the Governing Board is the main forum for handling political, managerial, and programmatic issues, or (2) redefine the governance structure by decoupling the politics and science.

The principal argument for keeping the existing structure is that it is established and is generally considered to work well. However, we acknowledge the concerns presented to us regarding the absence of 'real' science in the Governing Board, the difficulties in segregating Voting Participants from non-voting, the increasing difficulties in stimulating discussions as the number of Participants accumulates, and the related expectation that the efficiency of the Governing Board will diminish.

Conclusions about the documents of regulation

With regard to the question of legal instruments on which to base GBIF, we are convinced that the choice of an MoU instead of a treaty was correct and explains why GBIF was formed rather quickly. A non-binding, voluntary MoU is not only sufficient and appropriate; we also believe that it will not be possible to find support for elevating this legal status to a binding agreement.

The Rules of Procedure generally serve GBIF well and are by and large supported by the GBIF community. Nevertheless, the Review Committee concludes that the MoU and the RoP in several respects need to be better aligned with each other and with the operational considerations that have become evident since the establishment of GBIF. The following points highlight some of the areas that may need modification:

- The MoU and the RoP have some inconsistencies relating to the different types of Participants and their rights, which need to be clarified. It may be appropriate for each type of Participant to have its own MoU (see recommendations in section 5.2.5 above).
- After having two annual meetings of the Governing Board during GBIF's formative years, the need for such frequent meetings is becoming reduced and may be expected to be reduced further when a new MoU and RoP are in place. There is a strong desire in the GBIF community to minimize the high costs and the time spent on the Governing Board meetings. Article II.2.1 of the existing RoP already considers this eventuality and describes only one annual meeting in

regular session. If this is done, however, the responsibility of the Executive Committee will need to be increased.

- The voting sessions at Governing Board meetings are considered to be too prolonged and inefficient by many members.
- The principle of consensus decision making generally is considered appropriate. Much of this success is ascribed to individuals, however, which emphasizes the need to have competent successors available to become officers of the organization.
- One of the compromises made by the Interim Steering Committee when it was establishing the MoU was to mandate this independent review of GBIF in its third year, in order to see if it was working and to make recommendations for any needed changes. This has proved to be too short, as the inevitable delays encountered in setting up the organization and hiring staff for it have meant that there is actually not a well-established record of experience and results yet for us to analyze. However, with many of the initial growing pains resolved, a three-year schedule of external reviews under the new MoU would be reasonable.

5.3.7 Recommendations on the governance structure

1. The Review Committee suggests a significant change in the governance structure of GBIF, based on the findings and conclusions presented above. The change should accomplish the following goals:

- Simplify the governance structure by segregating politics from operations;
- Enable an increased focus on the science aspects of GBIF;
- Create a stable structure independent of the number of Participants;
- Enhance the open-endedness of GBIF in scientific and technical subjects, but not in governance subjects;
- Strengthen the responsibility and decision-making power of the Executive Committee.

The reformed governance structure is illustrated in the figure below.

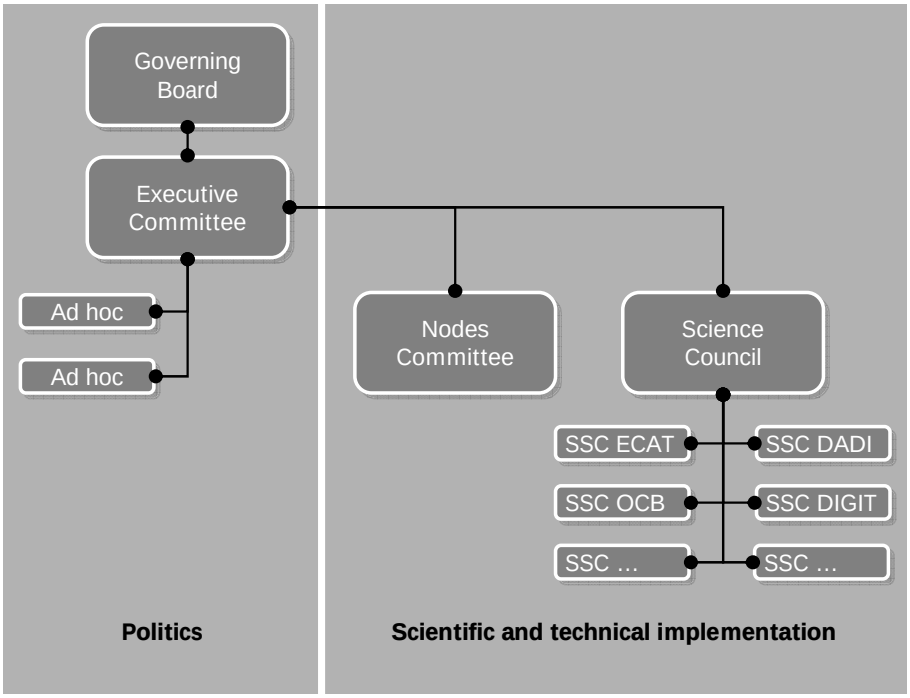


Figure 5.15
A reformed governance structure

2. The suggested revision to GBIF's governance structure is based on the following high-level considerations and design principles:

- *Governing Board*. Each Voting Participant is entitled to one seat and one vote. The Governing Board assembles once a year for one or two days with an agenda focused solely on political and diplomatic decision making, problem solving, and limited reporting. Consistent with current practice, the annual assembly is accompanied by various other activities and meetings. We believe the composition of the Governing Board should mainly attract delegates with a background in science policy. Other procedural changes concerning Governing Board meetings are suggested below in section 5.3.8.
- *Executive Committee*. The responsibility and tasks of the Executive Committee should be increased significantly. At present, the composition of the Executive Committee is indirect and can be described as bottom-up, since the chairs and vice chairs of the Governing Board and the chairs of the Budget Committee, the Science Committee, and the Nodes Committee are members. We believe GBIF will require an Executive Committee with a clear and strong competence for intersessional decision making, albeit fully responsible to the Governing Board. In order to reach this goal, we suggest that the Executive Committee consist of:
  - The chair and the vice chairs of the Governing Board, who have the same functions in the Executive Committee.
  - One representative for each of the countries and inter-governmental organizations that financially contribute in the top three categories of the financial mechanism.

- Two representatives elected among the countries and inter-governmental organizations that financially contribute in the middle two categories – category 4 and 5 – of the financial mechanism.
- Two representatives elected among the countries and inter-governmental organizations that financially contribute in the lowest two categories – category 6 and 7 – of the financial mechanism.
- The chair of the Science Council and the chair of the Nodes Committee.

The Executive Committee may establish permanent and ad hoc Subcommittees as necessary to support its work. Because "budgeting is the lifeblood of government,"[24] we recommend that the existing Budget Committee be integrated into the Executive Committee as a permanent Subcommittee, with members recruited among the Executive Committee's members. Other international organizations, such as the International Council for Science (ICSU) and the Consultative Group on International Agricultural Research (CGIAR), also have Executive Committees with strong responsibilities for intersessional decision making and to prepare the basis for decision making at their General Assemblies.

- *Science Council*. The Governing Board is the political or business component of the governance system, which by its nature has an orientation different from GBIF's scientific and technical activities. In order to strengthen science and technology in GBIF, we recommend establishing a Science Council led by a chair and two vice chairs elected by the Governing Board. The purpose of the Science Council should be to provide the main mechanism for scientific discussion in support of the Governing Board, much like the current Science Committee does.

  The composition of the Science Council should secure representation from segments of providers and users from the Participant countries and organizations, regardless of their status in GBIF as Voting, Associate, or Affiliated Participant. The Science Council should mainly attract delegates with a scientific or applied background, although members of the Governing Board and the Nodes Committee may also be members.

- *Science Subcommittees.* In support of GBIF's programmatic areas, the Science Council may establish focused Subcommittees, just as they are under the current Science Committee. Each Subcommittee would have a chair and vice chair, with its members elected by the Science Council.

- *Nodes Committee*. We believe the existing Nodes Committee is already exceptionally well-functioning and we recommend that this committee continue in its present form.

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[24] This statement emphasizes the importance of placing budget issues in the center of the governance structure, which we believe should be the Executive Committee. Wildavsky, Aaron (1979), The Politics of the Budgetary Process, Little, Brown and Company, Boston.

- *Science Symposium*. We believe that science symposia could be the main attraction related to the Governing Board meetings in the GBIF community. Besides demonstrating the use of the GBIF network, they could become a significant and recurring event in biodiversity informatics and thus be of interest of many. Additionally, the symposia should demonstrate the open-endedness of GBIF by welcoming everyone who is interested. Obviously, this is not part of the governance system of GBIF, but these events could be important for enhancing the GBIF community and for increasing the recruitment of Participants, Affiliates, and Partners.

5.3.8 Recommendations on the documents of regulation

Many of our other recommendations would lead to changes in the MoU and the RoP. The regulatory consequences of our recommendations related to governance structure, categories of participation, and funding are found in other sections. This section focuses on other types of recommendations concerning the MoU and the RoP.

1. The documents of regulation should be aligned to the changing realities of the GBIF organization, which is one of the main reasons for clarifying the categories of participation as recommended above. Our recommendations are as follows:

- *The complex of regulations*. The new MoU could be shortened significantly, because a number of the existing provisions are no longer relevant. Content-related goals can be formulated and revised in the Strategic Plan and RoP, and the Staff Rules and Financial Regulations can incorporate some of the provisions. A careful review by the Governing Board and the Secretariat of these various regulatory documents can simplify, clarify, and integrate them better.
- *Open-ended MoU*. The new MoU should not be limited in time, as the present MoU is, but should have an open-ended duration.
- *Future Reviews*. An external review should be conducted every three years after the new MoU has been established (i.e., with the next review coming five years from now and every three years after that).
- *Meetings*. As mentioned earlier regarding the reform of the governance structure, we recommend that the Governing Board meetings be fewer, more focused, and more prepared in the sense that problems be solved and discussed beforehand in other forums. Consequently, the mandates of the Executive Committee should be revised and extended significantly, and the other Committees need to meet prior to the Governing Board meeting, so that consultations by the GBIF community are comprehensive in preparation for the Governing Board meetings.
- *Voting*. The requirement of a supermajority and the convoluted process for voting for committee chairs and vice chairs is not efficient. We recommend decision making by a simple majority for chairs and vice chairs, based on one round of voting. This is the practice in organizations such as ICSU and CERN. Decision making by consensus

should be the preferred method in GBIF whenever possible, which is also the case for CERN and CGIAR.

5.4 Funding

As mentioned at the beginning of this chapter, the Review Committee is expected to respond to a few explicit questions regarding funding. Slightly interpreted, the questions put forward to us are:

1. Has the present funding been sufficient for GBIF to achieve its goals?

k. Should the financial contributions for Voting Participants and procedure to handle those contributions be changed?

l. Has sufficient and appropriate progress been made by the Participants in increasing their in-country or intra-organizational investments in biodiversity information infrastructure in support of GBIF, as the Memorandum of Understanding encourages them to do?

We have divided our responses to these essential questions into three main sections: one focusing on the funding mechanism as it is described in the Annex of the MoU, one addressing the level of funding, and one examining in-country and intra-organizational funding of GBIF-related activities.

5.4.1 The funding mechanism

As is the case with most other international organizations, the funding of GBIF is based on a model of solidarity in which the Voting Participant countries with the greatest financial capabilities provide the largest funding contributions, but only those who pay can vote. The mechanism is described in Annex I of the MoU. The Annex is reproduced in full in the box below.

Annex I. Financial Contributions for Voting Participants

1. Intent of this Annex
   This Annex describes the suggested financial contributions for voting participation in GBIF.
2. Suggested Basic Financial Contributions
   Voting rights are conferred when a Participant indicates its intention to contribute the suggested amount according to the table below. Participants whose per capita GDP is less than US$ 10,000 may contribute the amount for the category one lower than that corresponding to their GDP, unless they are already in the lowest category.
3. Initial Year Payment
   For the first year of their participation in GBIF, Participants in categories 1-6 inclusive in the table below may acquire voting rights by making a contribution of at least one half of the suggested amount according to the table below.

All figures are in US dollars.

Participant Categories and GDPs	Suggested Annual Basic Financial Contribution
1—GDP > $3000 billion	$700 000
2—GDP $2000-3000 billion	$450 000
3—GDP $1000-2000 billion	$250 000
4—GDP $100-1000 billion	$100 000
5—GDP $50-100 billion	$50 000
6—GDP $25- 50 billion	$20 000
7—GDP < $25 billion	$500
Associate Participant (non-voting)	No monetary contribution; must agree to establish a node and to share data.

Figure 5.16
The funding mechanism of GBIF (MoU, Annex I)

The questionnaire to the GBIF community posed questions about the financial mechanism, including the respondents' views on the principle that non-contributing nations have no voting rights and, related to this, the principle of equitability among Voting and Associate Participants. Basically, the community clearly supported the principle of GBIF being "funded primarily by those that have the greatest financial capabilities" (MoU, § 3.2.c), while maintaining a difference in voting rights between those who contribute and those who do not.

Nevertheless, as we already noted in the previous section, it was mentioned repeatedly in the responses to our questionnaire and in interviews that the Associate Participant countries lack sufficient incentives to become Voting Participants. The various Governing Board members suggested that some measures need to be adopted to encourage Associate Participants to change their status after a specific period of time. Such a change was generally considered "fair," "fine and logical," "reasonable," and "appropriate and needed." A few respondents, however, found the principle "questionable" and favored giving all the Participants voting rights. "GBIF deals with biodiversity and not with US$ or €, so why base the voting right exclusively on financial contribution?," as one respondent put it. However, we view this not so much a matter of funding as a general matter of governance.

Some respondents were somewhat resigned when presenting their opinions on the funding mechanism, and made comments such as:

"A model for this will always be difficult but the current mechanism is probably the best that could be expected."

"Financial arrangements are probably not ideal for most but are the result of significant debate and compromise all round and are probably optimal."

In summary, the funding mechanism is accepted by and generally supported by the GBIF community. The mechanism has several strengths:

- It is considered legitimate, transparent, simple, formulaic, and unambiguous.
- It allows 'trial' membership for countries.
- It progressively relates the size of a contribution to a country's general capability to pay (i.e., based on GDP), thus allowing smaller countries to participate. The mechanism thus implies a redistribution of economic resources among the participants.
- The mechanism has been able to provide the necessary basic contributions to begin implementing GBIF, to set up the Secretariat, and to commence programme activities.
- It gives GBIF the ability to include Participants that have much to contribute in kind, but lack financial resources for making direct monetary contributions.

However, the GBIF community also finds several weaknesses in the financial mechanism:

- It is rather static and makes it difficult to increase funding without either raising the levels of contributions or the number of contributors. Raising the levels of contributions in each category requires a re-negotiation of the MoU. Raising the number of Participants might not improve funding much since most large GDP countries are already contributing members.
- It appears that several countries – also major contributors – have substantial challenges in securing the necessary funding in-country. The contributions from most countries are pulled together from different sources, which, to our knowledge, typically has not always been easy.
- The emphasis on payments in US dollars have been a disadvantage for GBIF due to problems in the USD - €/DKK exchange rates.
- The funding mechanism is based on a non-legally binding agreement. This means that it is voluntary and therefore potentially volatile, because a Voting Participant can withdraw at any time.
- It puts too much reliance on too few countries. Only three Participants (USA, Japan, and Germany) provide more than 50% of the basic contributions to GBIF. If one or more of these major Participants were to terminate their participation or not renew the MoU, the viability of GBIF would be threatened.

- It does not enforce the punctual and regular payment of the contributions.
- The tangible advantages may be inadequate for some contributing members.
- GBIF has not been supported by substantial additional funds from international donors or funding bodies. There also is not an obvious mechanism to obtain funding from international organizations – especially from inter-governmental organizations.

The table below shows which Participants contribute and at what level to GBIF. The Voting Participants contribute with 3.6 million USD. Japan, USA, Germany, UK, and France together contribute 65%. If the Associate Participant countries were to become Voting Participants they would contribute an additional 0.5 million USD – a total increase of less than 15%.

	Category	Suggested Basic Contribution	Contributing countries	Non-contributing countries
1	GDP > $3000 billion	$700 000	Japan United States of America	
2	GDP $2000-3000 billion	$450 000	Germany	
3	GDP $1000-2000 billion	$250 000	United Kingdom France	
4	GDP $100-1000 billion	$100 000	Norway Denmark Sweden Netherlands Finland Korea, Republic of Portugal Spain Australia Canada Belgium	Switzerland Austria Taiwan (Economy)
5	GDP $50-100 billion	$50 000	New Zealand Mexico South Africa	Poland Argentina India Indonesia
6	GDP $25- 50 billion	$20 000	Slovenia Peru	Czech Republic Colombia Pakistan
7	GDP < $25 billion	$500	Iceland Estonia Costa Rica Nicaragua	Slovak Republic Bulgaria Morocco Papua New Guinea Ghana Madagascar Tanzania
Actual and potential sum of contributions			3 642 000$	563 500$

Table 5.3
The actual and potential contribution to GBIF (Additional source: http//unstats.un.org/unsd/snaama/)

As noted above, the GBIF community mentioned that the funding mechanism is fragile because it is too dependent on too few participants. As depicted in the figure below, this is obviously correct: 50% of the actual funding is provided by 10% of the participants, which we believe could be problematic (the actual contribution line). What the figure also shows is that this reliance will not change significantly if all the Associate Participants change to Voting Participant status and begin to contribute financially to GBIF at the levels established by the MoU Annex (the intended contribution line), although the total level of contribution will of course increase. The diagonal line illustrates the line of equilibrium – that is, where the 10% of the contributors provide 10% of the funding, and so on.

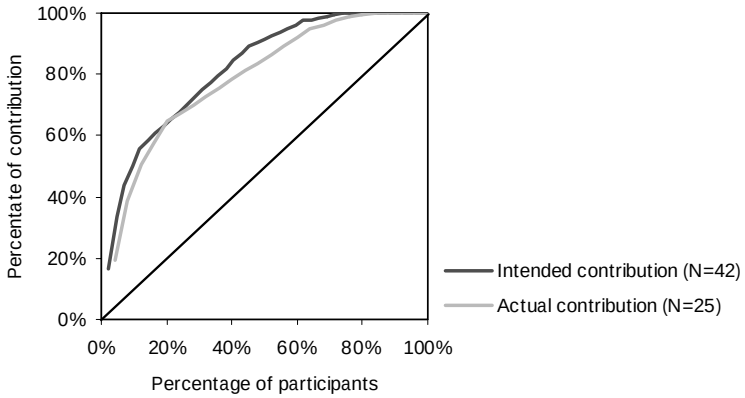

Figure 5.17
The fagile reliance on only a few Participants

Based on all the input presented to us, the Review Committee finds that the funding mechanism of GBIF has several positive qualities mainly because it has already been negotiated and agreed upon, and is simple and formulaic. Its redistributing characteristic is reasonable and is generally supported by the community.

However, we find a number of difficulties with the existing funding arrangements as well. The bottom level of the mechanism is mostly symbolic and could perhaps be raised to 1,000 USD. Although quite a few countries with low GDP have chosen not to become Voting Participants, we believe that this decision is not caused by the level of dues but by the lack of sufficient incentives and expectations to become Voting members. The mechanism therefore supports free-riding tendencies not only by developing countries, but by some OECD countries, too. We find that time restrictions on Associate Participant status – as suggested by several GBIF respondents– would eliminate this tendency and could convert most if not all of the current Associate countries to Voting Participant status.

There also is a significant potential for increasing the numbers of Voting Participants in South America, Asia, Africa, and the Middle East. Some of these – e.g., Brazil, Russia, and Indonesia – could contribute with 50,000 USD each. Unfortunately, there are few potential countries left that would be able to contribute on a larger scale, though countries like China and Ireland could contribute 100,000 USD, current Associate Participants, such as Austria and Switzerland, also with 100,000 USD, and Italy with 250,000 USD. In other words, an increase in the number of Voting Participants

would increase the total basic contributions to some extent, but not significantly unless several new counties will join and assuming that none of the current major Voting Participants drops out. In our opinion, there is a need for either a change of the financial mechanism, additional funding, or both if the activities of GBIF are to be increased substantially over the coming years.

The top level of the funding mechanism seems very sensitive partly because contributions from the United States and Japan are rather disproportional when compared to Germany, the UK, and France. We are concerned about the mechanism's dependence on very few countries. We believe that GBIF's interest in achieving basic funding stability partly necessitates reducing this dependence on the major contributors. We address this in our recommendations.

Quite a few respondents also mentioned that the funding is unstable due to a lack of a long-term funding commitment by countries because of the non-binding nature of the MoU. This is indeed a major potential risk – which is exacerbated by the dependencies mentioned above – although we consider this to be an unavoidable condition for GBIF since a treaty is not acceptable to most Participants. Moreover, while a treaty may improve stability, it still is not an immutable guarantee of continued funding.

At a more technical level, we find it problematic that the funding mechanism has not built in an automatic raise in contributions indexed to inflation. A further problem is that the mechanism requires payments in USD, when many of GBIF's expenditures are in Danish kroner. A shift from USD to Euros would eliminate this problem, since the Danish kroner is linked to the Euro. Consequently, the currency risk would shift from GBIF to the Participants, which we consider to be fair. The actual payment, however, could be in other currencies than the Euro as long as the annual payment is equivalent to the Euro amount at the time of payment.

There also are latent disagreements between those who think GBIF should be a grant-giving institution and those who think GBIF should "only" be an infrastructure program. Several delegates from developed countries emphasized that an increase in the level of funding is considered necessary for increased programmatic activities, whereas some developing country representatives suggested increasing outreach activities and support for Participant countries.

5.4.2 The level of funding

According to §11.1 of the MoU, "GBIF will come into existence on March 1, 2001, or when at least ten Participants have signed the MOU and the sum of the contributions they have pledged to contribute totals at least 2 million US dollars, whichever is the later date." By March 2001, 18 countries had signed the MoU and pledged to contribute a total of 2.9 million USD. The table below shows the income and expenditures of GBIF from 2001 to 2006 (the last three years are either according to the budget or the financial plan). The table below shows that GBIF has been and in the coming years will be

operating with an annual budget of approximately 4 million USD. The financial management by GBIF's Secretariat is addressed in section 5.5.

Table 5.4
Income and expenditures of GBIF 2001-2006

million USD		Realized		Budget		Financial plan
		2001/02	2003	2004	2005	2006
Opening balance	+		1.73	2.66	0.39	0.36
Income	+	3.08	4.28	2.66	3.78	3.85
Expenditures	-	1.49	3.94	5.13	3.81	3.69
Exchange rate differences	-	0.14	0.59			
Expected additional savings	-			0.20		
Result	=	1.73	2.66	0.39	0.36	0.53

The questionnaire to the GBIF community contained questions about their opinions on the level and distribution of funding. Generally, the respondents expressed the view that many more resources are needed for GBIF and GBIF-related activities, including comments such as:

> *"GBIF is [still] micro-science, not mega-science. The (virtual) facility is the Secretariat, the data, the informatics tools, the network, the research, and the outputs. Only a marginal amount of the needed funding is given. This is the equivalent of creating a cyclotron by asking/begging countries to supply pipes and cement without any coordination. Truly the failure of the key decision makers in understanding what a virtual mega-science facility should be."*

> *"Not by far enough money for the needs. This is not mega-science in any sense. We should be getting hundreds of millions per year. Or causing such moneys to be spent."*

> *"Too small scale of finance for [a] global-scale programme."*

These types of views – which were shared by a large number of members of the GBIF community – provide the main argument for increasing the funding of GBIF. Several also emphasized that the initial OECD Working Group estimated a budget somewhere between 7 million and 10 million USD (as of 1999) and a staff considerably larger than the current one.

In addition to these quite compelling reasons, there are others why the level of funding should be increased, some of which have already been noted above. The actual value of the contributions to GBIF has deteriorated substantially due to a severe drop in the exchange rate of the USD in relation to other currencies and to the lack of adjustment for inflation. In addition, the increase in Associate Participants further stresses the budget because they do not contribute financially to GBIF (although many contribute with the provision of data and other in-kind support). Finally, the Secretariat is very thinly staffed and therefore vulnerable.

Additional funding

Beside the basic contributions from Voting Participants, GBIF has a supplementary fund that contains voluntary contributions from other sources. This fund can increase GBIF's financial health and flexibility, but depends entirely on the success of GBIF's efforts in raising such funds. According to the rules for the supplementary fund the:

> *"Funds may be received to contribute to the goals of the work programmes. In addition, GBIF is very aware of the need to increase participation from developing countries and economies in transition. Accordingly GBIF encourages contributions to its Supplementary Fund for the purposes of assisting such countries and economies to fully participate in GBIF activity, including travel to Governing Board meetings, participation in the work programme, and development of computer networks."*

So far, only a few countries or organizations have chosen to contribute to this fund, as shown in the table below.

Table 5.5
Contributions to the supplementary fund

Country	Source	Contribution	Year
Denmark	Ministry of Foreign Affairs	154 000 DKK	2002
Finland	Ministry of Foreign Affairs	€20 000	2003
Denmark	Ministry of Foreign Affairs	500 000 DKK	2003
USA	US Embassy, Copenhagen	17 357 DKK	2003
Denmark	Ministry of Foreign Affairs	500 000 DKK	2004
Denmark	Natural Science Research Council	500 000 DKK	2005

Fund-raising

Developing strategies that are believable and trustworthy for investors and funding authorities in the individual countries is thus an important function. Most significantly, a new fund raising strategy developed by the Secretariat was approved by the Governing Board at the October 2004 meeting in New Zealand. Several subcommittee and Governing Board members have volunteered to be actively involved in the new fundraising pursuits.

The Secretariat also already hired one consultant to make recommendations about how to organize a donors' conference. The OCB Programme Officer was involved in developing a proposal to a private foundation with the view of establishing an Amazon Basin Biodiversity Information Facility (ABBIF). Other members of the Secretariat are also approaching various foundations to raise funds for GBIF.

Nevertheless, the Review Committee finds the amount of supplementary contributions that have been made up to now disappointingly low. There is no doubt that an increase in these contributions is necessary to fund highly relevant activities of GBIF, such as enhancing core programmatic activities and supporting better participation by developing countries. Besides this, there is pressure on the Secretariat to demonstrate to the GBIF community that it is able to attract additional funding. However, we believe that the GBIF community has a significant responsibility as well to support GBIF beyond the basic level of dues. We also note that no inter-governmental

organization has provided any contributions to the supplementary fund over the years.

At the same time, we are pleased to see that GBIF is pursuing fundraising efforts and that a strategy for increasing contributions to the supplementary fund was presented at the October 2004 Governing Board meeting. Moreover, the new Work Programme for 2005-2006 (see Appendix E) separates funded and un-funded activities, which serves to highlight the activities for which additional funding is required. In our view, this is a welcome enhancement to the planning process for the Work Programmes and will hopefully encourage and inspire donors to contribute in a focused way to programmatic activities, in addition to the support that has already been provided for developing countries' participation in GBIF events. This is true for all types of donors and not just for GBIF Participants.

A possible future budget

The figure below depicts a possible future budget for GBIF.

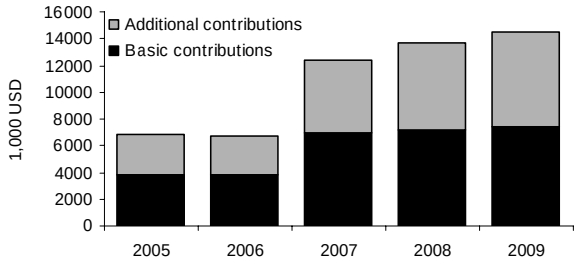

Figure 5.18
The possible future budget

Until 2006, the budget is based on the existing levels of basic contributions from Voting Participants. For 2007, it would be nearly doubled. The level of supplementary contributions is expected to be approximately 3 million USD already in 2005, the same amount the next year, and after that increasing considerably.

The prospective budget is based on the principle that expenditures necessary to keep GBIF and the portal up and running – such as the core Work Programme activities, core program staff, administrative staff, infrastructure, Governing Board, and other essential operating expenses – are covered by the basic contributions from Participants' dues. The supplementary fund covers expenditures for enhancing and expanding activities that are more focused on improving the effectiveness and usability of the network, such as integration and linking of data, cooperative activities, capacity building, increasing digital content, and expanding the use of the portal.

The Review Committee finds that the present level of funding has been sufficient for initiating and implementing GBIF's first phase of work.

However, we find that more funding is needed for GBIF in its next phase for several compelling reasons as discussed throughout this report, but especially including the following:

- As discussed in chapter 3, the Secretariat is extremely stretched and vulnerable, and essential functions are thinly covered. Furthermore, we believe that a regionally based support system for nodes and users will be needed in a few years.
- As discussed in chapter 4, the development of the portal has reached a point where user services and support – e.g., new interfaces and information, analytical tools, and demonstration projects – are becoming more and more necessary. GBIF might not be able to provide all of these features quickly, but it has to initiate and support their development to maintain credibility with the user community and to fulfil its mandate.

We do not believe that a higher level of funding can be reached solely on the basic contributions from the Voting Participants. Even though a progressive increase in the dues levels over a number of years appears to be desirable and necessary, an increase in the supplementary funding from other sources will be needed. Clearly, many GBIF Participants expect this to happen. It also will be necessary to attract additional Voting Participants and to upgrade the existing Associate Participants to Voting Participant status, as we have already discussed above.

5.4.3 In-country and intra-organizational funding

The MoU (§3.3.c/d) states that all Participants should invest in national or intra-organizational activities in support of GBIF, for example, in the establishment of nodes. As part of our questionnaire to the GBIF community we tried to identify the approximate level of investments by the Participants in the biodiversity information infrastructure in 2002 and 2003, disregarding their direct contributions to GBIF. The result, which is presented in the table below and which we admit is insufficient and inconclusive, indicates that 13 country and organizational Participants have invested annually more than 20 million USD in activities generally supporting GBIF goals. However, since the data are coarse and incomplete and only a few Participants have been able to provide information about this, we believe the amount actually invested may be significantly higher.

Table 5.6
In-country and intra-organizational investments in GBIF-related activities

Participant (million USD)	2002	2003
EASIANET	0.0	0.0
NatureServe	6.5	6.6
SAFRINET	0.0	0.1
UNEP	1.0	1.0
Belgium	0.3	0.3
Denmark	0.1 – 0.2	0.2
Japan	0.5 – 0.9	0.4 . 0.9
Mexico	1.8	1.8
Netherlands	2.0	2.7
New Zealand	2.0	2.5
Nicaragua	0.0	0.0
Slovenia	0.0 – 0.6	0.0-0.6
United States of America	8.0-30.0	8.0-30.0
Total	22.2 – 45.3	23.6 – 46.7

The delegates to the Governing Board were asked to state the approximate level of investments from their Participant in biodiversity information infrastructure in 2002 and 2003 in USD, and excluding the direct contributions to GBIF.

Also, Figure 5.14 above exemplifies the in-country or intra-organizational efforts in supporting GBIF by providing data to the portal.

Comments from the GBIF community clearly suggest that many countries and organizations have several initiatives in place for increasing investments in biodiversity informatics, such as: establishing nodes; funding equipment; digitizing legacy data in specimen collections; supporting young researchers; holding national network meetings, workshops, and international conferences; and supporting the development of the necessary skills, hardware, and software to provide access to their institutional data via the GBIF network.

When added together, these distributed functions and activities depict a much larger level of effort than just the core GBIF budget level and related Work Programme components. However, this information remains incomplete and not systematically reported or analyzed, making the knowledge of what is being done and actual progress over time difficult. The lack of comprehensive information about the nature of the distributed activities also makes it hard for the Secretariat to effectively prioritize and focus strategically on where to focus its limited capabilities of direct support and indirect assistance.

As discussed in chapter 3, the Secretariat tries to support the various national and organizational efforts by providing some targeted support and seed money grants. GBIF staff also travel to high-value forums or to meet with key decision makers in order to explain GBIF's goals and activities. GBIF has also worked with people who are submitting proposals to various funding agencies by identifying appropriate data resources for their research and by writing letters of support for their activities.

It is our understanding, however, that with the exception of these targeted programs and assistance, GBIF funding is not supposed to be used for external functions such as digitization of legacy data, developing nodes, or for support of other activities that are otherwise the responsibilities of GBIF's Participants at the national and institutional levels. Those are

national and organizational obligations, although GBIF can be a catalyst and forum for helping to secure other funding and promoting cooperation between countries with a common interest in such activities.

5.4.4 Conclusions

The present funding has been sufficient for GBIF to achieve its goals in the initial phase of establishing GBIF and the Secretariat. It is obvious to us, however, that the next phase will require an increased level of funding in order to be able to continue the activities laid out in the Work Programme and to stabilize the present development of GBIF. A very acute need for increased funding is in the Secretariat, which is too thinly staffed even for its present level of activity.

The funding of GBIF is almost completely based on contributions from the Voting Participants. The number of Voting Participants has seemingly stagnated at twenty-five countries, though the number of Associate Participants appears to be increasing. The Review Committee is concerned about this because Associate Participants are also cost drivers for GBIF, even though they provide some in-kind contributions.

The countries' incentives for paying more are weak, since the rights of the different types of Participants are somewhat similar or are not perceived as that important. The incentive to become a Voting Participant currently is not sufficient for Associate Participants to shift category.

The funding of GBIF therefore is too dependent on the basic funding from Voting Participants. Moreover, this funding base is potentially unstable due to lack of long-term commitments from the countries. This situation probably will not change, since only a few countries seem to be interested in a more legally binding agreement than the current MoU.

Nevertheless, we conclude that there is a significant, but as yet unrealized, potential for increasing the number of Voting Participants by recruiting new countries and inter-governmental organizations, and by converting Associate Participant countries to Voting Participant status. There also are substantial opportunities for increasing voluntary contributions to te supplementary fund. The Review Committee is especially pleased that the Secretariat is developing a funding strategy to pursue these goals more vigorously.

Another obvious way of improving the total level of funding is to increase the level of financial contributions for Voting Participants. Although the funding mechanism is basically considered fair, clear, and agreed upon we conclude that there are more weaknesses with the funding mechanism than strengths. One major weakness is in the top categories of Participants. The risk is that the total contribution to GBIF will suffer severely if one of the top countries withholds its contribution to GBIF. The risk is of course only potential, but some countries could have some difficulties in pulling funds together because of their government's budgetary pressures or because of a failure in internal negotiations between the institutions and agencies that

together provide the contribution. Furthermore, the mechanism needs to take inflation and the choice of currency into account, which will help stabilize GBIF's finances to a considerable degree.

Finally, we have not been able to uncover fully whether Participants have made sufficient and appropriate progress in increasing their in-country or intra-organizational investments in biodiversity information infrastructure in support of GBIF. Clearly, efforts are being made – although very unevenly. One indication is the number of nodes. Another is the significant amount of data already provided to the network. However, too many Participants have not yet been able to establish the internal structure and support necessary to provide data and resources.

5.4.5 Recommendations on the level of funding

1. Consistent with GBIF's potential importance and relevance as described in this report, the Participants in GBIF must do more to ensure that their environmental and science policymakers understand the enormous value that GBIF could return to them if it were properly funded at both the global and in-country levels. Further, as the founding organization of this initiative, the OECD has a special responsibility to help ensure that GBIF obtains the commitments for the level of funding required to achieve its established objectives.

2. We recommend that the level of funding for GBIF be increased to a level similar to the level suggested in the 1999 OECD report that recommended the formation of GBIF – that is, in the area of 7-10 million USD.[25] However, the drop in the USD in recent years means that the value of contributions at the 1999 level in USD is significantly lower now in the currencies most used by GBIF. The table below clearly shows this.

Table 5.7
Drop in currency in the USD

Exchange	Year	Million USD	Million DKK	Million EUR
USD → DKK → EUR	1999	7.0 – 10.0	48.9 – 69.8	6.6 – 9.4
	2004	7.0 – 10.0	41.9 – 59.9	5.6-8.1
EUR → DKK → USD	2004	9.7-13.9	58.3-83.3	6.6-9.4

Consequently, trying to reach the same Euro level as in 1999 would mean raising the USD level in 2004 to a range of 9.7 and 13.9 million USD.

We suggest a target level of 10 million USD (at the 2004 level) split according to 7 million USD in basic contributions from Voting Participants and at least 3 million USD from voluntary, supplementary sources.[26]

[25] Final Report of the OECD Megascience Forum Working Group on Biological Informatics (January 1999), OECD, Paris.

[26] The suggested level of funding is based on our interpretation of a suggested future budget presented by the Secretariat and by the level initially suggested by the OECD Working Group, adjusted for fluctuations in the exchange rate.

The distribution of the expenditures to be covered by the basic contributions is shown in the table below.

Management and administrative staff, including non-programmatic expenditures	0.7
Promotion of GBIF	0.3
Governing Board and committees	0.3
Program activities including staff and consultants directly supporting these activities	5.7
Total (2009 level)	7.0

Table 5.8
Distribution of basic contributions (2009 level)

3. We recommend that the increase in basic contributions be reached incrementally over a period of two or three years, and that the increase be clearly explained by specific allocations in programmatic activities. We also recommend that the Voting Participants each consider providing significant supplementary funding contributions. Flexibility in the allocation of additional supplementary funds is essential because donors generally have special interests in which activities they fund.

4. The efforts so far in attracting both kinds of funding have been poor, as shown in section 5.4.2. Nevertheless, we fully support GBIF's emerging plans to obtain additional funds and the ideas in the new fundraising strategy. Besides focusing on increasing the number of Voting Participants paying basic contributions, we recommend that GBIF's efforts to obtain more supplementary funding be focused on: government ministries, inter-governmental organizations, ad hoc consortia of nations, and philanthropic organizations and individuals. Additional funding also could be generated through a membership fee from "Friends of GBIF."

5.4.6 Recommendations on GBIF's funding mechanism

We generally support the concept of basic contributions from Voting Participants for GBIF's core funding as established in Annex 1 of the current MoU. We recommend that this mechanism be continued, but with the following suggested changes.

1. The increase in the level of funding, as justified above, should be supported by the following initiatives:

- The existing Associate Participant countries shift their status to Voting Participants, either immediately upon approval of the new MoU or following a set period of time, thereby becoming paying contributors to the core fund (see section 5.2.5).
- A continuous focus on recruiting new Voting Participant countries.
- A continuous focus on maintaining existing Voting Participants, e.g., by GBIF actively supporting and offering guidance to countries on securing their funding.

- An incremental increase in total basic contributions, as described below.

2. We suggest two potential options for an incremental increase in funding. The principles in support of either of these options are: [27]

- All countries, economies, and inter-governmental organizations – except for new Observer Participants – contribute financially.
- The new funding mechanism is founded on the existing mechanism.
- The new mechanism is implemented in three steps:
  - 2007: No change in funding levels, except that existing Associate Participants become Voting Participants and contribute financially, depending on the time period established in the new MoU for that shift in status.
  - 2008: Contributions changed by 50% of the total change.
  - 2009: New levels fully implemented.

(a) Option 1

(a) Option 1 suggests a restructuring of the levels of contributions in each category in order to diminish the dependence on a minority of counties and thereby provide a better balance in the funding situation. The following additional principles apply under this option:

- The top three categories are joined and levelled out.
- The variance of distribution is reduced significantly, although the principle of proportionality is maintained.

Following this option, the redistribution will lead to a significant relative discount to the top level contributors in comparison to all others. However, we recommend that these countries in particular make substantial, voluntary supplementary contributions to offset this reduction in dues. The table below shows the new recommended levels of contribution under this option.

Categories and GDPs	2006	2007	2008	2009
1 – GDP > $3000 billion	$700 000	$700 000	$600 000	$500 000
2 – GDP $2000-3000 billion	$450 000	$450 000	$475 000	$500 000
3 – GDP $1000-2000 billion	$250 000	$250 000	$375 000	$500 000
4 – GDP $100-1000 billion	$100 000	$100 000	$175 000	$250 000
5 – GDP $50-100 billion	$50 000	$50 000	$75 000	$100 000
6 – GDP $25- 50 billion	$20 000	$20 000	$30 000	$40 000
7 – GDP < $25 billion	$500	$500	$750	$1 000

[27] Yet another strategy could be a continuous scale related more directly to GDP. We have analyzed this approach, however, and this model – if based on the present level of funding and the existing Voting Participants – implies a doubling of the U.S. contribution and a reduction in all other Participants' contributions. We consider this unrealistic and counterproductive, and consequently abandon this approach as an option.

Categories and GDPs	2006	2007	2008	2009
Associate Participant Country	No contribution	Not applicable	Not applicable	Not applicable
Observer Participant	Not applicable	No contribution	No contribution	No contribution
Total contribution	$3 642 000	$4 205 500	$5 558 250	$6 911 000

Assumptions:
1) All figures are at the 2006 level.
2) Calculation based on the Voting Participants and Associate Participants as of December 2005.
3) Inter-governmental organization contributions not included because their levels would be subject to negotiation, rather than a formula

Table 5.9
New levels in the funding mechanism under option 1

(b) Option 2

(b) Option 2 assumes that some Participants may not be willing to redistribute the levels of contribution under the formula suggested above, despite its more equitable distribution. This second option is based on the principle of continuity, on the assumption that the current Participants will be more willing to increase their contributions based on existing categories and levels of funding that have already been negotiated and agreed.

The increases would target a total level of basic contribution of 7 million USD – estimated on the basis of the existing Participants. This new level would be reached by increasing the existing levels in each category by 65%. The table below shows the recommended levels of contribution under option 2.

Categories and GDPs	2006	2007	2008	2009
1 – GDP > $3000 billion	$700 000	$700 000	$927 500	$1 155 000
2 – GDP $2000-3000 billion	$450 000	$450 000	$596 250	$742 500
3 – GDP $1000-2000 billion	$250 000	$250 000	$331 250	$412 500
4 – GDP $100-1000 billion	$100 000	$100 000	$132 500	$165 000
5 – GDP $50-100 billion	$50 000	$50 000	$66 250	$82 500
6 – GDP $25- 50 billion	$20 000	$20 000	$26 500	$33 000
7 – GDP < $25 billion	$500	$500	$663	$825
Associate Participant Country	No contribution	Not applicable	Not applicable	Not applicable
Observant Participant	Not applicable	No contribution	No contribution	No contribution
Total contribution	$3 642 000	$4 205 500	$5 572 288	$6 939 075

Assumptions:
1) All figures are at the 2006 level.
2) Calculation based on the Voting Participants and Associated Participants as of December 2005.
3) Contributions from inter-governmental organizations not included.

Table 5.10
New levels in option 2

Consequences of both models

The consequences of the redistribution are shown in the figure below. In the existing scheme – which is the same as in option 2–20% of the Participants provide more than 60% of the funding. In the revised redistribution scheme – that is, in option 1 – 20% of the Participants provide just above 40% of the funding, as explained in the discussion above.

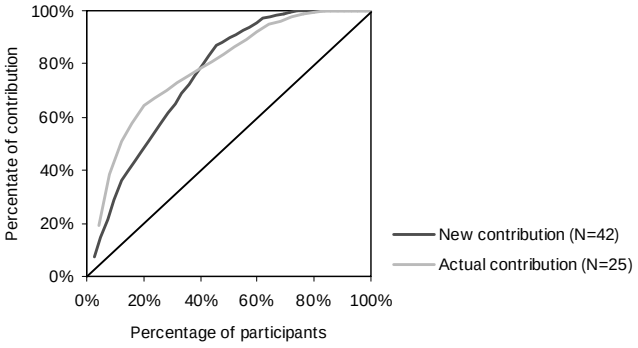

Figure 5.19
The consequences of redistribution of basic contributions

3. Because the existing funding mechanism is not adjusted for inflation, the value of each contribution diminishes every year. We therefore recommend an annual increase in the levels of contribution based on the projected rate of inflation in the county that is hosting the Secretariat (presumably Denmark). This projection should be made in three-year increments and should be accompanied by a budget forecast by GBIF for the same period.

4. The funding mechanism is based on USD, which has turned out to be a severe problem for GBIF, as mentioned in section 5.4.5. See the figure below, which shows the fluctuations in the exchange rates from 1999 to 2004. An essential purpose of the funding mechanism should be to maximize the stability in GBIF's funding by distributing as much of the risk of uncertainty among the Participants.

We recommend that the levels of contributions be set in Euros and preferably paid in Euros, although USD are acceptable for payment as is the currency that is used in the country where the Secretariat is located.[28].

[28] We considered basing the mechanism on Special Drawing Rights (SDR), which is a fictitious currency maintained by the IMF. The Special Drawing Rights (SDR) was initially an international reserve asset, created by the IMF in 1969 to supplement the existing official reserves of member countries. Today, the SDR mainly serves as the unit of account of the IMF and some other international organizations. Its value is based on a basket of key international currencies. The SDR is neither a currency, nor a claim on the IMF. Rather, it is a potential claim on freely usable currencies. However, the fluctuations of the SDR over the last couple of years indicate that SDR will not provide GBIF with sufficient stability as long GBIF is located in a Euro-based or Euro-linked country. More information on SDR is available on: www.imf.org/external/np/exr/facts.

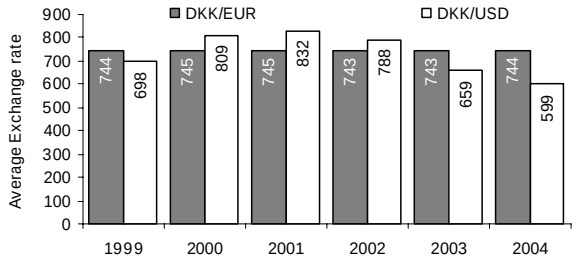

Figure 5.20
Fluctuations in exchange rates, 1999-2004

Source: Danmarks Nationalbank

We believe that the Euro would provide the most stable basis for GBIF finances and that the practical implications for the Participants will be insignificant, after the adjustment is made.

5.5 Operational and Financial Management at the Secretariat

In this section we examine the organization of the GBIF Secretariat, its relationship with the host institution, the University of Copenhagen, and its financial management. Some of the organizational issues, of course, are also discussed in chapter 3 and the financial issues are also discussed in the sections on Governance and Funding above.

The main questions posed by the Statement of Task to the Review Committee in this regard were:

> *1. Ha[s] the present organizational structure…been sufficient for GBIF to achieve its goals?*

and

> *(d) Operations of the Secretariat and the Governing Board: are they appropriate and efficient?*

The information resources for doing this part of the review included key management documents, especially the material submitted to the Governing Board and Budget Committee. In addition, the Review Team interviewed every employee in the Secretariat, as well as Governing Board members, who also responded to the questionnaires with regard to the Secretariat performance.

The first years of GBIF obviously have been focused on the initiation and consolidation of the organization's operational and management functions. The GBIF Secretariat has done a great amount of work just to get GBIF organized and operating. Doing these tasks for the first time has also given

the GBIF Secretariat a lot of experience within the broad spectrum of GBIF operations and management. Several of these experiences have already resulted in some changes (e.g., in internal financial regulations). Others may be integrated into the new MoU and National Host Agreement. This part of our review builds on these experiences and should not be viewed as criticism in a negative sense, but more as collection of lessons learned that the Secretariat and the broader GBIF membership can take into consideration.

5.5.1 Secretariat staff

As of December 2004, the Secretariat staff comprised:

- The Executive Secretary.
- Two Deputy Directors (Deputy Director for Management and International Relations, and Deputy Director for Informatics).
- Four Programme Officers, one for each of the existing Work Programme components (DADI, DIGIT, ECAT, and OCB).
- A Scientific Liaison Officer in charge of public relations.
- Three administrative secretaries (a personal secretary for the executive secretary, a secretary responsible for finance, and a secretary responsible for administrative Web content). All of the secretaries are fluent in at least three languages and cover to some extent each other's areas of work.
- Two IT professionals (a Senior Software Engineer and a Webmaster and Network Administrator).
- A University Liaison Officer hired by the University of Copenhagen, who works with the financial reporting, and administers relations between GBIF and the various units of the University.
- GBIF also has decided to hire a Nodes Liaison Officer. This person is not yet employed and has not been placed in the organizational diagram. The placement of the Nodes Liaison Officer in the figure below, therefore, is still subject to confirmation.

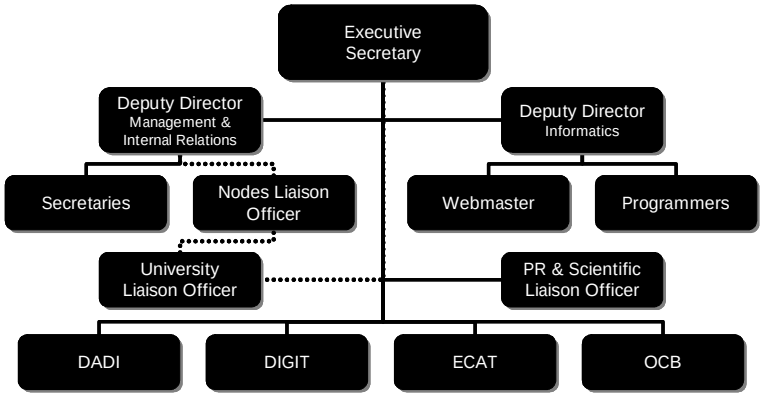

Figure 5.21
Organizational diagram of the Secretariat

GBIF employees are hired on contracts of up to five years' duration, and may be renewed. The employees have expressed the view that the employment contract and the salary and benefit package are attractive.

As has already been noted, GBIF originally was intended to be a 10 million USD per year operation. However, GBIF has operated and achieved substantial results with far less funding. Nevertheless, the reduced levels of funding have resulted in a very thinly staffed organization, as noted many times throughout this report. GBIF certainly should not have a smaller staff under the next MoU, although the existing position profiles or categories could be changed as suggested, for example, in the OCB section in chapter 3.

It also should be noted that various staff members will be leaving in the coming years (including the Executive Secretary and some Programme Officers), which means that staff continuity and corporate memory are endangered. The organizational continuity of GBIF and its smooth transition in day-to-day operations are thus of considerable concern.

5.5.2 The host agreements

GBIF operates with two host agreements: the National Host Agreement, which establishes GBIF as an international organization in Denmark, together with the rights and immunities that flow from that; and the Institutional Host Agreement, which specifies the service that the University of Copenhagen will provide for GBIF.

National Host Agreement

The National Host Agreement exempts GBIF from taxation and from a number of Danish regulations normally applied to companies and organizations in Denmark. These exemptions are based on a Danish law (Lov nr 567, om rettigheder og immunitet for internationale organizationer, 1983) concerning the rights and immunities of international organizations. This law, together with the Institutional Host Agreement discussed below, give GBIF extraordinary freedom to operate within the Danish law and territory.

The employees of GBIF benefit very much from this arrangement. Employees are exempted from Danish tax on their remuneration from GBIF (whereas income from other sources is not exempted). The actual taxes that employees are paying in total, both to Denmark and to the country of citizenship, vary according to the tax agreements made between Denmark and the country in question. Foreign employees are also in some cases exempted from the VAT and the other taxation of goods. These individual benefits for employees are also based on the 1983 law.

Institutional Host Agreement

The GBIF Secretariat is hosted by the University of Copenhagen and this relationship is regulated through the Institutional Host Agreement. The arrangement has several advantages. Perhaps the greatest advantage is that the University – through a grant from the Aage V. Jensen Foundations – constructed an addition to the Zoological Museum to house the GBIF Secretariat. Moreover, the Institutional Host Agreement functions as a service level agreement, stipulating what services in kind the University is to provide, and this is discussed further below.

Financial regulations

The Financial Regulations regulate the Secretariat's financial matters, and the Staff Rules and Instructions regulate the staff. By and large, the Financial Regulations follow the equivalent regulations of the host institution and the Danish state, and the Staff Rules are substantially patterned after those of the European Radiocommunications Office.

The Staff Rules and Instructions regulate the salaries, benefits, evaluation procedures, sanctions, and other staff activities. These are standard institutional regulations in many ways. Education and health care benefits for children are included in the contracts for foreign employees, because these would otherwise not be covered under the national Danish system. There is no pension included in the salary, and there is no agreement within GBIF about internal payments or any internal "tax" to GBIF in order to share the surplus (coming from the individual tax exemption) between GBIF and its employees. Salaries are based on an OECD salary scale that is frequently applied to inter-governmental organizations. These salaries are high - compared to Danish standards for academic and administrative personnel - but at or below the salary levels of organizations such as the United Nations or the Commission of the European Communities.

5.5.3 Relations of GBIF to the University of Copenhagen

According to the Institutional Host Agreement, the University is to provide the physical infrastructure for GBIF, including the office space and its other physical needs, including most of the furnishings and equipment (such as computers, printers and net connections) and utilities. The University pays all the bills associated with this infrastructure, and the accounting and financial reporting expenses, except auditing. The University also pays for the full-time professionally trained liaison officer.

The University estimates that the costs of hosting GBIF is 1.5 million DKK (about 250 000 USD at the current rate of exchange) per year. The building

that was built using the grant from the Aage V. Jensen Foundations is worth approximately 12.5 million DKK (or roughly 2 million USD).

Based on all our interviews and research, the administrative interface and day-to-day operation between the University and GBIF can be described as functioning well. However, the renegotiation of the institutional host agreement should be prepared well in advance of its termination. In this regard, the University has already extended the Institutional Host Agreement through the end of 2006 and has indicated that it is positively disposed to negotiating a renewal of the agreement beyond that date.

In the scientific area, the results of the interaction between the University and GBIF are not yet well known and are difficult to assess. The expectation of the University, however, is that the benefits of hosting GBIF will accrue and become more apparent over the longer term.

5.5.4 Financial management

GBIF's finances have already been discussed to a large extent in the Funding section above. In this section the focus is on the expenditure or cost side of financial management, in contrast to the focus on the revenue side in the Funding section.

The budget projections for GBIF indicate that the majority of GBIF's savings will be spent in 2004. Assuming that a conservative estimate in the increase in GBIF's basic financial contributions will be realized after 2004, almost all costs will decrease except for salaries, which are based on a yearly increase of about 4% according to OECD estimates.

The projection of income and expenditures in the table below shows that GBIF is on a minimal budget and that the operations are squeezed between an almost fixed income and increasing costs. This situation indicates the need for either a larger increase in basic financial contributions or for supplementary funding of GBIF activities, or both, as discussed in the Funding section. Reducing costs will reduce GBIF's efficiency and effectiveness because the marginal program activities (that is, activities on top of the basic operations of IT, administration, etc.) are the activities that are of the highest value for the community.

GBIF currently reports its income and expenditures using the University of Copenhagen's financial system (Oracle Financials). In the earlier phases of the Secretariat, obligations from contracts and payment plans were not satisfactorily integrated into this financial system. Consequently, the Secretariat did not have an accessible overview of the total expenditures (actual payments and obligations to make payments) at any given time during the financial year (e.g., on a monthly basis). This was rectified in late 2004.

GBIF Income and Expenditures: 2001-2006

USD	Realized		Budget		Financial plan
	2001/2	2003	2004	2005	2006
Opening balance		1 731 050	2 657 415	391 415	363 915
Income	3 078 998	4 278 070	2 660 000	3 777 500	3 852 500
TOTAL INCOME AND SAVINGS	3 078 998	6 009 120	5 317 415	4 168 915	4 216 415
Staff expenditures	917 173	1 398 487	1 705 000	1 730 000	1 840 000
Running expenditures	145 939	243 853	405 000	250 000	200 000
Secretariat facilities	14 451	6 047	21 000	15 000	15 000
Work Programme	310 710	1 566 300	2 325 000	1 500 000	1 500 000
Ebbe Nielsen Prize			35 000	40 000	40 000
Expenses of the Governing Board	102 951	142 697	300 000	180 000	90 000
Third-year review			160 000	90 000	
Projects not completed year n-1			175 000		
Capital expenditures		585 489			
TOTAL EXPENDITURES	1 491 224	3 942 873	5 126 000	3 805 000	3 685 000
Exchange rate differences	143 276	591 168			
Expected additional savings			200 000		
RESULT (budget contingency fund)	1 731 050	2 657 415	391 415	363 915	531 415

Figure 5.22
Financial facts and estimates, 2001-2006

The table above shows the development of income and expenditures from 2001 to the financial plan for 2006. The figures do not make apparent an alarming loss of 3.8 million DKK (equals more than 620,000 USD at an exchange rate of 6.1 DKK/USD) as a direct consequence of the falling exchange rate of the USD to the DKK since 2001, because nearly all income is received in USD and many expenses are paid in DKK. To avoid future losses of that magnitude, GBIF has begun to use forward contracts, which means that GBIF's bank agrees to exchange USD to DKK at a fixed exchange rate. This service is not free, however. GBIF also has been given hedging options to be able to withdraw forward contracts in case this would be in GBIF's favor. This service on the other hand is free of charge.

The Review Committee sees nothing wrong with these practices per se. An addition to the financial regulations concerning the Secretariat's authority to handle exchange rate variations was approved at the GB9 meeting in New Zealand.

Another issue raised by the GBIF income and expenditures table above is that the various budget categories are quite different in magnitude, and especially two categories are very large—the salaries and Work Programme. It would be more useful if these categories were broken up according to the different Work Programme components and that the salaries were also divided up accordingly. Salaries are the single most expensive part of GBIF's operations. After GBIF's current savings are spent on the Work Programme, the percentage share used on salaries in the total budget will increase.

A large portion of the GBIF budget is spent on travel (see the running expenditures in the table above). We recognize that the staff needs to travel a lot and in our view GBIF is doing a great job of minimizing the actual expenses on airplane tickets and per diem costs.

It also should be noted that to date the auditors of the GBIF accounts have raised no criticisms regarding the GBIF Financial Reports for 2001, 2002, and 2003 and have certified that the accounts have been prepared properly.

5.5.5 GBIF community opinions on the organization and management of the GBIF Secretariat

The overall impression of the members of the GBIF community who responded to the Governing Board questionnaire is that the performance of the Secretariat in working to establish GBIF as a mega-science facility has been excellent. More than two-thirds of the respondents felt this way. The Secretariat is staffed and managed by highly competent, responsive, and effective people from many countries. They work in an un-bureaucratic organization, which can respond quickly and flexibly, and are able to perform in a way that gives GBIF Participants a world-class service, despite a limited budget. One indicator of the rapid responsiveness of the Secretariat is that a number of our criticisms of existing practices or activities during the course of this review were corrected even before this report was written. Indeed, all the respondents to the questionnaire were positive, although several did note some concerns.

The main weakness that was identified focused on the well-documented problem of the limited amount of resources in relation to the organization's tasks. There is a need for a more vigorous fund raising function in GBIF. This issue is also addressed in the Funding section above. The lack of resources and the thinly staffed organization lead to the concern that staff members are too busy and do not have the opportunity to take on some of the activities proposed in this report and by the Governing Board. Other respondents believed that there needs to be more focus on different aspects of GBIF's work outside the Secretariat and less on administration. These concerns are raised as well in the context of our assessment of the Work Programme in chapter 3.

Some respondents also pointed out that the Secretariat often is too "democratic" in its decision making and that draft papers get spread around for review too much. This apparently has led in some cases to the impression that the Secretariat sometimes can be slow or indecisive.

Some other respondents pointed out that the Secretariat spends too much on salaries and its activities are too centralized, and that fewer people in the Secretariat would require GBIF to perform more tasks externally.

5.5.6 Conclusions

GBIF's finances are currently stable, with a substantial amount of savings in hand that provides some room for manoeuvre by the Governing Board and the Secretariat. Salaries are almost certain to increase faster than funding unless GBIF manages to convert a lot more Associate Participants to Voting Participants, or in other ways augments the supplementary fund, as recommended elsewhere in this chapter.

Improving the finances by cutting costs and by reducing staff or program activity will not increase the efficiency or effectiveness of GBIF. On the contrary, cutting down on the number of employees will either mean that professionals will do administrative jobs, or will directly decrease activity in GBIF's core Work Programme.

Although GBIF basically has a sound financial position at this time, the organization has experienced some financial difficulties due to the fact that its income is in USD and a large proportion of its expenditures is in DKK. GBIF has suffered a loss of 620,000 USD because of the exchange rate. A further drastic fall in the exchange rate of USD to DKK is not very likely, but Danish economists do not foresee an improvement in the value of the USD compared to the DKK in the near term either. The GBIF Secretariat has been right to buy forward contracts, as recommended by the auditors, and the approval to do so is documented through the revisions made to the Financial Regulation agreed to at GB9. We must emphasize, however, that this approach should only be seen as a stop-gap measure and that a much preferred solution to this exchange problem is recommended in the section on Funding above.

The financial reporting system and progress reports that GBIF together with the University of Copenhagen produce can be improved in several ways.

The Institutional Host Agreement between GBIF and the University of Copenhagen will expire by the end of December 2006. A new agreement should be negotiated well before the expiring date.

Some key Secretariat staff members have indicated that they are unlikely to renew their contracts, leaving substantial uncertainty as to succession, continuity, and retention of corporate memory.

The existing strategic plan for GBIF does lay out the future challenges of GBIF, but the plan lacks specific considerations for the transition of GBIF into its next phase of development. This 3rd-Year Review should provide the opportunity to develop such a plan. One area that needs to be considered is the possibilities for expansion of GBIF's physical facilities. Another is the future potential decentralization of the Secretariat on a regional basis as the organization grows.

5.5.7 Recommendations in order to meet existing concerns

1. GBIF should revise its financial reporting rules in a way that enables the management and the Budget Committee to show that money is spent on

Work Programme components according to the established plans and budgets to improve the utility of the budget as a management tool. There are two categories that are especially large – salaries and the Work Programme – and these categories ought to be broken up into the specific Work Programme components (DADI, DIGIT, ECAT, OCB, ICT, and now Nodes).

2. GBIF should establish an ad hoc committee in the Governing Board with the aim of analysing the costs and benefits of a further decentralization of the Secretariat on a regional basis as a way of handling future growth. We do not suggest a decentralization of the Secretariat at the present level of funding and activities, however.

A. The Review Committee and Review Team Members

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B. List of GBIF Participants

Voting Participant …	Denmark (2001/01)) United States of America (2001/01) Australia (2001/02) Belgium (2001/02) Germany (2001/02) Japan (2001/02) Netherlands (2001/02) New Zealand (2001/02) Slovenia (2001/02) Spain (2001/02) Sweden (2001/02) Canada (2001/03) France (2001/03)	Mexico (2001/03) Finland (2001/04) Costa Rica (2001/05) Korea, Republic of (2001/05) Iceland (2001/06) Nicaragua (2001/06) Portugal (2001/06) United Kingdom (2001/08) Peru (2002/09) South Africa (2003/05) Estonia (2003/09) Norway (2004/03
Associate Participants (Countries and economies) …	Switzerland (2001/02) Ghana (2001/03) Poland (2001/03) Bulgaria (2001/08) Pakistan (2001/08) Slovak Republic (2001/08) Austria (2001/09) Argentina (2002/03) Taiwan (Economy) (2002/09)	Tanzania (2002/09) Czech Republic (2002/10) Madagascar (2003/01) Morocco (2003/06) India (2003/08) Colombia (2003/09) Papua New Guinea (2004/03) Indonesia (2004/11)
Associate Participants (organizations) …	European Commission (2001/02) Expert Center for Taxonomic Identification (2001/03) Integrated Taxonomic Information System (2001/03) Species 2000 (2001/03) BIONET-International (2001/05) Inter-American Biodiversity Information Network (2001/05) NatureServe (2001/05) UNESCO, Man and the Biosphere Programme (2001/05) UNEP, World Conservation Monitoring Centre (2001/05) Ocean Biogeographic Information System (2001/06) CABI Bioscience (2001/09) All Species Foundation (2002/03) BIOSIS (2002/03) Taxonomic Databases Working Group (2002/03) EASIANET (2002/09)	ASEANET (2002/10) World Federation for Culture Collections (2002/10) Société de Bactériologie Systématique et Vétérinaire (SBSV) (2002/12) Wildscreen Trust (2003/01) SAFRINET (2003/08) IUCN (2003/09) Freshwater Biological Association - FreshwaterLife (2003/10) ASEAN Regional Centre for Biodiversity Conservation (2003/12) Finding Species (2003/12) International Centre for Insect Physiology and Ecology (2004/03) Nordic Gene Bank (2004/03) Botanic Gardens Conservation International (2004/08) Pacific Biodiversity Information Forum (2004/09

Table B.1
The Participants of GBIF (source: gbif.org – as of 7 December 2004)

C. Memorandum of Understanding for the Global Biodiversity Information Facility

The signers of this non-binding Memorandum of Understanding, being countries, economies, or inter-governmental organizations, or entities designated by countries, economies, or inter-governmental organizations, have decided that a co-ordinated international scientific effort is needed to enable users throughout the world to discover and put to use vast quantities of global biodiversity data, thereby advancing scientific research in many disciplines, promoting technological and sustainable development, facilitating the equitable sharing of the benefits of biodiversity, and enhancing the quality of life of members of society. The importance of making biodiversity data openly available to all countries and individuals is underscored by various international agreements, especially the Convention on Biological Diversity.

Recognising this need, the delegates to the Meeting of the OECD Committee for Scientific and Technological Policy at Ministerial Level in Paris on 22–23 June 1999 endorsed a recommendation from the OECD Megascience Forum that a Global Biodiversity Information Facility (designated hereafter as GBIF) be established, with open-ended participation.

The signers of this Memorandum of Understanding hereby express their intention to become Participants of GBIF as a form of technical and scientific international co-operation.

Paragraph 1. Definitions

1. Biodiversity
   The short form for "biological diversity." This means the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes genetic diversity, and diversity within species, between species and of ecosystems.

2. Biodiversity Data
   In the context of this MOU, biodiversity data refers to scientific information, primarily about biological species and specimens. At the species level, such data would include the scientific names of the species and all of its synonyms; the common name(s) of the species; and other information about the species, such as a description of the species, its physiological properties, its genetics, its geographic distribution, its phylogenetic relationships, its role in the dynamics of ecosystem processes including cases of invasions, its applications, etc. Specimen-level data including samples for molecular analysis, would include the scientific name of the species to which the specimen belongs; information on where, when and by whom the specimen was collected; where the specimen is currently located; who identified it; what is the specimen number; and other associated information derived from the specimen (e.g., living culture, frozen tissues, photographs, parasites, hosts) and any other related field notes written by the collector of the specimen.

3. Node
   A stable computing gateway that allows real-time inter-operational search of multiple institutional, national, regional and/or subregional databases containing primary or meta-level biodiversity data (such as specimen records, catalogues, bibliographic, sequence, protein and ecosystem data) or a single, web-accessible computer containing one or more significant maintained biodiversity databases. A node must provide descriptions of an accepted standard of metadata of the contents and quality of each database. Each node must state an explicit policy regarding Intellectual Property Rights. A node may also contain or link to software tools, including data validation tools. Each Participant may have one or more nodes.

4. Participant
   A country, economy, inter-governmental organization or other organization, or an entity designated by a country, economy, inter-governmental organization or other organization, that has signed this MOU and has expressed its intention to observe the provisions herein. A Participant may designate an entity to take part in the operation of GBIF and to act for the Participant in such matters as the Participant chooses to delegate to it.

5. GBIF Secretariat Host
   The institution, agency or other entity which provides the administrative and logistical support capabilities for the GBIF Secretariat and in which the GBIF Secretariat may be located and housed.

6. SpeciesBank
   A means of access to information of all sorts about species, both known and new.

Paragraph 2. Understandings

1. GBIF is an open-ended international co-ordinating body set up with the overall aim of furthering technical and scientific efforts to develop a global digitized information facility for biodiversity data.
2. The Participants' involvement in this MOU is subject to the goodwill and appropriation or allocation of funds by the appropriate governmental authorities and to the applicable laws and regulations of the Participants.
3. Nothing in this MOU should be read to contradict the principles of the Convention on Biological Diversity and other relevant Conventions.
4. This document is not legally binding and will have no effect as a legal or political precedent.
5. The Governing Board of GBIF should strive to reach decisions by consensus whenever possible.

Paragraph 3. Obejctives

1. Purpose
   The purpose of GBIF is to promote, co-ordinate, design and implement the compilation, linking, standardization, digitization a and global dissemination of the world's biodiversity data, within an appropriate framework for property rights and due attribution. GBIF will work in close co-operation with established programmes and organizations that compile, maintain and use biological information resources. The Participants, working through GBIF, will establish and support a distributed information system that will enable users to access and utilize considerable quantities of existing and new biodiversity data.
2. Goals of GBIF
   It is the intention of the Participants that GBIF:
   a. be shared and distributed, while encouraging co-operation and coherence;
   b. be global in scale, though implemented nationally and regionally;
   c. be accessible by individuals anywhere in the world, offering potential benefits to all, while being funded primarily by those that have the greatest financial capabilities;
   d. promote standards and software tools designed to facilitate their adaptation into multiple languages, character sets and computer encodings;

e. serve to disseminate technological capacity by drawing on and making widely available scientific and technical information; and

f. make biodiversity data universally available, while fully acknowledging the contribution made by those gathering and furnishing these data.

3. Involvement of the Participants
Each Participant should seek to:

a. participate actively in the formulation and implementation of the GBIF Work Programme;

b. promote the sharing of biodiversity data in GBIF under a common set of standards;

c. form a node or nodes, accessible via GBIF, that will provide access to biodiversity data;

d. as appropriate, make other investments in biodiversity information infrastructure in support of GBIF; and

e. contribute to training and capacity development for promoting global access to biodiversity data.

4. Scope of Activity
Through their participation in the GBIF Work Programme, the Participants may carry out some or all of the following activities:

a. Improving the accessibility, completeness and interoperability of biodiversity databases, including:

i. Contributing data and technical resources, within an Intellectual Property Rights framework (such as that described in Paragraph 8);

ii. Developing novel user interface designs that incorporate features to support their functionality in a multi-lingual global context;

iii. Developing suitable tools and standards for accessing, linking and analysing new and existing databases, including standards and protocols for indexing, validation, documentation and quality control in multiple human languages, character sets and computer encodings; and

iv. Providing access to new and existing databases;

b. Facilitating development of an electronic catalogue of the names of known organisms;

c. Designing and implementing SpeciesBank;

d. Developing a digital library of biodiversity data;

e. Developing partnerships with other relevant organizations and projects;

f. Improving high-speed networking and computation infrastructures;

g. Sharing computational facilities, including high-volume data storage;

h. Developing model curricula for biodiversity informatics training;

j. Training researchers, data managers and technicians;

k. Implementing specific programs to enhance the biodiversity informatics capacity and technical skills base of developing countries; and

l. Helping to co-ordinate and harmonise the biodiversity informatics programs of the Participants.

5. Co-operation and Co-ordination
The Participants intend to encourage co-operation amongst themselves in the implementation of GBIF and in the development of joint work programmes in areas of mutual interest with the Secretariat of the Convention on Biological Diversity and other appropriate bodies to avoid duplication and to benefit from existing resources and expertise.

Paragraph 4. THE Governing Board

1. Role and Purpose
The Governing Board will be the means by which the Participants will make collective decisions on all matters relating to GBIF, which will then be put into effect by the GBIF Secretariat.

2. Establishment
The Governing Board will come into existence at the first meeting of the Participants after establishment of GBIF, subject to the provisions of Paragraph 11.

3. Composition
The Governing Board will consist of one representative from each Participant. There are two modes of participation:

   a. Voting Participants
   Participants that decide to make the financial contribution suggested in Annex I, or, in the case of an economy, inter-governmental organization or other organization, the financial contribution negotiated under the provisions of Paragraph 4.4, may vote on the Governing Board, following the procedures indicated in Paragraph 4.5.

   b. Associate Participants
   Participants that have not decided to make a financial contribution as suggested in Annex I may take part in the deliberations of the Governing Board, but may not vote.

4. Additional Participants
The Secretariat of the Convention on Biological Diversity will be

invited to designate a non-voting representative to the Governing Board. The Governing Board, acting by consensus, and if consensus cannot be reached, by super-majority vote, may also offer voting or non-voting participation for such period as the Governing Board deems appropriate to any economy, inter-governmental organization or other organization. The Governing Board will negotiate a fair and appropriate financial contribution for such Voting Participants.

5. Voting

   a. Unless otherwise indicated, the provisions of this Paragraph apply only to Voting Participants pursuant to Paragraph 4.3(a).

   b. The Governing Board should strive to work by consensus whenever possible. Except where mandated that a decision must be made by consensus, if consensus cannot be reached after reasonable attempts have been made, then approval by super-majority of those present and voting is required.

   c. A super-majority vote is the affirmative vote of a two-thirds majority of the Participants present and voting.

   d. In all cases in which this MOU expressly provides that the Governing Board act by means of a consensus decision or a vote of the Participants present and voting, “present” can mean face-to-face, by telephone, video conference, or other practical means determined in advance by the Governing Board.

6. Responsibilities
   The Governing Board may:

   a. select a GBIF Secretariat Host with reference to the criteria established to solicit bids for the GBIF Secretariat Host;

   b. adopt for each year the Work Programme and the Budget, together with an indicative program of work and budget for the following two years; the Governing Board may, by consensus, make adjustments to the Work Programme and the Budget at any time after it has been adopted;

   c. adjust, by consensus, the scales of financial contributions suggested in Annex I, using appropriate economic indicators such as GDP;

   d. adopt such rules, regulations and policies as may be required for the sound management of the Work Programme, while assuring adherence to the provisions of Paragraph 9 and any financial rules established by the Governing Board;

   e. allow employees or agents of a Participant to utilize some of the funds provided in the Budget to implement the Work Programme, consistent with the regulations and decisions of the Governing Board;

   f. monitor the performance of the GBIF Secretariat Host; if necessary, the Governing Board may replace the GBIF Secretariat Host;

g. select an Executive Secretary; the Governing Board may also remove the Executive Secretary;

h. approve the staffing level and staffing plan for the GBIF Secretariat based on recommendations from the Executive Secretary;

i. provide guidance and direction to the Executive Secretary on the duties of the position and monitor the Executive Secretary's performance;

j. carry out the other functions conferred upon it by this MOU, including by any Annexes or modifications hereto;

k. consider any matters pertaining to GBIF or its operations submitted to it by the Executive Secretary, the GBIF Secretariat Host, or by any Participant; and

l. consider at each meeting any outstanding applications by any organization seeking to sign the MOU, as well as any outstanding applications by any economy, inter-governmental organization, or other organization seeking to become a Voting Participant, in accordance with Paragraph 4.4.

7. Procedures
The Governing Board may establish such subsidiary bodies and rules of procedure as are required for its proper functioning.

Paragraph 5. The GBIF Secretariat Host

1. Role and Purpose
The GBIF Secretariat Host will provide the location, facilities and services agreed to in an arrangement between the Governing Board and the GBIF Secretariat Host. The services may cover staff management, financial management, accountancy, legal assistance, etc. The GBIF Secretariat Host may house the GBIF Secretariat and manage it in accordance with the laws in force in the country of the GBIF Secretariat Host. The GBIF Secretariat Host will also obtain or provide legal status for the GBIF Secretariat.

2. Selection

a. The GBIF Secretariat Host will be chosen via a competitive bidding process, as outlined in Paragraph 4.6(a).

b. Any Voting Participant is entitled to submit a bid for the GBIF Secretariat Host.

c. The bidders for the GBIF Secretariat Host will be required to demonstrate their capacity to provide institutional arrangements that conform to the closest extent possible, under their respective domestic laws, with the criteria for the GBIF Secretariat Host, GBIF Secretariat and Executive Secretary, as outlined in this MOU and in the Request for Proposal to Host the GBIF Secretariat, and that satisfy any other criteria required by the Governing Board.

3. Scope of Authority
Subject to the laws of the jurisdiction in which the GBIF Secretariat Host is located:

   a. The GBIF Secretariat Host will be accountable to the Governing Board for all matters pertaining to GBIF, except as otherwise provided in this MOU;

   b. The GBIF Secretariat Host will either house the GBIF Secretariat and employ the Executive Secretary and other GBIF staff, or will facilitate such housing and employment.

4. GBIF Secretariat/GBIF Host Relationship
The GBIF Secretariat Host should assist the GBIF Secretariat to implement the Governing Board decisions.

5. Reimbursement of Costs
Through appropriate financial arrangements with the GBIF Secretariat, expenses and costs reasonably and properly incurred by the GBIF Secretariat Host in supporting the GBIF Secretariat, above those costs that the GBIF Secretariat Host itself has agreed to provide, may be paid from the funds collected pursuant to Paragraph 9. Neither the GBIF Secretariat Host, nor its experts, employees, agents, representatives or contractors are entitled to commit the Participants to any expenditure beyond what is available in the Central Fund, as defined in Paragraph 9.1.

Paragraph 6. The GBIF Secretariat

1. Designation
The GBIF Secretariat will consist of the Executive Secretary and such staff as are judged necessary by the Governing Board to implement the Work Programme.

2. Legal Status
The GBIF Secretariat Host is responsible for ensuring that the GBIF Secretariat is accorded a legal personality in the Host country, in order that it can, for example, make contracts, and acquire and dispose of movable property.

3. Accountability
The GBIF Secretariat will be responsible through the Executive Secretary to the Governing Board for the execution of all scientific and administrative activities undertaken to implement the GBIF Work Programme. The activities of the GBIF Secretariat will be subject to the laws and jurisdictions in force in the country of the GBIF Secretariat Host.

4. Responsibility
The GBIF Secretariat will execute the Work Programme and expenditure of the budget, under the direction of the Executive Secretary.

5. Tasks
The GBIF Secretariat will:

a. employ the Executive Secretary and other GBIF Secretariat staff;

b. be the holder of the Central Fund described in Paragraph 9.1;

c. be responsible for developing financial contracts with Voting Participants specifying how those Participants will make their financial contributions to the Central Fund; and

d. hold in trust, and for the benefit of the Participants, all assets which may accrue to or be acquired for GBIF.

6. Transfer of Tasks to the Secretariat Host
Through appropriate financial arrangements between the Secretariat Host and the Secretariat, and with the approval of the Governing Board, some or all of the tasks listed in Paragraph 6.5 may be transferred to the GBIF Secretariat Host.

Paragraph 7. The Executive Secretary

1. Authority
The Executive Secretary will act as the chief executive officer of GBIF and will have the authority, within limits and guidelines decided by the Governing Board, and, subject to the provisions of this Memorandum of Understanding, to enter into contracts and administer funds on behalf of GBIF. The activities of the Executive Secretary will be subject to the laws and jurisdictions in force in the country of the GBIF Secretariat Host.

2. 2. Accountability
The Executive Secretary will be responsible to the Governing Board for the execution of all scientific and administrative activities of the GBIF Secretariat. The duties of the office will be specified in an annex to the employment contract of the Executive Secretary.

3. 3. Responsibilities
The responsibilities of the Executive Secretary are to:

a. Oversee the execution of the Work Programme and expenditure of the Budget;

b. Recommend to the Governing Board the hiring of such staff as may be required to carry out the Work Programme;

c. Supervise the work of the GBIF Secretariat and its staff, including consultants and seconded personnel;

d. Prepare and submit to the Governing Board, not later than three months before the beginning of each financial year, a draft annual Work Programme and a Budget, together with an indicative Draft Work Programme and a Draft Budget for the following two years; and

e. Provide the Governing Board with a technically substantive annual report on the Work Programme, including financial accounts, tasks achieved, tasks not achieved and any appropriate explanations.

Paragraph 8. Intellectual Property

1. Applicable Law
   Nothing in this MOU should be read to alter the scope and application of Intellectual Property Rights and benefit sharing agreements as determined under relevant laws, regulations and international agreements of the Participants.

2. Access to Data
   To the greatest extent possible, GBIF is foreseen as an open-access facility. All users, whether GBIF Participants or others, ought to have equal access to data in databases affiliated with or developed by GBIF.

3. Intellectual Property Rights to Biodiversity Data
   GBIF should encourage the free dissemination of biodiversity data and, in particular:

   a. should not assert any Intellectual Property Rights in the data in databases that are developed by other organizations and that subsequently become affiliated to GBIF;

   b. should seek, to the greatest extent possible, to place in the public domain any data commissioned, created or developed directly by GBIF; and

   c. should respect conditions set by data providers that affiliate their databases to GBIF.

   When establishing affiliations or linkages with other databases, GBIF should seek to ensure that the data so made available will, in effect, be in the public domain, and will not be subject to limitations on its further non-commercial use and dissemination, apart from due attribution.

4. Attribution
   GBIF should seek to ensure that the source of data is acknowledged and should request that such attribution be maintained in any subsequent use of the data.

5. Access to Specific Data
   Nothing in this MOU should be read to restrict the right of owners of databases affiliated with GBIF to block access to any data.

6. Validity of Data
   It should be a condition of access to and use of GBIF that users acknowledge that the validity of the data in any databases affiliated with GBIF cannot be assured. GBIF should disclaim responsibility for the accuracy and reliability of the data as well as for the suitability of its application for any particular purpose.

7. Legitimacy of Data Collection
   Where the collection of new data has entailed access to biodiversity resources, GBIF should ask for reasonable assurances from the data holder that such access was consistent with applicable laws, regulations and any relevant requirements for prior informed consent.

8. Intellectual Property Rights to Biodiversity Tools
   GBIF may claim appropriate Intellectual Property Rights available

within applicable national jurisdictions over any tools, such as search engines or other software products, that are developed by GBIF while carrying out the GBIF Work Programme.

9. Technology Transfer
The Participants acknowledge that, subject to any relevant Intellectual Property Rights, GBIF should seek to promote the non-exclusive transfer to research institutions in developing countries of such informatics technology as it has available, especially in conjunction with training and capacity development programs.

Paragraph 9. Finance

1. Basic Financial Contributions
Financial contributions made by Participants in accordance with the scales set out in Annex I (and transferred to the GBIF Secretariat via the financial contracts described in Paragraph 6.5.c), or negotiated with the Governing Board under the provisions in Paragraph 4.4, are considered to be Basic Financial Contributions. These contributions are to be held by the GBIF Secretariat in a Central Fund and used to fund the Work Programme, as established by the Governing Board in accordance with Paragraph 4.6.b), and to reimburse the GBIF Secretariat Host for expenses incurred in accordance with Paragraph 5.5.

2. Supplementary Financial Contributions
In addition to Basic Financial Contributions, Participants may make Supplementary Financial Contributions to fund specific parts of the Work Programme, or for other specified purposes agreed to by the Governing Board. Those specified purposes may include facilitating attendance by Participants from developing countries at meetings of the Governing Board. Supplementary Financial Contributions are to be held by the GBIF Secretariat, kept separate from other contributions, and used only for the purposes specified by the Participants making them.

3. Other Income
The Governing Board may accept other income offered for the purposes set out in this MOU.

4. Costs Borne by Participants
Participants bear the costs of their own participation in GBIF, including the costs of formulating or transmitting reports, travel costs, and other expenses related to attendance by their representatives at meetings of the Governing Board and other GBIF functions, events, and activities.

5. Crediting of Income
Any income generated in the course of GBIF activities that accrues to the GBIF Secretariat or the GBIF Secretariat Host is to be used for advancing the GBIF Work Programme.

Paragraph 10. Association and Disassociation of Participants

1. Association of Participants
   Association with this MOU is open to any country, economy, inter-governmental organization or other organization, or to an entity designated by a country, economy, inter-governmental organization or other organization. Such association becomes effective upon signature of this MOU.

2. Participant Status
   Any Participant becomes eligible to be a Voting Participant on the Governing Board by making the financial contribution suggested in Annex I, or, in the case of economies, inter-governmental organizations or other organizations offered voting participation by the Governing Board under the provisions in Paragraph 4.4, by making the negotiated financial contribution. In order to retain its voting status, a Voting Participant must make its financial contribution within six months of completing the requisite financial contract with the GBIF Secretariat, as described in Paragraph 6.5.c. In subsequent years, the financial contribution will continue to be due within six months of the anniversary date of the financial contract with the GBIF Secretariat.

3. Disassociation of Participants
   Any Participant may disassociate itself from this MOU by advising the Governing Board in writing of its intention to do so and of the effective date. In the event of disassociation of a Participant, the Governing Board may agree by consensus to adjust the Work Programme and the Budget to take account of such disassociation or, again by consensus, may decide to adjust the scale of contributions of Participants to the Budget.

Paragraph 11. Other matters

1. Establishment of GBIF
   GBIF will come into existence on March 1, 2001, or when at least ten Participants have signed the MOU and the sum of the contributions they have pledged to contribute totals at least 2 million US dollars, whichever is the later date.

2. Duration
   Except as provided below, GBIF will be set up for an initial 5-year period. In the third year, an independent review of its operations, financial mechanisms, legal basis, governance structure, and links to other organizations will be conducted to determine if any changes are needed. The lessons learned will be used to evaluate the effectiveness of the governance structure and to recommend any necessary changes.

3. Termination
   The Voting Participants, acting by consensus, may terminate this MOU at any time. Upon termination or expiration of this MOU, the GBIF Secretariat, acting in accordance with the laws of the jurisdiction in which it is located, will arrange for the liquidation of the assets of GBIF; property held by the GBIF Secretariat for the

benefit of the Participants is to be regarded, for this purpose, as assets of GBIF. In the event of such liquidation, the GBIF Secretariat, so far as practicable, will distribute any assets of GBIF, or the proceeds therefrom, in proportion to the basic financial contributions which the Participants have made from the beginning of the operation of GBIF, and for that purpose will take into account the contributions of any former Participants.

4. Annexes
   Annexes to this MOU are an integral part of the document.

5. Modifications
   Except where otherwise specified, this MOU and any Annexes thereof may be modified at any time by the Governing Board.

Annex I. Financial Contributions for Voting Participants

1. Intent of this Annex
   This Annex describes the suggested financial contributions for voting participation in GBIF.

2. Suggested Basic Financial Contributions
   Voting rights are conferred when a Participant indicates its intention to contribute the suggested amount according to the table below. Participants whose per capita GDP is less than US$ 10,000 may contribute the amount for the category one lower than that corresponding to their GDP, unless they are already in the lowest category.

3. Initial Year Payment
   For the first year of their participation in GBIF, Participants in categories 1-6 inclusive in the table below may acquire voting rights by making a contribution of at least one half of the suggested amount according to the table below.

All figures are in US dollars.

Participant Categories and GDPs	Suggested Annual Basic Financial Contribution
1—GDP > $3000 billion	$700 000
2—GDP $2000-3000 billion	$450 000
3—GDP $1000-2000 billion	$250 000
4—GDP $100-1000 billion	$100 000
5—GDP $50-100 billion	$50 000
6—GDP $25- 50 billion	$20 000
7—GDP < $25 billion	$500

Participant Categories and GDPs	Suggested Annual Basic Financial Contribution
Associate Participant (non-voting)	No monetary contribution; must agree to establish a node and to share data.

D. Rules of Procedure of the Governing Board of the Global Biodiversity Information Facility

Preface

The Governing Board of the Global Biodiversity Information Facility (GBIF) has adopted the following Rules of Procedure in accordance with Paragraph 4 of the GBIF Memorandum of Understanding (MOU). These rules of procedure shall apply to the conduct of business of the GBIF Governing Board.

Pursuant to Paragraph 4.7 of the MOU the Governing Board may establish such subsidiary bodies and rules of procedure as are required for its proper functioning.

Article I - Governing Board Structure

1.1. Pursuant to Paragraphs 4.3 and 4.4 of the GBIF MOU, the Governing Board will comprise one representative of each Participant. The Secretariat of the Convention on Biological Diversity will be invited to designate a non-voting representative to the Governing Board. Each Participant may also designate an alternate representative to serve on the Governing Board in the event that its designated representative is unable to do so.

1.2. Each Participant will notify the Chair of the Governing Board of the name of its Representative and alternate, and of any change thereto.

1.3. Each Representative may be accompanied to Governing Board meetings by up to four (4) advisers and experts, as the Representative may

deem necessary. (Note: A maximum of 5 advisers and experts was agreed for the First Governing Board meeting based on logistics concerns for the meeting planning.) The Representative to the Governing Board will be the Head of Delegation.

1.4. A signed MOU and the signed financial contract or exchange of letters stipulated in paragraph 3.5 must be received by the Chair at least 14 days prior to a meeting for a new Voting Participant to vote in that meeting. The Governing Board may, by consensus, grant an exemption from this rule.

1.5. The Governing Board shall have a Chair and Vice-Chair.

1.5.1. The Chair and the Vice-Chair of the Governing Board will serve for a two year term.

1.5.2. The Chair and Vice-Chair shall be elected from Voting Participants.

1.5.3. Three months before the annual meeting of the Governing Board, the Executive Secretary will send out a call for nominations for Chairs and Vice Chair(s) that are due for election. One month before the meeting the Executive Secretary will provide the Governing Board with the list of nominations.

1.5.4. The Chair and Vice-Chair shall be elected by secret ballot with a super-majority as defined in Article 4.5 of the MoU

1.5.5. The Chair may be elected for only two consecutive terms.

1.5.6. The Vice-Chair may be re-elected.

1.5.7. The terms of the Chair and Vice-Chair expire at the end of the Governing Board meeting at which elections for these positions take place. If, due to timing of Governing Board meetings, the election of the new Chair and Vice Chair take place more than two years after the previous election, then the already elected Chair and Vice Chair terms will be automatically extended.

1.5.8. If it is not possible at the annual meeting to elect a Chair or a Vice-Chair the already elected Chair or Vice Chair will automatically have its term extended.

1.5.9. If the Chair is unable to perform its function the Vice-Chair will assume its function.

1.5.10. If either the Chair or Vice Chair is being considered for re-election, then the Chair of the Budget Committee will assume the function of the Chair of the Governing Board during the election process.

1.5.11. If the Chair resigns before the end of his term, the Vice-Chair will assume the Chair’s position until the next meeting of the Governing Board where an election can be held.

1.5.12. If the Vice-Chair resigns before the end of his term, the Chair of the Budget Committee will assume the duties of Vice-Chair of the Governing Board until the next meeting of the Governing Board where an election can be held.

1.6. The Governing Board may elect additional Vice-Chairs for specified tasks and service lengths.

1.6.1. Such additional Vice-Chairs may be from Voting or Associate Participants.

1.7. The Governing Board shall have an Executive Committee to be comprised of the Chair, Vice-Chair(s), Executive Secretary (ex officio member), and the Chairs of all standing committees that it should constitute.

1.7.1. The Executive Committee may be authorised to take decisions as specified in Articles III, V,VII and VIII of the Rules of Procedure.

Article II – Meetings

2.1. The Governing Board will convene an annual meeting in regular session. This meeting will be held in the last quarter of the fiscal year, for the purposes of electing officers, and approving the following year's budget, science work programme, the previous year's financial statements and the auditors' report, the annual report and transacting such other business as may properly come before the meeting.

2.2. Additional meetings of the Governing Board may be decided at the annual meeting of the Governing Board.

2.3. Extraordinary meetings may be called by the Chair of the Governing Board in consultation with the Executive Committee of the Governing Board or by written request from a quorum of Voting Participants. A quorum is one half of the Voting Participants plus one.

2.4. Notice of a meeting shall state the purpose(s) for which the meeting is called, and shall indicate that it is being issued by, or at the direction of, the person or persons calling the meeting.

2.5. The Governing Board may convene in Executive Session in which participation is limited to the Representative and Alternate identified in Article 1.2 of these Rules of Procedure.

2.6. The Governing Board may invite representatives of the Secretariat Host to attend meetings of the Governing Board and subsidiary bodies in an advisory capacity with no voting rights.

2.7. The Executive Secretary and invited Staff of the GBIF Secretariat should participate in the Governing Board meeting when the Board is not meeting in Executive Session.

2.8. The Governing Board may invite representatives from other non member countries, economies or relevant organizations as observers.

2.9. At least two (2) months before each meeting of the Governing Board, notice of the time, place and purpose of the meeting will be given to each

Participant and to other persons or entities entitled or invited to attend the meeting.

2.10. The Chair will dispatch the draft agenda and supporting documents to the Participants at least two (2) weeks before the meeting will take place.

2.10.1. Notices of proposed changes to the MOU need to be provided to Participants two (2) months in advance of the meeting.

2.11. At the beginning of each meeting the Board shall adopt an agenda, taking into account the draft agenda.

2.12. The quorum necessary for the Governing Board to transact business will be onehalf of the number of Voting Participants plus one (less any resulting fraction).

2.12.1. A quorum is necessary at all times for the Governing Board to transact business. If the withdrawal of any Voting Participant after the commencement of a meeting results in there no longer being a quorum the Governing Board cannot transact business.

2.12.2. Pursuant to Paragraph 4.5 of the MOU, in all cases in which the MOU expressly provides that the Governing Board act by means of a consensus decision or a vote of the Participants present and Voting, "present" can mean face-to –face, by telephone, video conference, or other practical means determined in advance by the Governing Board.

2.13. Meetings of the Governing Board shall be led by the Chair of the Governing Board. In the Chair's absence or at the Chair's request the meeting may be led by the (one of the) Vice-Chair(s). If neither is present at the Governing Board meeting the Governing Board may elect a meeting Chair.

2.14. The Chair of the meeting shall not have a vote.

2.15. The Chair of the meeting will ensure that minutes of each meeting clearly describing actions taken and any resolutions adopted are distributed promptly after the meeting to each Participant and any other person or entity entitled or invited to attend the meeting.

2.16. The Chair is to provide at the beginning of each Governing Board meeting a list of current Voting Participants. This list must be updated and available to the Governing Board in the event a vote is taken out of session by electronic or other means as in Article V of these Rules of Procedure.

Article III – Requirements for Voting Participation

3.1. Any country, economy, Inter-Governmental or other organization that is an Associate Participant or that meets the requirements for an Associate Participant and is prepared to make a financial contribution toward the core funding of GBIF may petition to become a Voting Participant, subject to Article 3.2 of these Rules of Procedure.

3.2. The question of allowing Voting Participation for inter-governmental, nongovernmental and other organizations will be considered by the independent review of GBIF in the third year of operation and will then be considered by the Governing Board at the subsequent Governing Board meeting. Until that time, inter-governmental, non-governmental and other organizations can only apply to become Associate Participants.

3.3. Procedure for countries

3.3.1. Countries that are already Associate Participants can change status to Voting Participation by sending an official letter agreeing to pay a financial contribution according to Annex 1 of the MoU.

3.3.2. Petitions for voting participation from new countries that have signed the MOU and agreed in writing to make a basic financial contribution according to Annex 1 of the MoU will be considered by the Chair, Vice-Chair and the Executive Secretary.

3.3.3. When a financial contract has been signed or an exchange of letters between the Participant and the Executive Secretary giving the financial details about the institution(s) to be invoiced and the payment schedule has occurred, the Chair will inform the country of its official status as a Voting Participant with voting rights.

3.4 Procedure for economies, Inter-Governmental Organizations or other organizations.

3.4.1 Subject to the provisions of 3.2 petitions for voting participation from economies, Inter-Governmental Organizations and other organizations that have signed the MoU will be considered by an Ad Hoc Membership Committee designated by the Executive Committee.

3.4.2 Ad hoc Membership Committee members must be Voting Participants.

3.4.3 If the Ad Hoc Membership Committee finds the petition to be acceptable, the Executive Secretary will undertake preliminary negotiations with the petitioner regarding a fair and appropriate financial contribution as per Paragraph 4.4 of the MOU. Economies with a GDP should make the suggested annual basic financial contribution listed in Annex 1 of the MOU.

3.4.4 A letter of agreement or draft contract outlining the financial details about the institution(s) to be invoiced and the payment schedule will be prepared based on the negotiations.

3.4.5 The Ad hoc Membership Committee will present the outcome of its negotiations and put forward its recommendation to the Governing Board.

3.4.6 If the Governing Board find the requirements met for voting participation the Executive Secretary will sign the letter of agreement.

3.4.7. When the petitioner has signed the letter of agreement the chair will inform the petitioner of its official status as a Voting Participant.

3.5 All Voting Participants should establish a financial agreement with the Secretariat after signing the MOU, either a financial contract or by an exchange of letters of payment between the Participant and the Executive Secretary. This agreement gives the financial details and payment schedule. Voting rights can first be exercised fourteen (14) days after the exchange of the signed MOU and financial contract or letters of payment.

3.5.1 In the financial contract or exchange of letters, the Participant will identify the date on which payment will be made. This payment date will be considered to be the "anniversary date of the financial contract" mentioned in paragraph 10.2 of the MOU.

3.6 The Executive Committee has the authority to suspend the voting rights of Voting Participants if the agreed financial contribution is not received within six months of establishing a financial contract as per Article 3.5 and in subsequent years if the agreed financial contribution is not received within six months of the anniversary as defined in paragraph 3.5.1. Voting rights resume once the Voting Participant has made all outstanding financial payments.

Article IV - Voting

4.1. Each Voting Participant shall have a single vote subject to Article 4.2.

4.2. Regional economic integration organizations shall exercise their right to vote with a number of votes equal to the number of their member economies/countries that are Voting Participants to the MOU. Such an organization shall not exercise its right to vote if any of its member economies/countries exercise its right, and vice versa.

4.3. Regular Voting

4.3.1. Pursuant to Paragraph 4.5(b) of the MOU, the Governing Board should strive to work by consensus whenever possible. Except where mandated by the MOU that a decision must be made by consensus, if consensus cannot be reached after reasonable attempts have been made, then approval by super-majority of those present and voting is required.

4.3.2. If more that two options are presented in a vote, then voting proceeds in a number of elimination rounds. At each round the option with the least number of votes is eliminated until a supermajority is reached.

4.3.3. If two Voting Participants ask for a written ballot then such vote shall be taken. In all other cases, votes shall be taken by a count of hands, unless otherwise mandated by the MOU or Rules of Procedure.

4.3.4. Voting Participants abstaining will be considered as not voting.

4.3.5. A vote can either be a blank vote, indicating abstention, or indicate the preferred outcome.

4.3.6. A Vote that does not fulfil these criteria is invalid.

4.3.7. For intersessional decision making as specified in Paragraph 5.4, a quorum is considered to be one half of the Voting Participants plus

one. Representatives from Voting Participants are considered to have abstained if they do not respond by the due date. The due date will normally have to be at least two weeks after the date of the request.

4.3.8. The Chair shall ask the Executive Secretary or other GBIF secretariat staff members and two appointed members of the Governing Board or staff to carry out the counting of votes.

4.3.9. The Chair will announce the results.

Article V – Intersessional Decision Making

5.1. Between meetings of the Governing Board, the Executive Committee is authorized to take decisions on issues of limited scope not foreseen at the last Governing Board meeting and that need resolution before the next meeting of the Governing Board.

5.2. The Governing Board may also authorise the Chair or the Executive Secretary with a mandate to take decisions on matters that may seriously delay the works or operations of GBIF. The authorisation may be given either in a meeting of the Governing Board or by web-based voting procedure or other appropriate means of communication on a specific item.

5.3. The Governing Board shall be kept informed about any such decisions either immediately or at the next meeting of the Governing Board.

5.4. The Governing Board may set up procedures for electronic (email) or webbased decision making processes or other appropriate means of communication for use between meetings.

Article VI –Committees and Other Subsidiary Bodies

6.1. Pursuant to Paragraph 4.7 of the MOU, the Governing Board may establish such subsidiary bodies and their rules of procedure as are required for its proper functioning. Unless otherwise specified by the Governing Board these subsidiary bodies must follow the same voting rules as specified in Article IV of these Rules of Procedure.

6.2. The Governing Board may establish and assign responsibilities to ad hoc or standing committees and other subsidiary bodies as it may require. The Governing Board will set or approve the terms of reference, guidelines and budgets for these committees and other subsidiary bodies.

6.2.1. Each Committee shall serve at the pleasure of the Governing Board.

6.2.2. Ad hoc Committees may be constituted by the Executive Committee between Governing Board meetings. The continuation of such ad hoc Committees shall be decided by the Governing Board at its next meeting.

6.3. There will be at least three standing committees: a Science Committee, a Budget Committee and a Participant Node Managers Committee. Details

for these Committees are laid down in terms of reference for each Committee. The overall goals of the Committees are:

6.3.1. The Science Committee is an advisory committee that will oversee the development and progress of the GBIF work programme and make recommendations to the Governing Board and the Secretariat.

6.3.2. The Budget Committee will provide advice to the Governing Board on financial issues pertaining to the operations and directions of GBIF and will oversee the audit of the annual accounts submitted to the Governing Board by the selected auditors company.

6.3.3. The Participant Node Managers Committee will serve as a forum for sharing information about the status and best practices of Participants' nodes, and will make recommendations to the Governing Board, Science Committee and the Secretariat concerning relevant issues for the nodes.

6.4. Election of Committee Chairs and Vice-Chairs.

6.4.1. The Chairs of Standing Committees will be elected by the Governing Board from among Voting Participants.

6.4.2. Vice-Chairs of Standing Committees and Chairs of Subcommittees will be elected by the Governing Board from among Participants.

6.4.3. Standing Committee Chairs and Vice-chairs and Chairs of Subcommittees serve for a period of two years.

6.4.4. The Chairs and Vice-Chairs of Standing Committees and the Chairs of Subcommittees may be elected for only two consecutive terms.

6.4.5. Elections of officials as Chairs, Vice-Chairs of Standing Committees and Chairs of Subcommittees will normally take place at the annual Governing Board meeting in regular session (see Article 2.1.).

6.5. Nomination procedure

6.5.1. Three months before the annual meeting of the Governing Board, the Chair of the Governing Board will send out a call for nominations for Chairs and Vice Chairs of Standing Committees that are due for election.

6.5.2. One month before the meeting the Chair of the Governing Board will provide the Governing Board with the final list of nominations.

Article VII – Administration of the Supplementary Fund

7.1 According to the Memorandum of Understanding (paragraph 9.2 and 9.3) a Supplementary Fund has been established to receive “Supplementary Financial Contributions” and “Other income” for specific GBIF-relevant activities. The Governing Board will decide on the overall purpose and administration of the Fund.

7.2 The Executive Committee will oversee the Supplementary Fund and decide on whether contributions can be accepted or not accepted into the Supplementary Fund when contributors have stipulated particular uses of their contributed funds.

7.3 The management of the Supplementary Fund will be the responsibility of the Executive Secretary, following the guidance of the Executive Committee.

Article VIII – Institutional Affiliation

8.1 Relevant institutions that deal with biodiversity data, including universities and university departments, governmental research institutes, agencies, foundations, private companies and national organizations, can become affiliated to GBIF. The cost of affiliation will be decided by the Governing Board.

8.2 The Executive Committee will consider petitions for affiliation to GBIF according to guidelines agreed to in the Governing Board.

8.3 The affiliated institutions, agencies, foundations, private companies and national organization cannot become Associate or Voting Participants and are not entitled to participate in Governing Board affairs (unless invited to do so by the Governing Board per Article 2.8), but will receive information about GBIF activities and may assist in disseminating information about GBIF.

Article IX– Amendment

9.1 The Governing Board may amend these Rules of Procedure at any time by a super-majority vote, pursuant to Paragraph 4.5 of the MOU. Such amendments if approved shall become effective two (2) weeks after the Chair of the Governing Board has notified all Participants of the approved changes.

Article X – Overriding Authority of the MOU

10.1 In the event of any inconsistency between these Rules and the MOU, the MOU shall prevail to the extent of the inconsistency.

E. Summary Work Programme 2005-2006

ACTIVITY		COMMENTS	INVOLVEMENT (hours)					BUDGET (100USD)			
			DADI	DIGIT	ECAT	OCB	ICT	2005 Core	2005 Unfunded	2006 Core	2006 Unfunded
1.	**Nodes and GBIF Network Implementation**	Develop the GBIF Network to implement the basic architecture and standards identified in 2003/2004.									
1.1	**Developing and maintaining the GBIF information infrastructure**	Operating and expanding the central GBIF services, development of tools for data validation, adding new service types to the registry, etc.									
		Subtotal for Goal 1.1 for 2005	140	0	15	0	35	190	*220*		
		Subtotal for Goal 1.1 for 2006	95	0	0	0	45			140	*110*
1.2	**Sharing biodiversity data**	Development of tools particularly for use by data providers									
		Subtotal for Goal 1.2 for 2005	0	0	15	20	60	95	*60*		
		Subtotal for Goal 1.2 for 2006	0	0	15	10	60			85	*60*
1.3	**Presenting biodiversity data**	Development of tools particularly for use by GBIF Participant nodes									
		Subtotal for Goal 1.3 for 2005	40	0	0	0	50	90	*0*		
		Subtotal for Goal 1.3 for 2006	45	0	0	0	40			85	*0*
SUBTOTAL FOR GOAL 1 (NODES and GBIF Network Implementation) for 2005			180	0	30	20	145	375	*280*		
SUBTOTAL FOR GOAL 1 (NODES and GBIF Network Implementation) for 2006			140	0	15	10	145			310	*170*
2.	**Digital Biodiversity Science**	In 2005 GBIF will work to establish foundations on which scientists can start to carry out scientific activity in a fully digital environment. The eventual goal is to abandon paper entry of information, and to move to ensure that materials are digitally captured from the start									

ACTIVITY		COMMENTS	INVOLVEMENT (hours)					BUDGET (100USD)			
			DADI	DIGIT	ECAT	OCB	ICT	2005 Core	2005 Unfunded	2006 Core	2006 Unfunded
2.1	**Infrastructure and Standards for the Exchange of Biodiversity Data**										
		Subtotal for Goal 2.1 for 2005	100	0	0	0	0	100	*640*		
		Subtotal for Goal 2.1 for 2006	100	0	0	0	0			100	*540*
2.2	**Integrating and Linking Biodiversity Data Sources**										
		Subtotal for Goal 2.2 for 2005	10	0	0	0	0	10	*160*		
		Subtotal for Goal 2.2 for 2006	40	0	0	0	0			40	*210*
2.3	**Developing Digital Content**										
		Subtotal for Goal 2.2 for 2005	0	365	370	0	0	735	*1320*		
		Subtotal for Goal 2.2 for 2006	0	365	385	0	0			750	*1260*
SUBTOTAL FOR GOAL 2 (Digital Biodiversity Science) for 2005			110	365	370	0	0	845	*2120*		
SUBTOTAL FOR GOAL 2 (Digital Biodiversity Science) for 2006			140	365	385	0	0			890	*2010*
3.	**Furthering Participation, impact and benefits of GBIF**	Considering how GBIF can realise its potential by supporting the widest possible communities. This includes gathering feedback on directions pursued.									
3.1	**Strengthen cooperation with major international initiatives**	Highlight the contributions that GBIF can make to the work of relevant initiatives concerned with biodiversity, and reach out to and influence decision-makers									
		Subtotal for Goal 3.1 for 2005	0	0	0	15	0	15	*0*		
		Subtotal for Goal 3.1 for 2006	0	0	0	15	0			15	*0*
3.2	**Increase Participation and funding**	Improve GBIF's ability to carry out its mission by increasing both core and supplementary budgets, as well as bringing additional partners into the work.									
		Subtotal for Goal 3.2 for 2005	0	0	0	10	0	10	*0*		
		Subtotal for Goal 3.2 for 2006	0	0	0	10	0			10	*0*
3.3	**Increase visibility of GBIF**	Promote a wider awareness of GBIF's work, its usefulness and tangible benefits									
		Subtotal for Goal 3.3 for 2005	0	0	0	50	0	50	*0*		
		Subtotal for Goal 3.3 for 2006	0	0	0	50	0			50	*0*
SUBTOTAL FOR GOAL 3 (Furthering the impact and benefits of GBIF) for 2005			0	0	0	75	0	75	*0*		
SUBTOTAL FOR GOAL 3 (Furthering the impact and benefits of GBIF) for 2006			0	0	0	75	0			75	*0*
4.	**Training and capacity building in biodiversity informatics**										
4.1	**Expand human capacities to increase the on-line availability of biodiversity data**	Data providers and users to fully benefit from available electronic tools. Build on already existing expertise.									
		Subtotal for Goal 4.1 for 2005	0	35	0	20	0	55	*100*		
		Subtotal for Goal 4.1 for 2006	0	35	0	20	0			55	*90*
4.2	**Expand the use of electronic tools and know-how by our Participants**	Promote effective communication among GBIF members and training in data uses to benefit wide audiences									
		Subtotal for Goal 4.2 for 2005	0	0	0	105	0	105	*400*		
		Subtotal for Goal 4.2 for 2006	0	0	0	125	0			125	*400*

ACTIVITY		COMMENTS	INVOLVEMENT (hours)					BUDGET (100USD)			
			DADI	DIGIT	ECAT	OCB	ICT	2005 Core	2005 Unfunded	2006 Core	2006 Unfunded
4.3	**Promote the emerging field of biodiversity informatics**	Works towards the generation of a cadre of biodiversity informaticists to bring species-level data onto the internet.									
		Subtotal for Goal 4.2 for 2005	0	0	0	45	0	45	*150*		
		Subtotal for Goal 4.2 for 2006	0	0	0	45	0			45	*150*
SUBTOTAL FOR GOAL 4 (Training and Overall Capacity Building) for 2005			0	35	0	170	0	205	*650*		
SUBTOTAL FOR GOAL 4 (Training and Overall Capacity Building) for 2006			0	35	0	190	0			225	*640*
GRAND TOTALS FOR 2005 WORK PROGRAMME			290	400	400	265	145	1500	*3050*		
GRAND TOTALS FOR 2006 WORK PROGRAMME			280	400	400	275	145			1500	*2820*

F. New Mechanism of Funding

All in USD	Status	Per Capita GDP 2003	GDP Billions 2003	Initial group	End group	Intended	Actual			Model a		Model b	
Country								2006	2007	2008	2009	2008	2009
Argentina	AP	3.375	130	4	5	50.000	0	0	50.000	66.250	82.500	75.000	100.000
Australia	VP	26.525	523	4	4	100.000	100.000	100.000	100.000	132.500	165.000	175.000	250.000
Austria	AP	31.187	253	4	4	100.000	0	0	100.000	132.500	165.000	175.000	250.000
Belgium	VP	29.257	302	4	4	100.000	100.000	100.000	100.000	132.500	165.000	175.000	250.000
Bulgaria	AP	2.533	20	7	7	500	0	0	500	663	825	750	1.000
Canada	VP	27.097	854	4	4	100.000	100.000	100.000	100.000	132.500	165.000	175.000	250.000
Colombia	AP	1.744	77	5	6	20.000	0	0	20.000	26.500	33.000	30.000	40.000
Costa Rica	VP	4.189	17	7	7	500	500	500	500	663	825	750	1.000
Czech Republic	AP	8.834	90	5	6	20.000	0	0	20.000	26.500	33.000	30.000	40.000
Denmark	VP	39.497	212	4	4	100.000	100.000	100.000	100.000	132.500	165.000	175.000	250.000
Estonia	VP	6.232	8	7	7	500	500	500	500	663	825	750	1.000
Finland	VP	31.069	162	4	4	100.000	100.000	100.000	100.000	132.500	165.000	175.000	250.000
France	VP	29.222	1.758	3	3	250.000	250.000	250.000	250.000	331.250	412.500	375.000	500.000
Germany	VP	29.137	2.403	2	2	450.000	450.000	450.000	450.000	596.250	742.500	475.000	500.000
Ghana	AP	354	7	7	7	500	0	0	500	663	825	750	1.000
Iceland	VP	36.328	11	7	7	500	500	500	500	663	825	750	1.000
India	AP	555	591	4	5	50.000	0	0	50.000	66.250	82.500	75.000	100.000
Indonesia	AP	944	208	4	5	50.000	0	0	50.000	66.250	82.500	75.000	100.000
Japan	VP	33.819	4.317	1	1	700.000	700.000	700.000	700.000	927.500	1.155.000	600.000	500.000
Korea, Republic of	VP	11.059	528	4	4	100.000	100.000	100.000	100.000	132.500	165.000	175.000	250.000
Madagascar	AP	318	6	7	7	500	0	0	500	663	825	750	1.000
Mexico	VP	5.945	615	4	5	50.000	50.000	50.000	50.000	66.250	82.500	75.000	100.000
Morocco	AP	1.463	45	6	7	500	0	0	500	663	825	750	1.000
Netherlands	VP	31.759	513	4	4	100.000	100.000	100.000	100.000	132.500	165.000	175.000	250.000

All in USD	Status	Per Capita GDP 2003	GDP Billions 2003	Initial group	End group	Intended	Actual			Model a		Model b	
Country								2006	2007	2008	2009	2008	2009
New Zealand	VP	19.350	75	5	5	50.000	50.000	50.000	50.000	66.250	82.500	75.000	100.000
Nicaragua	VP	750	4	7	7	500	500	500	500	663	825	750	1.000
Norway	VP	48.881	222	4	4	100.000	100.000	100.000	100.000	132.500	165.000	175.000	250.000
Pakistan	AP	498	77	5	6	20.000	0	0	20.000	26.500	33.000	30.000	40.000
Papua New Guinea	AP	577	3	7	7	500	0	0	500	663	825	750	1.000
Peru	VP	2.238	61	5	6	20.000	20.000	20.000	20.000	26.500	33.000	30.000	40.000
Poland	AP	5.355	207	4	5	50.000	0	0	50.000	66.250	82.500	75.000	100.000
Portugal	VP	14.645	147	4	4	100.000	100.000	100.000	100.000	132.500	165.000	175.000	250.000
Slovak Republic	AP	6.019	33	6	7	500	0	0	500	663	825	750	1.000
Slovenia	VP	13.831	27	6	6	20.000	20.000	20.000	20.000	26.500	33.000	30.000	40.000
South Africa	VP	3.551	160	4	5	50.000	50.000	50.000	50.000	66.250	82.500	75.000	100.000
Spain	VP	20.424	839	4	4	100.000	100.000	100.000	100.000	132.500	165.000	175.000	250.000
Sweden	VP	33.925	301	4	4	100.000	100.000	100.000	100.000	132.500	165.000	175.000	250.000
Switzerland	AP	43.486	312	4	4	100.000	0	0	100.000	132.500	165.000	175.000	250.000
Taiwan (Economy)	AP	12.680	287	4	4	100.000	0	0	100.000	132.500	165.000	175.000	250.000
Tanzania	AP	271	10	7	7	500	0	0	500	663	825	750	1.000
United Kingdom	VP	30.355	1.799	3	3	250.000	250.000	250.000	250.000	331.250	412.500	375.000	500.000
United States of America	VP	36.924	10.857	1	1	700.000	700.000	700.000	700.000	927.500	1.155.000	600.000	500.000
Sum						4.205.500	3.642.000	3.642.000	4.205.500	5.572.288	6.939.075	5.558.250	6.911.000

G. Comparative Aspects of Governance

G.1 European Science Foundation (ESF)

Raison d'etre	The aim of ESF is to act as a catalyst for the development of science by bringing together leading scientists and research funding agencies to debate, plan and implement pan-European initiatives. The ESF aims to promote all branches of science and research in Europe. This aim will be pursued through the following principal objectives: • to advance European cooperation in research at the forefront of knowledge; • to examine and advise on research and science policy issues of strategic importance; • to promote the mobility of researchers and assist the free flow of information and ideas; • to facilitate cooperation in the use of existing facilities and in the planning and provision of new facilities; and • to plan and, where appropriate, to manage collaborative research activities. (Article II, EFS Statute)
Participation	76 member organizations (national research organizations with a significant proportion of funds provided by the government of the country in which it resides) from 29 European countries (full members of the Council of Europe). Each member organization contributes to the ESF general budget. The amount they contribute is calculated pro-rata on the basis of net national income. The member organizations

	of each country decide how their total contribution is to be divided between them. In addition, member organizations contribute specifically to the scientific programmes in which they are participating. Observer status can be granted to representatives of the European Commission, ALLEA, EUA, and of research organizations in countries outside the Council of Europe.
Legal basis	All members sign the EFS Statute, according to which all disputes will be subject to resolution under French law (Article XVIII). The seat of the ESF is in Strasbourg. It is subject to articles 21 to 79 of the local Civil Code, maintained valid through the law introducing French civil legislation of June 1, 1924 (ESF Statute, Article I).
Voting	Voting rights: Only member organizations can vote on the Annual Assembly. Each member has at least one vote, and further allocation of votes is made on the basis of the member countries' percentage contributions to the general budget. Voting rules: Simple majority vote for passing of resolutions, qualified majority vote for delegating decision making power to the Governing Council.
Governance structure	Annual Assembly: The main decision-making body of the ESF. All member *organizations* represented. 76 members. Governing Council: Sets, approves, directs and monitors the overall strategy direction of the EFS. All member *countries* represented. 36 members. Executive Board: Implements the strategy and policy set by the Governing Council under the overall guidance of the Annual Assembly. 7 voting members + 1 non-voting. Standing Committees: One for each scientific discipline, app. 35 members each. Expert Committees, Network Group and EURESCO Steering Committee. Strasbourg Office: Manages the day-to-day business of the ESF. 76 people.
Funding	The basic budget for 2003 is approx. 6.6 million Euros. This does not include the à la carte funding of specific scientific programs by Member Organizations and partial funding of the program of the EURESCO (European research

	conferences) by the European Union; if these are added to the basic budget, the total annual cash flow is over 17 million Euros.

G.2 European Radiocommunications Office (ERO)

Raison d'etre	ERO is the permanent office supporting the Electronic Communications Committee (ECC) of the CEPT (European Conference of Postal and Telecommunications Administrations). ECC is the Committee that brings together the radio- and telecommunications regulatory authorities of the 46 CEPT member countries. ERO is the distribution point for all ECC documentation and also provides detailed information about the work of the ECC via the ERO web site. ERO supports the activities of the ECC and its Working Groups as well as it conducts studies for the ECC and the European Commission. In addition to these tasks, ERO has the following functions: • to provide a centre of expertise which shall act as a focal point, identifying problem areas and new possibilities in the radio- and telecommunications fields and to advise the ECC accordingly; • to draft long-term plans for future use of the radio frequency spectrum at a European level; • to support and work together with national frequency management authorities; • to conduct consultations on specific topics or parts of the frequency spectrum; • to publish ECC Decisions and Recommendations and keep a record of the implementation; • to identify and promote best practice in administration of national numbering schemes and number assignment procedures; • to oversee the registrar service for the European Telephony Numbering Space; and • to manage the One-Stop-Shopping procedure (OSS) for satellite licences and authorisations.
Participation	Contracting administrations: 30 CEPT members that have signed the 'Convention for the establishment of the European Radiocommunications Office' and are represented in the ERO Council. Other administrations: 16 CEPT members that enjoy ERO support but have *not* signed the Convention and are thus *not* represented in the ERO Council.

Legal basis	ERO was established on the basis of a Memorandum of Understanding (MoU). In 1996 this MoU was replaced by the "Convention for the establishment of the European Radiocommunications Office," which has been signed by 30 CEPT administrations and which defines the terms of reference for ERO and the funding arrangement.
Voting	---
Governance structure	ERO Council: Management function for ERO. The Council consists of representatives from the contracting administrations. ERO staff: 16 persons from different CEPT countries, 9 experts and 7 administrative staff members.
Funding	---

G.3 European Environment Agency

Raison d'etre	The EEA aims to support sustainable development and to help achieve significant and measurable improvement in Europe's environment through the provision of timely, targeted, relevant and reliable information to policy making agents and the public. The core task of the EEA is to provide decision-makers with the information needed for making sound and effective environmental policies. The EEA is responsible for disseminating best practice in environmental protection and technologies, and supporting the European Commission in diffusing information on the results of environmental research. The EEA ensures that information about the state of and pressures on the environment is available to the general public through its publications and website. The EEA gathers and distributes its data and information through the European environment information and observation network (EIONET) which is coordinated by the EEA.
Participation	Member countries: 31 (25 EU members, 3 applicant countries, 3 members of the European Economic Area). Other participating countries: 6 (European countries outside the EU).
Legal basis	The EEA was established by EEC Regulation 1210/1990 and amended by EEC Regulation 933/1999. The EEA has legal personality and enjoys in all member states the most extensive legal capacity accorded to legal persons under their laws.

Voting	Qualified majority vote (2/3) required for decisions of the Management Board.
Governance structure	Management Board: 35 members + 1 observer from the EEA Scientific Committee; one representative from each member state, two representatives of the European Commission, two scientific personalities designated by the European Parliament, one optional representative from each participating country, in accordance with the relevant provisions. The Board adopts a multi-annual work program (including budget estimate) and must file an annual report on the EEA's activities to the European Parliament, the Council, the Commission, the Court of Auditors, and the Member States. Executive Director: Head of the EEA, appointed by Management Board on proposal from the Commission for a period of five years. Legal representative of EEA, responsible for preparing, implementing, and executing decisions made by the Management Board and for administration. Accountable to the Board. Scientific Committee: Scientists designated by the Management Board, assists the Board and the Executive Director by delivering an opinion whenever provided for in the Regulation or needed. Staff: Approximately 100 people.
Funding	EEA's revenue consists of a subsidy from the Community entered in the general budget of the European Communities and payment for services rendered. EEA reports financially to the Commission's accounting officer. Annual budget: Approximately 25 MEuro.

G.4 International Council for Science, ICSU

Raison d'etre	The aim of ICSU is to strengthen international science for the benefit of society. To that end, the principal objectives of ICSU are: • to encourage and promote international scientific and technological activity for the benefit and well-being of humanity; • to facilitate coordination of the international scientific activities of its full members; • to stimulate, design, coordinate or participate in the implementation of international interdisciplinary

	scientific programs; • to act as a consultative body on scientific issues that have an international dimension; • to encourage the strengthening of human and physical scientific resources worldwide with particular emphasis on the developing world; • to promote the public understanding of science; and • to provide independent, authoritative advice to stimulate constructive dialogue between the scientific community and governments, civil society, and the private sector.
Participation	Members (100): Two categories; Scientific Union Members (27) and National Scientific Members (73). Members pay annual dues in a category of their own choosing on a scale established by the General Assembly. Members have a voting right. Associates (38): Three categories: International and Regional Scientific Associates (23) and National Scientific Associates (15). The first two categories pay a fixed amount, whereas National Associates pay no dues. No voting rights to associates. Observers (14): Members that have failed to fulfil their financial obligations. No voting rights.
Legal basis	The ICSU Statutes are governed by, and interpreted in accordance with, French law.
Voting	Decisions of the General Assembly made by a majority of the votes of those present or otherwise taking part. Changes of the Statutes require 2/3 of the votes. Decisions of the Executive Board and of the Officers by a majority of the votes of those present or otherwise taking part.
Governance structure	General Assembly: The highest authority of ICSU, determines general policy. Consists of the representatives of the Scientific Union Members and of the National Scientific Members (100 people). Executive Board: 14 people, 6 Officers, 4 National Members representatives and 4 Union Members representatives. Responsible for implementing the resolutions determined by General Assembly. Responsible for the annual budgets and accounts. Accountable to the Assembly. The Officers: 6 people, the President, the Vice-President for Scientific Planning and Review, the Vice-President for

	External Relations, the Secretary-General, the Treasurer, and the Past-President or President-Elect. Responsible for the day-to-day affairs of ICSU between meetings of the Executive Board. Advisory Committees, Interdisciplinary Bodies, Joint Initiatives, Regional Offices Secretariat: 14 people.
Funding	Principal source of core income is member subscriptions and dues from associates. The core budget is approximately US$3.5m p.a., although this represents only a small fraction of the total financial investment in ICSU activities. Other major sources of income are grants from other organizations and foundations, including a subvention from UNESCO.

G.5 CERN, European Organization for Nuclear Research

Raison d'etre	CERN is the world's largest particle physics centre which exists primarily to provide particle physicists with the necessary tools; accelerators. CERN was made as a joint venture to advance particle physics and give most European countries the chance to participate in advanced experiments without consuming an unacceptable fraction of their national science budget.
Participation	Member states: CERN is run by 20 European member states with special duties and privileges. They contribute to the capital and operating costs of the CERN programs, and are represented in the Council. Observers: States or international organizations for which membership is not possible or not feasible. Observers can attend Council meetings and receive Council documents, without taking part in the decision-making procedures. There are currently 8 CERN observers, 6 states and 2 international organizations. Non-member states: Scientists from 220 institutes and universities of currently 28 non-member states use CERN's facilities and are involved in CERN programs.
Legal basis	--- (Joint venture of 20 nations)
Voting	In practice the Council aims for a consensus as close as possible to unanimity.

	Most decisions formally require a simple majority. Each member *state* one vote (two delegates).
Governance structure	The Council: 40 people, two official delegates from each member state. The Council is the highest authority and has the ultimate responsibility for all important decisions. Controls CERN's activities in scientific, technical, administrative, and financial matters. Ordinary sessions twice a year. Committee of Council: Where delegates meet less formally in between Council sessions. Scientific Policy Committee: Assists the Council. Composed of scientists from member and non-member states on the basis of scientific eminence. Finance Committee: Assists the Council, composed of representatives from national administrations. The Director General: Manages CERN and is authorized to act in its name. By tradition a scientist, appointed by the Council for five years. Reports directly to the Council. Directorate and Departments assist the Director General.
Funding	Physicists and their funding agencies from both member and non-member states are responsible for the financing, construction and operation of the experiments on which they collaborate. CERN spends much of its budget on building new machines, and it can only partially contribute to the cost of the experiments.

G.6 Consultative Group on International Agricultural Research, CGIAR

Raison d'etre	The aim of the CGIAR is to achieve sustainable food security and reduce poverty in developing countries through scientific research and research-related activities in the fields of agriculture, forestry, fisheries, policy, and natural resources management. The CGIAR System Research Centers conduct research that generates global and regional public goods to benefit the poor in developing countries, by increasing income and improve livelihoods, without harming the environment. CGIAR focuses on increasing productivity, strengthening national systems, protecting the environment, saving biodiversity, and improving policies.
Participation	Members (63): 24 developing and 22 industrialized countries, 4 private foundations, and 13 regional and international organizations that provide financing, technical

	support, and strategic direction. Minimum annual contribution: US$ 500,000. Member-Observers: Members that did not pay for two years. Cosponsors: The Food and Agriculture Organization of the UN (FAO), the International Fund for Agricultural Development (IFAD), the United Nations Development Programme (UNDP), and the World Bank. Also members of the Consultative Group. Partner organizations: Hundreds of organizations (national and regional research institutes, national governments, civil society organizations, and the private sector) currently engage in collaborative research programs with CGIAR centers
Legal basis	The CGIAR has no legal status. It is an informal association; a regularly interacting and interdependent network of independent institutions and countries. The members have signed the "Charter of the CGIAR System" that sets down roles and responsibilities of the main organs of the CGIAR.
Voting	The CGIAR reaches decisions by consensus, not by voting.
Governance structure	The Consultative Group (CGIAR/the Group): All members and cosponsors (67 representatives), primary decision making body of the CGIAR, responsible for policies of governance of the CGIAR System. The Executive Council: Subsidiary of the Consultative Group, acts on behalf of the Group, implements the decisions of the Group, reports to the Group. 21 members, 8 non-rotating and 13 rotating. Science Council: The science advisory organ of the CGIAR, 8 members (scientists). 15 autonomous international research Centers: Carry out agricultural research and related activities of an international public good nature. Responsible for planning, developing and implementing a research agenda that is approved of and unded by the CGIAR. System Office: A virtual organization, integrates the activities carried out by the main central service units of the CGIAR System - strategic planning, monitoring, evaluation, resource mobilization, and management services.
Funding	The CGIAR is financed by members' contributions. Individual members of the CGIAR support centers and programs of their choice, and each center directly receives

	and spends funds. Centers are primarily financed by annual support from CGIAR members and *ad hoc* sources that are not CGIAR members. In 2003, funding to the CGIAR amounted to $381 million.

G.7 European Bioinformatics Institute, EBI

Raison d'etre	The EBI is a center for research and services in bioinformatics. The mission of the EBI is to ensure that the growing body of information from molecular biology and genome research is placed in the public domain and is accessible freely to all facets of the scientific community in ways that promote scientific progress. The EBI serves researchers in molecular biology, genetics, medicine and agriculture from academia, and the agricultural, biotechnology, chemical, and pharmaceutical industries. The EBI does this by building, maintaining, and making available databases and information services relevant to molecular biology, as well as carrying out research in bioinformatics and computational molecular biology.
Participation	The EBI is an independent research centre and does not in itself have 'members'. Different researchers and contributors are active on different programs). 17 Member States of the European Molecular Biology Laboratory (EMBL - Western Europe and Israel).
Legal basis	The EBI is a non-profit academic organization that forms part of the EMBL. The EMBL is an inter-governmental organization with 17 Member States that contribute to the funding of the EMBL international network of research institutes. The EBI was established by the EMBL Council in 1992 as a successor of the EMBL Nucleotide Sequence Data Library.
Voting	---
Governance structure	No direct information on decision making power. The EBI does have a Director, who is probably responsible for day-to-day management of te EBI activities. There are some references to decisions of the EMBL Council, which is composed of representatives from the 17 EMBL Member States). EMBL-EBI Bioinformatics Advisory Committee: 5 people (scientists/experts) give advice to the EBI with regard to scientific strategy, future directions, and proposals on the realization of its program.

	EBI Staff: Approximately 300 people.
Funding	Funding for the EBI is provided by the Member States of EMBL (45%), the Commission of the European Union (25%), the US National Institutes of Health (12%), and the Wellcome Trust (8%). Other work is supported by contributions from UK Research Councils (4%) and the pharmaceutical and biotech industry (5%). Currently the EBI funding amounts to 22,760,000 Euro.

G.8 International Geosphere-Biosphere Programme, IGBP

Raison d'etre	IGBP's mission is to deliver scientific knowledge to help human societies develop in harmony with Earth's environment. The scientific objective is to describe and understand the interactive physical, chemical, and biological processes that regulate the total Earth System, the unique environment that it provides for life, the changes that are occurring in this system, and the manner in which they are influenced by human actions. IGBP works towards its objective in close collaboration with three other international global environmental change research programs (International Human Dimensions Programme on Global Environmental Change (IHDP), World Climate Research Programme (WCRP), and DIVERSITAS, an international program of biodiversity science). The International Council for Science (ICSU) is the common scientific sponsor of the four programs.
Participation	---
Legal basis	IGBP is an international scientific research program built on interdisciplinarity, networking, and integration. The IGBP was established by the ICSU in 1986.
Voting	---
Governance structure	The Scientific Committee: 32 people (10 ICSU-appointed Members, 4 ICSU-appointed Officers, 14 IGBP Project Chairs, 3 International Partner Chairs, 1 representative of the ICSU Advisory Committee on the Environment). Responsible for overall scientific guidance for the research program, develops specific scientific plans, oversees their implementation, and helps to publicize the results. Scientific Steering Committees: One for each project, undertake the detailed planning and implementation of the

	particular project. 14-30 people, membership rotates annually with three-year terms of appointment, once renewable. National IGBP or Global Change Committees: In 72 countries. The National Committees assist in the national coordination and fundraising and facilitate linkages between national and international global change research. IGBP Secretariat: Executive Director + 9 staff members, coordinating the central activities of the IGBP, implementing decisions of the Scientific Committee, fundraising, external communication, central budget administration. Congress: Brings together all Scientific Steering Committees and Transition Teams of IGBP projects, Chairs of IGBP or Global Change National Committees, representatives of joint projects and IGBP's partner programs, agency representatives and a number of invited specialists. Major scientific questions are finalized at the Congresses and new implementation strategies to tackle the questions are developed further. 300-350 researchers, representing about 50 countries, participate.
Funding	The IGBP is funded at two levels: Each IGBP project is funded by agencies or research councils within the host country of the Project Office. Annual budgets vary between US$ 150,000 and 450,000 p.a. The central budget is approximately US$ 2.1 million p.a., of which 1.5 million comes from national contributions from about 50 countries (multiple agencies within a country contribute). The rest comes from grants earmarked for specific activities.

G.9 Union of International Associations

Raison d'etre	The UIA is a not-for-profit international non-governmental organization having a scientific aim, operating as an institute for research, study, information, consultation, promotion, and service (Constitution of UIA, Article 3).
Participation	Full members: Individuals who are particularly interested in the organizations' aims. Limited in number to 250 individuals. May occasionally pay an annual subscription. Associate members: Organizations, foundations, institutions, business firms, and corporate bodies of individuals in general who may be interested in the organizations' aims and activities, and who wish to give their moral support, effective collaboration and pay subscription. Allowed to

	participate as observers at ordinary assemblies of the UIA. Corresponding organizations: International organizations providing information concerning their activities ad paying subscription. Are given priority in the contents of UIA's periodical "Transnational Associations" and preferential treatment at conferences.
Legal basis	The UIA is incorporated in accordance with the Belgian law of 25 October 1919 on international associations having a scientific aim by Royal Decree dated July 2, 1920.
Voting	General Assembly: Simple majority of full members who are present or represented. Executive Council: Proceedings are valid if one-third of its members are present or represented, and decisions are taken by simple majority of members present or represented.
Governance structure	General Assembly: All full members, limited to 250 people. Sessions held every second year. The Assembly elects the Executive Council and the full members. All powers necessary for achieving the association's aims are vested in the General Assembly. Executive Council: Manages the organization, 15 to 21 members whose term of office is four years, half being renewable every second year. All are eligible for re-election. The Council is empowered to call upon full members to participate in its work as observers without a voting right. All powers of management, administration, and disposal of assets are vested in the Council, subject to any limitation imposed by the General Assembly. Council Bureau: Six members (President, 3 Vice-Presidents, Treasurer + Secretary-General). The President and the Secretary-General are responsible for the daily administration of the UIA and for carrying out decisions taken by the Council or the Bureau. They can delegate their administrative duties. The President and the Secretary-General represent the UIA in all judicial proceedings, whether active or passive, as plaintiffs or defendants. Treasurer-General and Auditor: Responsible for an annual statement of accounts, financial reports, and budget estimates to Council members. A Development Committee (qualified people devoted to ensuring the development and prosperity of the UIA), a Comité d'honneur (individuals or bodies who have attracted the attention of the international world to the UIA), and Special Commissions (persons with competence in

	international relations or trans-national communications, who can help the Council in its work by recommendations, etc.) *may* be set up by the Council.

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CODATA is an international organization which seeks to improve the quality, reliability, management and accessibility of data of importance to all fields of science and technology. Its scientific agenda is implemented through a network of 23 member countries, 15 international scientific unions and 18 supporting organizations