

***GBIF REVIEW, 2009
FROM PROTOTYPE TO FULL OPERATION:
MANAGING EXPECTATIONS.***

A review of GBIF operations from inception to 2010.

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EXECUTIVE SUMMARY:

We have looked back over especially the last 6 years to see what lessons there may be, and how delivery can be improved. At first we should like to emphasise the finding of the previous review –that **GBIF is an important and powerful addition to the International Institutions dealing with Biodiversity. With the passage of time its value-add has, and continues to increase.** Yet we deliberately use the phrase “Managing Expectations” in our report title. We think that expectations of participants, of the secretariat and the potential world of users may not yet be consonant, and are still ahead of what resources can deliver. But resources usually means \$/€/£ - at several points we touch on ways participants must share the burden with the secretariat, and the secretariat must understand better the constraints participants work under, and both should understand the real needs of actual and potential users.

This report covers a reflective review of Science, Informatics, Capacity Building (and training), and Governance. We are firmly of the view that the real and urgent niche for GBIF is to consolidate its role as a global window on biodiversity data, and in that sense put its efforts fully towards being the global data-science interface for biodiversity, and not attempt to stray into becoming a science-policy interface; the global biodiversity institutional landscape is already crowded with such interfaces and more are under development.

The strategic plan for 2007-2011 had three stated major themes, within which tasks were grouped: *Content*, *Informatics*, and *Participation*, themes believed to be central to its success. The work plan for 2009-2010 reduced the activities to two thematic areas (*Informatics* and *Participation*), downgrading *Content* to a sub-item of *Informatics*. We, and our colleagues in the forward look team, believe moving *Content* from what was a central role to something *apparently* (our emphasis) less relevant is an error. If GBIF does not have content, it is nothing. Reducing the scope of work of the Secretariat due to its limited capacity and budget, and increasing the responsibility of the Participants seems an effective way to resolve this issue.

There are some key objectives in the current strategic plan - our comments on their achievements so far are;

- *GBIF will help Participants build sustainable capacity for sharing data that meets their information needs* – has been achieved in some areas, but much remains to be done, especially nurturing the nodes networks in developing countries and setting up opportunities for south-south as well as north-south capacity building opportunities.
- *GBIF will stimulate high impact science and exploit linkages among biodiversity data types at all levels of biological organisation and with data of other types through worldwide data sharing;* and

- *GBIF will deliver innovative, practical and enabling informatics to achieve its vision of being the preferred gateway, worldwide, to a comprehensive, distributed array of biodiversity data that will serve many kinds of users, including scientists and the biodiversity-related conventions* – these appear to be proceeding well, there is evidence of GBIF mediated data being used increasingly in high-impact science through publications, but less evidence on GBIF data being used to help the policy process nationally and in particular internationally. This is an issue GBIF participants should be addressing.
- *GBIF will help participants build sustainable capacity for sharing data that meets their information needs; so that they receive the benefits outlined in the vision, and will establish a cohesive and inclusive network of alliances and partnerships, and through these identify and meet user needs.* – Capacity building is taking place, but much more can be done, and the network of alliances and partnerships is not as well developed as it might be, although the signs are promising.
- *GBIF governance will lead and manage the delivery of the key objectives and goals for content, informatics, and participation and as such needs to be able to move swiftly and flexibly to take advantage of opportunities that arise.* – We believe that there a number of governance matters that warrant attention and discussion to improve the smooth running of the enterprise and its financial base. We also believe that although a new MoU is close to completion the GB should start thinking about a simpler and non-time limited instrument to replace it. The signals given by a short-term MoU for what is a long term enterprise are not helpful to public perception of the viability and importance of GBIF.

We find that there have been published some substantial papers which use GBIF data, and we suggest these and their ilk are used as an indicator of success rather than papers which simply mention GBIF. We are also not convinced by the usefulness of using simple mentions of GBIF in Convention on Biological Diversity (CBD) decisions as evidence of success – we believe a more intensive approach to all the biodiversity related conventions will be more productive in building relationships, networks, and essentially support.

In term of governance we see the opportunity to streamline some of the existing structures, including simplifying the MOU and/or rules of procedure as opportunities allow. We are supportive of the capacity building and training exercises, and believe they are well-targeted.

Finally we draw attention to the need for all members of the GBIF enterprise to take part in its activities, including providing agreed funding in a timely and effective manner, so the programme can be delivered effectively.

1. INTRODUCTION:

This review had its origins in a GB15 decision:

The Governing Board discussed the need for and nature of a Review of GBIF's current activities and a Forward Look into future plans for GBIF beyond 2011 as important background documents for the decision making process among Participants of signing a new MOU for a third phase of GBIF with associated funding implications outlined for Voting Participants. The Board agreed to have a Review, but would like to see the main focus put on the Forward Look for a next phase of GBIF.

A first review of GBIF held in 2004 had the following recommendation:

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).

Thus this review is being held also in conformity with that conclusion of the previous review.

We have made our major focus on three key areas: Science and Informatics, Process issues, including Communication, Outreach and Training, and Governance issues. These are dealt with *seriatim* in the following text, preceded by a list of all of our recommendations gathered together, and a short note on the GBIF Vision, Mission and Strategy.

We have devoted time to analysis and assessment of the impact of GBIF to date largely qualitatively, but have performed some quantitative analysis. Our recommendations are a synthesis of these assessments and are areas where we feel changes and improvements will add to the value of the GBIF enterprise.

2. SUMMARY OF RECOMMENDATIONS:

Strategy

1. The vision should be condensed and rewritten as, for example:

A world in which scientific biodiversity data are freely and openly accessible to everyone, and are available to help the world community understand, conserve, manage and share equitably its Biological Diversity

2. The mission should be expressed as, for example:

GBIF's mission, delivered through its Participants, their Nodes, data publishers around the world, and the Secretariat, is to:

- *Build an information architecture that offers web services to users and data publishers, and makes biodiversity databases interoperable among themselves and across levels of biological organisation;*
- *Encourage and facilitate the digital capture, documentation and geo-referencing of new specimens and observational records, as well as historical specimens, their label texts and associated materials, and observational data;*
- *Reach out to data owners and potential users of the data, providing them with opportunities to increase their capacity to share and utilise biodiversity data;*
- *Help its Participants meet their biodiversity information needs by providing the most up-to-date standards, knowledge transfer and technologies.*

3. The present strategic plan, which is overly complex to read and comprehend, be greatly simplified by developing a series of clear goals to achieve well-articulated strategies. It should be clear which member(s) of the GBIF enterprise are involved in delivery of these goals, and those elements of GBIF should be held accountable through regular review, against simple and measurable criteria, and simple well-defined indicators, by the Governing Board and/or the Executive Committee.

Science and Informatics

4. That GBIF remains clearly within its very important niche of being the leading global infrastructure for discovery, publishing and access to basic biodiversity data.
5. That the GB seek engagement with the Biodiversity Liaison Group (BLG) as a means of gaining exposure to all (especially global) Biodiversity-related MEAs, and as a means to gain and exchange information. Specifically, there should be negotiations to gain observer status at the meeting of the Chairs of the Subsidiary Scientific Bodies of the BLG Multilateral Environmental Agreements (MEAs).

6. That a more strategic emphasis be placed on increasing both taxonomic and global geographic coverage, and a de-emphasis on simple numerical targets, as this would benefit not only the high quality science being enabled by GBIF, but GBIF itself as a global public good.
7. That the Secretariat focuses its efforts on providing infrastructure
8. That the key role of GBIF in providing access to basic data and providing the most effective infrastructure for global access to those basic data is re-emphasised, and that the SC examine the possibilities of developing new work through time-limited task forces, rather than consultants.
9. That a search of publications is undertaken at the end of every calendar year and the website be updated correspondingly for publications using GBIF-mediated data.
10. That a quantitative comparison of the positive effects of the prior seed grant scheme and the campaign scheme be carried out with respect to benefits of;
 - additional data added to the GBIF network, and
 - additional participation in GBIF activities by new partners.
11. That the Secretariat and Science Committee discuss and agree the nature of the on-going GBIF/TDWG relationship as a matter of urgency.
12. That thorough user community needs be articulated in advance of future infrastructure developments and that pathways for incorporating user innovations to GBIF infrastructure are developed.

Communications and Training

13. That a Communications and outreach strategy is formulated and agreed by Executive Committee, with consultation from the nodes committee, which should include areas of focus for work in 2010.
14. That GBIF develop a concise set of indicators of success in capacity development, to include both individual personnel training and institutional capacity development for process of biodiversity data access.
15. That the close relationship between the training and the communications strategies be deepened, and that the officers for training and communication continue to work closely together. Country participants must continue to take seriously their responsibilities in this area, including the exchange of technology and techniques.

Governance

16. That the GB should consider allowing organisations with functions close to GBIF's mandate and willing to observe the provisions of the MOU, including making a financial contribution, to become voting participants on an equal footing with countries.
17. That if the proposal of the draft Memorandum of Understanding to allow associate non-paying membership for no more than two years is accepted by GB (which we RECOMMEND) this should *apply only to countries*. Participant organisations should have the right to remain non-paying, non-voting associate participants if they so wish.
18. That GB examine the possibility of establishing a *GBIF Assembly*, meeting biennially, and comprising the full GBIF community and including appropriate stakeholders meeting be created as the overall GBIF governing body.
19. That, consequent on Recommendation 17, a management structure (perhaps renamed Executive Board and replacing the Executive Committee) meet annually (and more frequently virtually if needed) but with a narrower and more business oriented agenda and restricted solely to voting participants.
20. That meetings of the Nodes Committee are held between (and not only back to back) with GB meetings (as is the case for meetings of the Science Committee).
21. That the Science Committee discuss its *modus operandi* as a matter of urgency; a strong suggestion from the RT for improving operational effectiveness and standards is that relevant staff are invited to attend for specific agenda items where their work area, skills or expertise are likely to help the deliberations of the Committee. If that suggestion is followed we suggest the meeting programme be designed to allow time for all secretariat staff and the science committee to meet in an informal setting.
22. That the Science Committee establish clear and transparent rules for dealing with the solicitation, evaluation and funding of any projects, campaigns, or similarly funded items.
23. That the Rules Committee be dis-established after the term of office of the current Chair comes to an end, and the Committee meanwhile considers ways to simplify the MoU the interaction of the MoU with Rules of Procedure be clarified.
24. That all committees' rules of procedure be amended with provisions for quorum.
25. That a task force, under the guidance of the GB, revisit the 2005 review in the light of the recommendations of this present reflective review and the FL, with a view to ensuring better governance as a result.

26. That the results of this present review and associated *Forward Look* be published in full by GBIF, together with a clear indication of which recommendations have been taken and which not, with a short narrative of reasoning in each case.

27. That a simpler, open-ended, MOU be developed as rapidly as possible.

3. CURRENT VISION, MISSION AND STRATEGY

In the current strategic plan, GBIF is introduced as:

*The Global Biodiversity Information Facility (GBIF) is an international organisation established in 2001 with the mission to make the world's biodiversity data freely and universally available via the Internet. The establishment of GBIF was initially recommended by a megascience initiative of the Global Science Forum of the OECD. However, from its inception GBIF has been global in its reach and inclusiveness, and is a global public good. Biological specimens, observations of nature, taxonomy and nomenclature are fundamentally important to science. These **species-level data are global public goods**: public funds have been invested in their collection over nearly three centuries, and many nations continue to gather new data. **The return on their investment can be multiplied by bringing these data into the GBIF network.***

GBIF's success is in delivering high quality data to scientists who can use it for a variety of activities, including taking it *via* science-policy interfaces through to supporting and developing Environmental Policy; at global, but also regional and national levels. GBIF should be therefore seen as a ***data-science portal***.

The strategic plan for 2007-2011 included three major themes: *Content*, *Informatics*, and *Participation*. These themes and their components were believed to be central to the strategy's success. The work plan for 2009-2010 appears to have reduced the activities to two thematic areas (*Informatics* and *Participation*), downgrading *Content* to a sub-item of *Informatics*. We (and our colleagues in the forward look team) believe moving *Content* from what was a central role to something apparently less relevant is an error. If the GBIF enterprise reduces its focus on content, it is nothing. Reducing the scope of work of the Secretariat due to its limited capacity and budget, while increasing the responsibility of the Participants for providing and improving content, seems an appropriate way to deal with this major issue.

The current vision for GBIF (what will result for its activities in the wider world) is currently in prose form and is not expressed in typical "vision" language and is therefore perhaps less accessible to the non-GBIF community.

We RECOMMEND the vision be condensed and rewritten as:

A world in which scientific biodiversity data are freely and openly accessible to everyone, and are available to help the world community understand, conserve, manage and share equitably its Biological Diversity

Similarly the mission is prolix and confused. We RECOMMEND the mission be expressed in terms such as the following:

GBIF's mission, delivered through its Participants, their Nodes, data publishers around the world, and the Secretariat, is to:

- Build an information architecture that offers web services to users and data publishers, and makes biodiversity databases interoperable among themselves and across levels of biological organisation;*
- Encourage and facilitate the digital capture, documentation and geo-referencing of new specimens and observational records, as well as historical specimens, their label texts and associated materials, and observational data;*
- Reach out to data owners and potential users of the data, providing them with opportunities to increase their capacity to share and utilise biodiversity data;*
- Help its Participants meet their biodiversity information needs by providing the most up-to-date standards, knowledge transfer and technologies.*

The vision and mission together must form the overarching elements of GBIF's strategic Plan, as well as acting as communication of the organisations ideology to the outside world – which is why they should strive for absolute clarity.

We RECOMMEND the present strategic plan, which is overly complex to read and comprehend, be greatly simplified by developing a series of clear goals to achieve well-articulated strategies. It should be clear which member(s) of the GBIF enterprise are involved in delivery of these goals, and those elements of GBIF should be held accountable through regular review, against simple and measurable criteria, and simple well-defined indicators, by the Governing Board and/or the Executive Committee.

From the GBIF MOU it is clear, and congruent with our view expressed earlier, that GBIF is meant to be a *data-science interface*, an infrastructure for biodiversity data. In a narrow sense it is possible to see infrastructure as simply machines and cables; we intend the term to mean the whole set of technical, organisational and human networks necessary to achieve the GBIF vision, through implementing its mission. We feel strongly that GBIF, over the past several years, has not incorporated in its organizational infrastructure and functioning the fact that 'data publisher' is not synonymous with 'data user', and neither are the same as 'funder and supporter'. That is, in recent years, GBIF's functioning has been oriented toward country participants, and has treated them as data publishers principally, and has only ruminated over why the country participants are not also becoming data users.

Not only that, but in recent years there seems to be an emerging wish to expand the scope towards GBIF also becoming *a science policy interface*. This trend has not appeared through explicit decisions or discussions in the Governing Board but more indirectly and organically. One reason for this may be that at the national level environment ministries have become more prominent in dealing with GBIF issues, taking the place of science ministries in many, but not all, member countries.

GBIF documents increasingly refer to GBIF data as a means for improved *decision making* rather than for improved *science* that underpins decision making and the visibility of GBIF in international policy fora such as the CBD (and lately also in the Climate Change Convention) has been highlighted as an important success parameter. As an example, in an advertisement for a side event at the UNFCCC CoP15 we see:

*The Global Biodiversity Information Facility (GBIF) is a multi-lateral initiative mandated to build a global research infrastructure to facilitate access to biodiversity data **to assist policy and implementing agencies in adaptation decision-making regarding biodiversity responses to climate change (our emphasis).***

We doubt whether this is the right way for GBIF to go and RECOMMEND that GBIF remains clearly within its very important niche of being the leading global infrastructure for discovery, publishing and access to basic biodiversity data. The biodiversity policy arena is already quite crowded with the CBD, other biodiversity related agreements and possibly soon with an IPBES. By moving focus towards biodiversity policy and policy makers in an attempt to make GBIF more policy relevant, GBIF risks spending considerable resources unsuccessfully while at the same time blurring its core mandate and diverting resources and attention from its main task. GBIF should make every effort not to become another UN-like inter-governmental organisation with governing bodies overly influenced by political instead of scientific and strategic considerations.

It should ensure also that its focus is not directed chiefly to the CBD, but rather also addresses all the Conventions in the Biodiversity Liaison Group (CBD, CITES, CMS, World Heritage Natural Sites, Ramsar, ITPGR). There are advantages in fact of working closely with Conventions other than CBD, as many of these really do need bioinformatics to carry out the decisions of the Parties.

For examples CITES and CMS have Appendices which deal with Taxonomic Names, and thus need the precision GBIF tools can give, Ramsar and World Heritage Natural Sites (as well as the UNESCO Programme of Biosphere Reserves) use bio-informatic data to define and circumscribe their sites through which the conventions are given expression – again GBIF tools can help. But we re-emphasise we are talking about GBIF providing tools for data access, not to engage in analysis for policy development, which is better handled by the other actors in, as we note, an already over-crowded field..

A specific instance arose during the writing of this report since the CITES meeting to be held in March 2010 had before it 2 resolutions:

- *DR 12.11 Harmonization of nomenclature and taxonomy with other Multilateral Environmental Agreements*, and
- *Doc 15.39 Using the taxonomic serial number (TSN) in international wildlife trade data: A role for CITES.*

Neither of these reports notes GBIF in any of the text, although the second draft Resolution is submitted by GBIF member Canada. DR12.11 has in the preambular text the following:

ACKNOWLEDGING the desirability of harmonizing, to the extent possible, the species nomenclature used by the biodiversity-related multilateral environmental agreements and noting the endorsement of this objective by the Chairs of the Scientific Advisory Bodies of Biodiversity-related Conventions;

This latter Group of Chairs is a creature of the BLG, showing the value in GBIF being present in some form at this group. There is an argument to seek representation in an observer capacity at the Chairs meeting by the Chair of the Scientific Committee. Accordingly, We RECOMMEND that the GB seek engagement with the Biodiversity Liaison Group (BLG) as a means of gaining exposure to all global Biodiversity-related MEAs, and as a means to gain and exchange information. Specifically, there should be negotiations to gain observer status at the meeting of the annual Chairs of the Subsidiary Scientific Bodies of the BLG MEAs, to bring GBIF's products and agenda to the group, and to take away messages from the people most concerned in the Science support bodies of the MEAs.

4. SCIENCE AND INFORMATICS

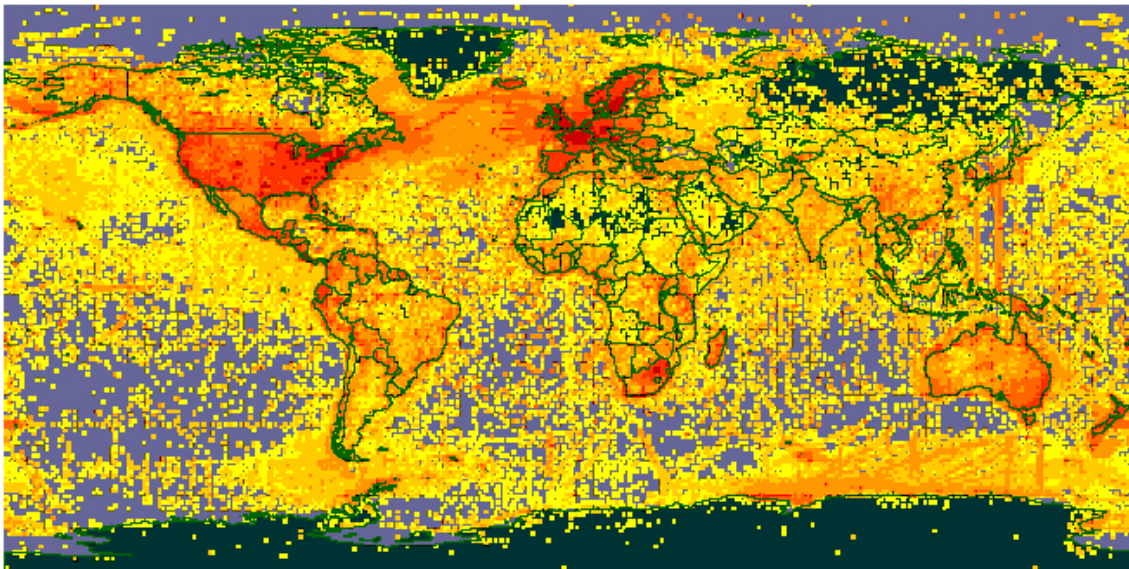
4.1 What kinds of data?

GBIF represents the richest single source of biodiversity information related to the spatial occurrence of organisms. These data are contributed through the efforts of hundreds of institutions and organisations *via* the GBIF portal, and can be seen as an enabling infrastructure for a wide variety of biological sciences. Following the establishment of GBIF as a science project by the OECD in 2001, GBIF has undergone a transition from proof of concept to full implementation, but in so doing has broadened the possible pool of data and analyses that can be used or developed.

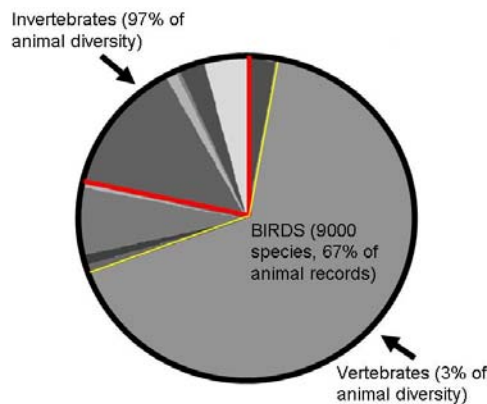
It is encouraging that numbers of records continue to increase (from 80 to almost 180 million records between 2007 and the time of writing). The number of data publishers has also increased from about 200 to almost 300. We note that greater taxonomic efforts through, for e.g. ECAT and IDA have been, and continue to occur. This activity is important to support as again it helps those in the science community gain access to data

which can enable better quality science to be performed, and ultimately better policy to be derived from that science.

This broadening has meant that the original focus on specimen level data from the world's museum collections has changed to an emphasis on observational and other types of data. This has increased the number of data objects served through the GBIF portal, but has introduced a significant imbalance in both geographical and taxonomic coverage provided. Most GBIF-mediated data are from Europe and North America (see below) and are largely records of birds (see below).



Above: Global spread of GBIF-mediated data records in 2008 (redder, more records).



Left: Taxonomic distribution of animal records via the GBIF portal. [NB: Animals represent 72% of GBIF-mediated records].

An analysis of publications using GBIF data revealed that of the 42 papers published in 2009 (to November); the majority were not using primarily the bird data (see Table below).

Taxonomic usage of GBIF-mediated data in scientific publications

Birds	Mammals	Other Vert.	Invertebrates	Plants	All Data
1	1	7	8	16	7

Even if the publications using all data are included in the bird category, this still does not make birds the predominant group being used by those analysing GBIF-mediated data. It is critical therefore that GBIF work to increase taxonomic coverage, rather than setting merely numerical targets, if the intention is to enable high quality science using biodiversity data. It is also clear that data served by GBIF are not a representative sample of the geographical distribution of Earth's biodiversity, despite the increase in number of records since 2007.

We RECOMMEND that a more strategic emphasis be placed on increasing both taxonomic and global geographic coverage, and a de-emphasis on simple numerical targets, as this would benefit not only the high quality science being enabled by GBIF, but GBIF itself as a global public good.

Implementation of such a recommendation would also stimulate greater and more intensive interaction with the science community, which is where the interaction must be if GBIF is to be fully successful in the future.

4.2 Data quality

GBIF data were originally envisaged as enabling biodiversity science, but that term has many meanings. It is important not to confuse science with technology – the informatics tools developed by members of the GBIF secretariat are *technology*, not necessarily *science*. Biodiversity informatics is largely developing in the absence of framing scientific questions, leading to an unfortunate tendency for tool development to be undertaken for its “gee-whiz” nature rather than to enable scientific questions to be addressed. In this way, the field, and developers with it, runs the risk of ceasing to be an enabling infrastructure and becoming a tools development programme for development's sake.

Establishment of GBIF as a “science enterprise” is in part at the root of this disconnect, but the excitement over the possibilities of new tools has led to what we perceive is a mandate for staff to do research, rather than provide infrastructure. Maintenance of high quality data is, of course, down to the contributors and Nodes, but we feel that infrastructural development is more critical for GBIF at this stage than research. This applies to both the secretariat and to the Nodes. Asking the question “does GBIF do research?” the answer to us appears to be “yes” in the current structure and implementation, while we think the answer should be “no”. We therefore RECOMMEND that the Secretariat focus its efforts on providing infrastructure.

That GBIF-mediated data are fit for purpose is critical for their use in the future, and for the persistence of GBIF as a going concern. The Strategic Plan for 2007-2011 included a strand entitled “quality of data served through the GBIF network is ‘fit for use’ and of high quality”. Of the four targets under this heading, we are concerned that only one of these has been achieved (data filtering tool-sets available), the rest are either seriously behind schedule (identifying potential uses due in 2007, only now being undertaken) or are identified as mostly mainly achieved.

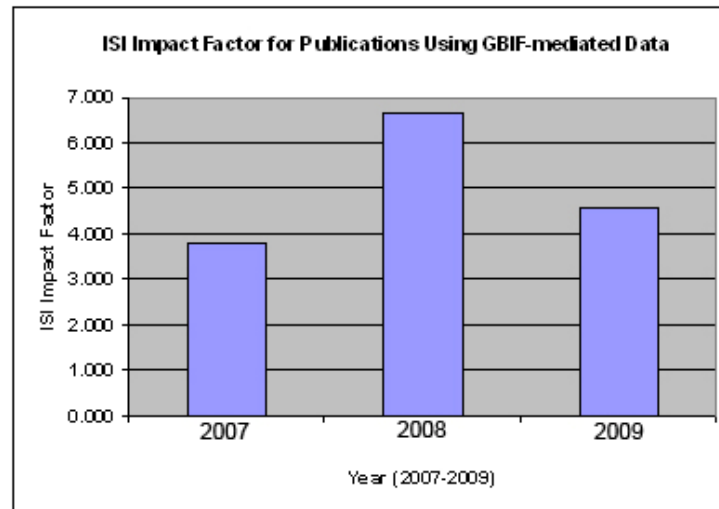
We also question if the recent call on the GBIF website for a white paper on “Enhancing fitness-for-use of primary biodiversity data” (posted 4 November 2009, contract finalised 30 November, release of white paper 30 March 2009) on a consultancy basis is an appropriately rigorous way in which to address this key issue for GBIF’s very survival.

We note there are currently also a number of other “white papers” being left for consultancy. This approach can certainly be useful, but the subject matters for these consultancies seem also to overlap somewhat the review and forward look process already in train. We feel it important that GBIF policy is developed and debated/developed/structured by the Executive Committee and/or the Science Committee. This may indeed be the case for these white papers but there does not appear to be an easily obvious audit trail, and we feel there should be – as in our recommendations under the Science Committee (p 22.) It may also be more effective for a time-limited task force drawn from participants to undertake this work, rather than a singleton consultant.

Consequently, we RECOMMEND re-emphasising the key role of GBIF in providing access to basic data and providing the most effective infrastructure for global access to those basic data, and that the SC examine the possibilities of developing new work through time-limited task forces, rather than consultants.

4.3. Data use

An analysis of publications using GBIF-mediated data (through Google Scholar) over the years since the last review has revealed a substantial increase in the number of peer-reviewed papers using these data from 15 in 2007, 36 in 2008 and 42 in 2009 (for titles see Annex I). The average ISI impact factor has also increased from 3.7 in 2007 to 4.3 in 2009 (see below). The impact factor average was much greater in 2008 due to a single paper in the journal *Science* (impact factor = 28.07), but we feel this is not on its own significant.



What is significant is that the quantity and quality of the work being published using GBIF-mediated data are both on the increase. We feel that little importance should be attached to the impact factor averages, but instead GBIF should be proud of the increase in use of data, and in the breadth of users it is attracting. The list of publications for 2009 includes a large number of local, developing country journals, none of which will have impact factors. This, however, is *exactly* the community of scientists that GBIF was created to help and it is encouraging to see an increase in use by this sector. Contact with these countries could bring new Nodes and or voting/associate members to the GBIF family.

We did not analyse publications that mention GBIF here – there are many, and a mention is of course useful for calling attention to the fact that GBIF exists. However, if in fact GBIF has gone from proof of concept to full implementation, we feel the measure of success is an increase in publications using the data served through the GBIF portal, *not in mere mentions of the service*.

The tracking of publications using or mentioning GBIF-mediated data on the GBIF website is seriously underestimating the impact of GBIF as a facilitator of high quality science. A quick comparison of numbers of publications recorded in our analysis and from the GBIF website reveals large discrepancies. The overestimate for 2007 derives from some publications that are cited as using GBIF data that merely mention GBIF, but use biodiversity data from other sources (such as CONABIO or INBio not mediated through GBIF). In 2009 one high-impact paper that uses GBIF-mediated data (Feeley and Silman, 2009)¹ was classified as a “mention” rather than “use”. It is probably not worth the effort to track simple mentions of GBIF now that the facility has gone to full implementation, the data will speak for themselves.

¹ Feeley, K.J. & Silman, M.R. (2009) Extinction risk of Amazonian plant species. *Proceedings of the National Academy of Sciences, USA* **106**:12382-12387

Publications citing GBIF-mediated data (citation as coming via GBIF)

Year	GBIF website	Our analysis
2007	20	15
2008	7	36
2009	3 (4)	42

By tracking the use of GBIF-mediated data, new users and potentially new country-level Nodes and voting members could be identified, and we RECOMMEND that a search similar to ours be undertaken at the end of every calendar year and the website be updated correspondingly, particularly for publications using GBIF-mediated data.

4.4 Projects and Campaigns

We understand the GB, through the secretariat, to be getting out of the business of providing small sums of money as seed grants to many recipients, as was done in the initial stages of proof of concept, and has moved to a “campaign” model for seed-funding a few research-type projects. These projects are envisioned as long-term initiatives that will be a mechanism to mobilise new funding streams and data of relevance to the GBIF mission. Four of these were approved for funding by GB14 in 2007, rather than the single campaign envisioned. Decisions on the final campaign(s) were taken by the Governing Board; these were based on an evaluation of campaign proposals by the Science Committee. Within the documents available to us, it is not, however, apparent that an in-depth evaluation was done by the Science Committee as to the strategic relevance of these campaigns, nor, apparently, were these four campaigns competitively funded. Minutes from the SC meetings do not record such evaluation or discussion. More transparent competitive peer-review would help with the acceptance of these as important aims of the global biodiversity informatics community seeking to improve quantity of and access to biodiversity data.

The activities themselves appear broadly successful and additional funds have been raised for three of the four campaigns. These funds have largely been components of other funded projects such as PESI (European Union) or BioCAN (Community of Andean Nations) that in all likelihood would have gone ahead with or without the GBIF campaign in place. So the value-added question for GBIF remains, in our view. We RECOMMEND a quantitative comparison of the positive effects of the prior seed grant scheme and this new campaign scheme should be carried out with respect to;

- additional data added to the GBIF network, and
- additional participation in GBIF activities by new partners.

Additionally, we believe the links between the GBIF strategic aims and the campaigns themselves need to be made clearer, and that a fully transparent process be instigated for all stages of project selection and funding.

4.5 Informatics

The tools developed for data publishing and data discovery are widely used in the GBIF community, and have had a significant effect in driving the global biodiversity informatics agenda. They have, however, contributed to that agenda being dominated by technical rather than scientific developments.

GBIF has played a key role in implementing TDWG standards, in fact, without the existence of GBIF we are sure these standards would still be being exhaustively discussed. The very existence of a portal through which standardised data could be served has been a significant driver for community change. The precise nature of the relationship between GBIF and TDWG is not particularly clear, and perhaps should be revisited. It is clear that TDWG vacillation has made achievement of some of the targets in the 2007-2011 strategic plan challenging. We RECOMMEND, therefore that the Secretariat and Science Committee discuss and agree the nature of the on-going GBIF/TDWG relationship as a matter of urgency.

An important product from the GBIF secretariat is the open-source software to enable various informatics tasks. Software developed by the GBIF secretariat staff is very well received by Nodes, and the training provided in its use is on the increase as the IPT and GBDRS are now or soon will be available (although it is slightly worrying that as of October 2009 only 23% of Nodes had used the IPT and that 45% had not yet installed it but were planning to in “the near future” – data from Preliminary Analyses from Participants’ Reports, 2009). It is also apparent that considerable software development expertise exists within the Nodes community, and that the support of the GBIF secretariat staff in developing this expertise is much appreciated and valued. It was brought to our attention, however, that there are a few problems with the transition from a donor-recipient relationship to a truly collaborative one with regards to software and tool development. These can be summarised as follows:

- Lack of rigorous technical documentation; open source software must be documented and annotated meticulously in order to take advantage of improvements made by users.
- Release of unstable code that is being worked on still by its initiators to a community who are not made aware that it is not finalised.
- Lack of implementation by the secretariat of a truly collaborative work flow that takes into consideration those who are modifying the code in the community concomitantly with the changes being implemented in Copenhagen.

While the use of, and expansion of open software code has become standard practice, concern was voiced by participants that the process for incorporating enhancements by the user community are not retained (or easily incorporated) when GBIF releases a new iteration or version of the platform code. The value of users building upon and evolving

GBIF functionality should be reviewed to incorporate the innovations and cross-fertilisation of user enhancements in the core informatics products.

Additionally, concern from the user groups was voiced during the RT's participation at the Nodes and Capacity Building weekend that the user community needs were not fully solicited prior to the development of new infrastructure. The desire to create an all-encompassing data infrastructure by the secretariat and then release it to the user community for testing and feedback was not viewed as the best approach. We RECOMMEND that thorough user community needs are articulated in advance of future infrastructure developments and that pathways for incorporating user innovations to GBIF infrastructure are developed.

It is encouraging that the GBIF secretariat is taking seriously the informatics desires and needs of participants with "needs assessments" framed around the trajectory from "content needs" to strategic mobilisation. We feel, however, that there is a certain amount of confusion of wants and desires with needs. This has led to assessments that are really "wants assessments" rather than true needs assessments in the more strategic sense. The differing technological skills levels of the various participant Nodes can make assessments of these kinds complex and difficult to analyse.

It might be helpful for the GBIF secretariat to have the assistance of social scientists in order to frame some of these needs assessments so they really capture the needs of the community rather than just their desires. It is vitally important that the GBIF community be fully integrated in the thinking and work of the Secretariat, with the understanding that a constant 2-way conversation while developing products is not always possible. We reinforce our understanding of the view of the Secretariat that conversations with the GBIF community are essential as new techniques and technologies are developed and urge that this practice continues and is re-enforced – this can also occur through aspects of the training programme.

5: COMMUNICATION, CAPACITY BUILDING AND OUTREACH

5.1 Introduction

Communications and outreach are a useful part of GBIF's activities, but care needs to be exercised over exactly what is being communicated, and to whom, and for what purpose. There are obviously internal communications between data providers and data users; there will be communications outwards to the biodiversity related MEAs, for example; and there may well be other broader communication messages that are useful to develop. But if there is agreement on GBIF being a data-science portal, it is not by its very nature going to make headline news every day. Nor is it wise to try and oversell the abilities or roles of GBIF.

We note the recent appointment of a new communications officer and see this as an

opportunity to have a new communications strategy developed; which should focus on making the GBIF family activities coherently expressed and seen as a functioning whole.

The team perceived some tension between the GBIF Secretariat and the ‘other’ participants in the network—nodes, associate members, data publishers, data users, etc. The present situation ‘feels’ quite top-down, with priorities set by the Secretariat, and activities determined by the Secretariat, such that a resetting of the ‘balance of power’ between nodes, Secretariat, and Governing Board is important, *if the nodes are genuinely to consider themselves as being GBIF, rather than serving the GBIF Secretariat.*

As a rather specific example, GBIF’s annual report focuses on what the Secretariat has achieved, but provides little information about the rest of the participants in GBIF—what has been achieved in the year across the entire GBIF network? Such a network-wide view could be achieved by means of more basal and fundamental interaction between the Secretariat and the broader GBIF community. Whether these perceptions are reasonable or not, the current tendency is to have an “us-versus-them” view of the relationship. One aspect that should be featured is the recently launched International Year of Biodiversity. GBIF through the participants and the secretariat can use this year to place targeted messages about its data-science role in helping other actors in the biodiversity arena, and indeed how it might contribute to formulation and monitoring of the post-2010 target(s).

We RECOMMEND therefore a Communications and outreach strategy is formulated and agreed by Executive Committee, with close consultation with and collaboration from the nodes committee, which should include areas of focus for work in 2010.

5.2 Training and Capacity building

These two topics are important elements of a communications and outreach programme. We were uncertain why there seemed a lack of interest at Governing Board level on the issue of training, which we see as an important element of delivering the global programme. The lack of nominations for the training committee seemed indicative to the RT of a lack of sufficient appreciation of the importance which should be afforded training by the Governing Board and member countries.

The CEPDEC process by which Denmark has provided a stream of funding for training and capacity building is very welcome, as is the French SEP-CEPDEC. We note that much of the training has focussed on issues related to accessing Biodiversity information, including GBIF technical architecture and tools, GBIF Participant Node management, the basics of biodiversity informatics (focusing on the technologies adopted by GBIF) and an introduction to the digitisation of biodiversity data (including digitisation project management, geo-referencing, data quality and cleaning, publication etc.)

We agree with these approaches, but in line with our earlier remarks we do not feel that training funds should be used for workshops and exercises dealing with *inter alia* the use of biodiversity data for planning and decision-making or other policy-related topics. This is of course a valuable use for the GBIF data, but diluting available funding away from the main focus of GBIF into such areas may not help accelerate the development and population of the GBIF database, which must be the main focus for the next decade. Nonetheless this issue should be kept under close observation by the training task force, seeking innovative ways to accomplish these joint aims.

Training is part of but not all capacity building. There is a case for seeing if capacity needs to be built (including technology transfer and technology acquisitions). Including in training support attendance at GB meetings, and assisting the Nodes workshops are indeed valuable ways to increase the spread of GBIF influence, and knowledge about its activities and we support the deepening and continuance of these aspects of the training programme.

A central challenge of any capacity building initiative is the ability to determine that capacity has been built. One means of determining this is the incorporation of GBIF technology and process into the normal biodiversity reporting processes at national level. The example provided by South Africa that biodiversity data be provided through the designated GBIF node at the SANBI is an indication not only of the uptake of GBIF standards by a government, but that the personnel skills and institutionalisation of a particular process has been accepted and entrenched.

We RECOMMEND that GBIF develop a concise set of indicators of success in capacity development (which we regard as both individual personnel training and institutional capacity development for process of biodiversity data access).

We understand and applaud that there are comprehensive training plans in place, and that production of handbooks continues (as a contribution to self-training).

We do feel, and so RECOMMEND, that the close relationship between the training and the communications strategies be deepened, and that the officers for training and communication should continue to work closely together. We especially feel that member countries must continue to take seriously their responsibilities in this area, including the exchange of technology and techniques.

6. GOVERNANCE

We have examined a number of governance-related issues, which we feel need attention as GBIF continues its development.

6.1 Membership and the MOU

The current MOU makes a clear distinction between “countries” and other GBIF participants. While countries are allowed to be voting participants, organisations and “economies” are only allowed to be associate participants with no rights to vote. Since GBIF is not a political organisation, but an organisation for consolidating data and building data infrastructure, we don’t see a clear rationale for this distinction.

We do perceive considerable concern regarding the strategy and preparation behind recent efforts by GBIF to approach key countries and organizations for participation. Quite simply, such efforts represent delicate and sensitive diplomatic arrangements, and should be treated as crucial steps to be taken at the highest levels of the GBIF organization. These negotiations will involve extensive preparation, investment of time and effort by the Executive Secretary under the guidance of the GB, and careful attention to the details of the particular situation. The goal, of course, is successful promotion of broader global participation in and support for GBIF efforts.

Obviously, government ownership of GBIF is vital, as governments will inevitably remain the main source of funding. However, non-governmental and inter-governmental organisations are also serving as important actual and potential contributors to (and consumers of) GBIF data. We therefore RECOMMEND that GBIF should consider allowing organisations with functions close to GBIF’s mandate and willing to observe the provisions of the MOU, including making a financial contribution, to become voting participants on an equal footing with countries.

One important distinction between country and non-country participants should remain: If the proposal of the draft Memorandum of Understanding to allow associate non-paying membership for no more than two years is accepted by GB (which we RECOMMEND) this should apply only to countries. Participant organisations should have the right to remain non-paying, non-voting associate participants if they so wish.

Of course the MOU is an important instrument with which all financial members of GBIF must be comfortable, in order to ensure Governments are also comfortable with a continued funding of the project. We note also that there some difficulties with the continued operations of the Secretariat due to late, or partial, payments of agreed dues, and that the MOU appears silent on date by which payments should normally be received by the Secretariat. Yet most intergovernmental ventures had such codification, and so we suggest that the budget committee strengthens its notification for a normal payment time.

The current due date is by 31 March, but it is not always possible for the Finance Ministries to adhere to that date, so we suggest the official notification be something like *“annual contributions should be received by the Secretariat **no later** than April 30th”*. We would urge all financial members of GBIF to ensure their contractual obligations are

carried out in a timely manner, in concordance with the protocol in the MOU. We also believe the Governing Board should take a strong interest in ensuring contributions are received on time, and empower the Executive Secretary to undertake negotiations through appropriate channels if contributions are continually late.

6.2 Governing Body issues

The governance structure of GBIF has certain similarities with politically constructed intergovernmental organisations and this seems a little over-elaborated for an organisation like GBIF with a strong technical/scientific mandate. This applies even more now that GBIF has moved from proof of concept to full operation.

The bureaucratic burden was eased considerably when GBIF moved from two GB meetings per year to one, but we believe a further streamlining of the governance structure is possible and should be considered so as to make more resources available for the basic operations of GBIF.

The 2005 GBIF review opened a discussion on the relationship between policy and science in the GB, and concluded that the GBIF governance structure could go two ways;

- 1) keep the existing governance structure in which the GB is the main forum for handling political, managerial and programmatic issues, or
- 2) redefine the governance structure by decoupling the politics and science.

The 2005 review group then proposed to “simplify the governance structure by segregating politics from operations”. The proposal does not appear to have been supported by the GB.

We share the view of the GB that it would be difficult for an organisation whose vision is to create a biodiversity data infrastructure, and whose primary supporters are governments, to decouple science from its political context. The politics in GBIF *is* about science to a very large extent, and the decisions of the GB will include both political and scientific components. A more important question concerns the *overall quality* of the GB. Based on GB reports, and our experience of attending GB 16 in October 2009, we see a need to strengthen both the *political* and the *scientific* components of the GB.

On the political side we noticed that most delegates *did not use* the opportunity at GB16 to engage in an open and general discussion on the important proposal for a new MOU as envisaged in the agenda. Delegates refrained from voicing opinions about this MOU arguing that they needed to seek mandates at a higher level in their government administrations especially on the issue of the “open-ended” nature of the MOU. This suggests that some delegates may have an inappropriate degree of delegation and that delegates with more “decision power” are needed at GB meetings.

On the scientific/informatics side we noticed that many of the national experts including node managers were either not present or articulate at the GB meeting, with the consequence that very important and fruitful discussions developed at the previous day's Node Committees meeting were not brought into the GB discussions, where they could have been incorporated into a political context.

6.3 Some ideas for reform.

6.3.1 A GBIF Assembly?

One way of better bridging science and political issues, while at the same time streamlining the governance structure, could be to create a *GBIF Assembly* as the overall GBIF body. This body could meet biennially, and would comprise the full GBIF community and a wider range of stakeholders. It should allow for a more open, cross-cutting and in depth discussions of GBIF issues than has been the case in the GB. It would also allow for organising various seminars and other events as part of or in the margins of the Assembly meetings. This would also allow for better treatment of the Science meeting, which while interesting seemed rather a distraction splitting GB discussions in two. We RECOMMEND this be examined by the GB.

We consequently RECOMMEND a GB (perhaps renamed Executive Board and replacing the Executive Committee) to meet annually (and more frequently virtually if needed) but with a narrower and more business oriented agenda and restricted solely to voting participants. This structure could be an incentive for associate participants to become voting and financial members.

6.3.2 Standing Committees

a) Executive committee

A new GB under a General Assembly limited to voting participants meeting annually with a streamlined business oriented agenda would essentially have the function of an executive committee and could in our view replace the present Executive Committee. A bureau of the GB (committee chairs and ES *ex-officio*) could be established to liaise with the Secretariat intersessionally.

b) Nodes Committee

The nodes are mandated to undertake what we believe are the core functions of GBIF, and the Nodes Committee in our view should have a more prominent role in the GBIF governance structure than at present.

The rules of procedure lay down that meetings of the Nodes Committee are to be held back to back with the GB meetings. This arrangement in our view prevents the Nodes Committee from feeding its recommendation properly into the GB and thereby limits

its important potential contribution to the overall GBIF policy. We believe this was apparent in relation to GB 16 in 2009 where a lot of important issues were raised at the meeting of the Nodes Committee which would have enriched discussions at the GB had the structure and timing of meetings allowed for this. We therefore RECOMMEND that meetings of the Nodes Committee are held between and not only back to back with GB meetings (as is the case for meetings of the Science Committee).

c) *Science Committee*

The terms of reference for the GBIF Science Committee state that it is “an advisory committee that will oversee the development and progress of the GBIF Work Programme and make recommendations to the Governing Board, the Executive Committee and the Secretariat”. The Committee is composed of 14 members, eight (8) of whom are elected by the GB members (chair, vice-chairs, work area chairs) and six (6) of whom (including the Executive Secretary) are *ex-officio* (as on <http://www.gbif.org/governance/advisory-committees/science-committee/>, accessed 22 April 2010).

It has been an excellent idea to do away with the sub-committee structure (recommendation of the previous review) and implement Task Groups instead. This has made the work of the Science Committee quicker, more focused and more relevant. The Task Group model also allows the secretariat to respond quickly to issues arising in the fast-evolving field of Biodiversity informatics and to potentially involve a wide community of participants from Nodes in setting priorities.

We see it as peculiar however, that all members of the SC, elected and *ex-officio*, are on the formal SC email list and therefore prematurely privy to sensitive and confidential discussions that will result in recommendations to the Secretariat. It is similarly peculiar that all programmatic GBIF secretariat staff attend the whole of the Science Committee (SC) meetings, making a significant number sitting at the table for SC meetings being staff of the GBIF secretariat. We feel that the Science Committee should be serving a strategic and evaluatory role for GBIF; as such it needs to operate to a considerable extent independently from the GBIF secretariat in order to fashion its recommendations in confidence and to enable the staff of the secretariat to be implementing tasks rather than talking about them. Staff participation in all Science Committee meetings means that the long strategic view is often hampered by day-to-day concerns of secretariat functioning. It also could be construed as a serious conflict of interest. It is of course important that secretariat staff members are involved with the Science Committee, but the current balance is, we feel, not correct, whether in digital exchanges, teleconference or face-to-face meetings. No other GBIF committees have such a high proportion of secretariat staff in attendance.

We RECOMMEND therefore that the Science Committee discuss its *modus operandi* as a matter of urgency; a strong suggestion from the RT for improving operational effectiveness and standards is that relevant staff are invited to attend for specific

agenda items where their work area, skills or expertise are likely to help the deliberations of the Committee. If that suggestion is followed we suggest the meeting programme be designed to allow time for all secretariat staff and the science committee to meet in an informal setting.

We also RECOMMEND that the Science Committee establish clear and transparent rules for dealing with the solicitation, evaluation and funding of any projects, campaigns, or similarly funded items.

d) Rules Committee

The Rules Committee has no doubt been a useful body in the initial phase of GBIF but at this stage we don't see a need to retain a permanent Rules Committee. The poor attendance of Rules Committee members at the meeting in conjunction with GB 16 in 2009 adds to this perception. Legal matters could be handled directly by the Executive Committee/GB and if needed, *ad hoc* groups could be established for specific targeted issues, in a manner analogous to the Task Groups used by the Science Committee. It should not be necessary for a separate standing committee to handle matters of staff rules, which should be undertaken by the Executive Secretary on advice from the Host country, and signed off at EC/GB level. We therefore RECOMMEND that, unless the committee itself can produce a viable justification for continued existence, the Rules Committee be dis-established after the term of office of the current Chair comes to an end, and the committee considers our suggestion that the MoU might become simpler and its interaction with Rules of Procedure be clarified.

e) Rules of procure of the standing committees

Given the importance of the committees it is appeared to us worrisome that there are so few candidates for the committees and that some meetings apparently have very low attendance of members. At the last Rules Committee, it appears the Committee Chair was the only elected member of the Committee in attendance, with other members being *ex-officio*. The rules of procedure have no provisions for a quorum but the limited participation did not prevent the Committee from holding the meeting and becoming the first stage in recommending to the GB on important issues concerning voting in the GB.

We believe that meetings of this kind could undermine the authority and credibility of the committees and we therefore RECOMMEND amending the committees' rules of procedure with provisions for quorum.

Of course our recommendations in the section are somewhat consequent on each other, but we believe that GB should accept the challenge to streamline and improve the efficiency, and importantly efficacy, of Governance arrangements.

6.4 Third Year (2004) Review

The Third Year Review of GBIF was finalised in 2005 with a very comprehensive report. Given the importance originally attached to the review and its quality (not to mention the resources put into the exercise) we believe that the review was not handled in a sufficiently systematic and transparent manner at the time. We have discussed in the previous section in some detail the degree to which issues raised the review were dealt with.

At GB 10 in 2005 a general discussion of the review took place, the GB “accepted” the report and then constituted a Review Response Team. The Team was comprised of the members of the EC plus the chair of the *Ad Hoc* group on the Rules of Procedure and elected representatives from the Associate Participants. The team invited participants to comment on the review, but it does not appear an actual response to the Review was prepared. Instead, a new MOU and Strategic Plan were prepared and discussed by GB11.

The GB was not given the possibility to thoroughly evaluate the long list of recommendations made in the Third Year Review and from our examination of material supplied by the Secretariat it appears that many of the recommendations remain unimplemented. Without going through the recommendations *seriatim* we are of the view that many good ideas from that review remain relevant, and that they are either as, or even more, pertinent today as they were then. Consequently we RECOMMEND a task force, under the guidance of the GB, revisit the review in the light of the recommendations of this present reflective review and the FL, with a view to ensuring better governance as a result.

We also RECOMMEND that the results of this present review and associated *Forward Look* be published in full by GBIF, together with a clear indication of which recommendations have been taken and which not, with a short narrative of reasoning in each case. This will allow future reviews a solid base of information which was not available to us.

6.5 MOU.

Our terms of reference did not include the MoU, which we understand is, in a parallel process, being revised for a third time. We have noted the changes proposed by various parties to the MOU both at GB16 and after. We also note a key conclusion of the 2005 review, namely that; GBIF should consider adopting a simpler, more general MOU to be signed by all Participants. We understand GB at the time did not agree with approach, but we are now at a situation where the MOU is becoming more complex, mainly through attempts to make subtle changes in English expression, which in reality are only providing confusion, not clarity. While we understand it is too late in the piece to open this up for further changes at the present time we RECOMMEND strongly that a simpler open-ended MOU be developed in the next iteration of the MoU. Apart from making

sure that the GBIF community understands clearly what is in the MOU, a simpler format is an encouragement for more to join; an increasingly prolix and convoluted one will only repel new members; especially from non-Anglophone countries. And a non-time limited MoU will be a very public affirmation from the international GBIF community that it has a long and essential future ahead of it.

ACRONYMS

BioCAN	Biodiversity Programme of Community of Andean Nations
BLG	Biodiversity Liaison Group
CEPDEC	Capacity Enhancement Programme for Developing Countries
CBD	Convention on Biological Diversity
CONABIO	Comisión Nacional para el Conocimiento y Uso de la Biodiversidad (Mexican National Biodiversity Information Organisation)
ES	Executive Secretary (of GBIF Secretariat)
FL(T)	Forward Look (Team)
GB	Governing Board
INBio	Instituto Nacional de Biodiversidad (of Costa Rica)
IPBES	International Panel on Biodiversity and Ecosystem Services
ISI	Institute for Scientific Information
ITPGR Agriculture	International Treaty on Plant Genetic Resources for Food and Agriculture
MEA	Multilateral Environment Agreement
MOU	Memorandum of Understanding
OECD	Organisation for Economic Co-operation and Development.
PESI	Pan-European Species Directories Infrastructure
RT	Review Team (preparators of this report)
SANBI	South African National Biodiversity Institute
SC	Science Committee
SEP-CEPDEC	Sud Expert Plantes - Capacity Enhancement Programme for Developing Countries
TDWG	Taxonomic Databases Working Group (www.tdwg.org)
UNFCCC	UN Framework Convention on Combating Climate Change

BRIEF BIOGRAPHIES OF TEAM MEMBERS.

Peter Bridgewater is currently Chair of the UK Joint Nature Conservation Committee, previously Secretary General of the Ramsar Convention, and has been involved with key international biodiversity Conventions since 1990. He helped develop the Global Taxonomy Initiative under the CBD, and Chaired the International Whaling Commission from 1995-1997.

Sandra Knapp is an Individual Merit Research scientist at the Natural History Museum in London. She is a taxonomist specialising in the nightshade family (Solanaceae), particularly in its documentation and discovery, as well as its evolution. She leads the collaborative project *Flora Mesoamericana*, and has been involved in creating a web-available global taxonomic treatment of the potatoes, tomatoes and relatives.

Monika MacDevette is currently Chief of the Capacity Development Branch, Din UNEP's Division of Early Warning & Assessments, and was previously Deputy Director of the UNEP World Conservation Monitoring Centre at Cambridge, UK. Her work has taken her from Canada to South Africa, India and Kuwait. She established and operated a private technology management consulting company in Cape Town prior to commencing work with UNEP in 2002.

Christian Prip is currently managing a research project for the United Nations University assessing National Biodiversity Strategies and Action Plans. Before he was focal point and lead negotiator for the Danish government to the CBD and chaired the CBD SBSTTA from 2005 - 2007

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ANNEXE I

Professional publications that use GBIF data or bioinformatic resources

Data collected to mid-November 2009

Authors	Year	Title	Journal + Collation	ISI Impact factor
Geraghty, M. J., R. R. Dunn, and N. J. Sanders	2007	Body size, colony size, and range size in ants (Hymenoptera: Formicidae): Are patterns along elevational and latitudinal gradients consistent with Bergmann's Rule?	Myrmecological News 10:51-58	0.000
Gontier, M.	2007	Scale issues in the assessment of ecological impacts using a GIS-based habitat model -- A case study for the Stockholm region	Environmental Impact Assessment Review 27:440-459	1.205
Grenz, J. H. and J. Sauerborn	2007	Mechanisms limiting the geographical range of the parasitic weed <i>Orobanche crenata</i>	Agriculture, Ecosystems & Environment 122:275-281	2.980
Guralnick, R.	2007	Differential effects of past climate warming on mountain and flatland species distributions: a multispecies North American mammal assessment	Global Ecology and Biogeography 16:14-23	5.304
Körner, C., M. Donoghue, T. Fabbroc, C. Häuse, D. Nogués-Bravo, M.T. Kalin Arroyo, J. Soberon, L. Speers, E.M. Spehn, H. Sun, A. Tribsch, P. Tykarski & N. Zbinden	2007	Creative Use of Mountain Biodiversity Databases: The Kazbegi Research Agenda of GMBA-DIVERSITAS	Mountain Research and Development 27(3):276-281	0.347
Montserrat, V., P. Joan, F. Xavier, and H. Bruelheide	2007	Regional assessment of plant invasions across different habitat types	Journal of Vegetation Science 18:35-42	2.037

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Papes, M. and P. Gaubert	2007	Modelling ecological niches from low numbers of occurrences: assessment of the conservation status of poorly known viverrids (Mammalia, Carnivora) across two continents	Diversity and Distributions 13:890-902	3.446
Peterson, A. T., M. Papeş, D. S. Carroll, H. Leirs, and K. M. Johnson	2007	Mammal taxa constituting potential coevolved reservoirs of filoviruses	Journal of Mammalogy 88:1544-1554	1.737
Shenbrot, G., B. Krasnov, and L. Lu	2007	Geographical range size and host specificity in ectoparasites: A case study with <i>Amphipsylla</i> fleas and rodent hosts	Journal of Biogeography 34:1679-1690	4.566
Sterling, J. A., O. Seberg, C. J. Humphries, F. Borschenius, and J. Dransfield	2007	Priority areas for rattan conservation on Borneo	in Curry, G. editor. Biodiversity Databases: Techniques, Politics, and Applications. Taylor & Francis, Boca Raton	0.000
van Erp, M.	2007	Retrieving lost information from textual databases: Rediscovering expeditions from an animal specimen database	Proceedings of the Workshop on Language Technology for Cultural Heritage Date (LaTeCH 2007) 2007:17-24	0.000
Wong, S., S. Lau, P. Woo, and K.-Y. Yuen	2007	Bats as a continuing source of emerging infections in humans	Reviews in Medical Virology 17:67-91	7.130
Yesson, C., P. W. Brewer, T. Sutton, N. Caithness, J. S. Pahwa, M. Burgess, W. A. Gray, R. J. White, A. C. Jones, F. A. Bisby, and A. Culham	2007	How Global Is the Global Biodiversity Information Facility?	PLoS ONE 2:e1124	0.000
Yi, T., A. J. Miller, and J. Wen	2007	Phylogeny of <i>Rhus</i> (Anacardiaceae) based on sequences of nuclear <i>Nia-13</i> intron and chloroplast <i>trnC-trnD</i>	Systematic Botany 32:379-391	1.403
Yingzhong, Y., Y. Droma, J. Guoen, B. Zhenzhong, M. Lan, Y. Haixia, C. Yue, K. Kubo, and G. Rili	2007	Molecular cloning of hemoglobin alpha-chain gene from <i>Panthalops hodgsonii</i> , a hypoxic tolerance species	Journal of Biochemistry and Molecular Biology 40:426-431	0.000

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			TOTAL 2007 (15 papers)	30.155
			AVERAGE	3.769
Aricò, S.	2008	Advances in concepts and methods for the marine environment: Implications for policy	Cell Biology and Toxicology 24:475-481	2.155
Bafna, S., J. Humphries, and D. P. Miranker	2008	Schema driven assignment and implementation of life science identifiers (LSIDs)	Journal of Biomedical Informatics 41:730-738	2.605
Banks, W. E., F. d'Errico, A. T. Peterson, M. Kageyama, and G. Columbeau	2008	Reconstructing ecological niches and geographic distributions of caribou (<i>Rangifer tarandus</i>) and red deer (<i>Cervus elaphus</i>) during the Last Glacial Maximum	Quaternary Science Reviews 27:2568-2575	4.730
Bode, M., K. A. Wilson, T. M. Brooks, W. R. Turner, R. A. Mittermeier, M. F. McBride, E. C. Underwood, and H. P. Possingham	2008	Cost-effective global conservation spending is robust to taxonomic group.	Proceedings of the National Academy of Sciences USA 105: 6498-6501	9.380
Buckley, L. B.	2008	Linking traits to energetics and population dynamics to predict lizard ranges in changing environments	American Naturalist 171:E1-E19.	4.660
Bug, W., G. Ascoli, J. Grethe, A. Gupta, C. Fennema-Notestine, A. Laird, S. Larson, D. Rubin, G. Shepherd, J. Turner, and M. Martone	2008	The NIFSTD and BIRNLex vocabularies: Building comprehensive ontologies for neuroscience	Philosophical Transactions of the Royal Society B: Biological Sciences 360:255-268	5.600
Carlos Lado & Diana Wrigley de Basanta	2008	A review of Neotropical Myxomycetes (1828-2008),	Anales del Jardín Botánico de Madrid 65(2): 211-254	1.403
Christenhusz, M. J. M. and T. K. Toivonen	2008	Giants invading the tropics: the oriental vessel fern, <i>Angiopteris evecta</i> (Marattiaceae)	Biological Invasions 10:1215-1228	2.788
Costa, G. C., C. Wolfe, D. B. Shepard, J. P. Caldwell, and L. J. Vitt	2008	Detecting the influence of climatic variables on species distributions: A test using GIS niche-based models along a steep longitudinal environmental gradient	Journal of Biogeography 35:637-646	4.566

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Ebeling, S. K., E. Welk, H. Auge, and H. Bruelheide	2008	Predicting the spread of an invasive plant: combining experiments and ecological niche model	Ecography 31:709-719	4.099
Faith, D. P., S. Ferrier, and K. J. Williams	2008	Getting biodiversity intactness indices right: Ensuring that 'biodiversity' reflects 'diversity'	Global Change Biology 14:207-217	5.876
Giovanelli, J., C. Haddad, and J. Alexandrino	2008	Predicting the potential distribution of the alien invasive American bullfrog (<i>Lithobates catesbeianus</i>) in Brazil	Biological Invasions 10:585-590	2.788
Grytnes, J.-A., and T. Romda	2008	Using museum collections to estimate diversity patterns along geographical gradients	Folia Geobotanica 43:357-369	0.964
Hardy, C. R. and N. W. Hardy	2008	Simple biodiversity mashups for non-tech-savvy biologists: A demonstration using the liana flora of Pennsylvania, USA	Journal of the Torrey Botanical Club 135:585-594	0.794
Heywood, V. H.	2008	Challenges of in situ conservation of crop wild relatives	Turkish Journal of Botany 32:421-432	0.143
Joaõ G. R. Giovanelli Æ Ce'lio F. B. Haddad Æ Joaõ Alexandrino	2008	Predicting the potential distribution of the alien invasive American bullfrog (<i>Lithobates catesbeianus</i>) in Brazil,	Biological Invasions (2008) 10:585–590	2.788
Kalliola, R., T. Toivonen, V. Miyakawa, and M. Mavila	2008	Open access to information bridges science and development in Amazonia: lessons of the SIAMAZONIA service	Environmental Research Letters 3:doi:10.1088/1748-9326/1083/1083/034004	1.719
Koch, F. H. and W. D. Smith	2008	Spatio-temporal analysis of <i>Xyleborus glabratus</i> (Coleoptera: Curculionidae: Scolytinae) invasion in eastern U.S. forests	Environmental Entomology 37:442-452	1.467
Lang, D., A. D. Zimmer, S. A. Rensing, and R. Reski	2008	Exploring plant biodiversity: the <i>Physcomitrella</i> genome and beyond	Trends in Plant Science 13:542-549	9.210
Laufer, G., A. Canavero, D. Núñez, and R. Maneyro	2008	Bullfrog (<i>Lithobates catesbeianus</i>) invasion in Uruguay	Biological Invasions 10:1183-1189	2.788
Lim, J., J. Bhak, H.-M. Oh, C.-B. Kim, Y.-H. Park, and W. K. Paek	2008	An Integrated Korean Biodiversity and Genetic Information Retrieval System	BMC Bioinformatics 9:S24	3.780

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Lobo, J.M.	2008	Database records as a surrogate for sampling effort provide higher species richness estimations.	Biodiversity and Conservation 17: 873-881	1.473
Menon, S., Z. Islam, J. Soberón, and A. T. Peterson	2008	Ecological and geographic analysis of the Asian nuthatches (Aves: Sittidae)	Wilson Journal of Ornithology 120:692-699	0.470
Milla, R., L. Gimenez-Benavides, and G. Montserrat-Marti.	2008	Replacement of species along altitude gradients: the role of branch architecture	Annals of Botany 102:953-966	2.755
Nepal, M. P.	2008	Systematics and reproductive biology of the genus <i>Morus</i> L. (Moraceae).	Ph.D. Dissertation, Kansas State University, Manhattan, Kansas.	0.000
Nijman, V., M. Aliabadian, A. O. Debrot, J. A. de Freitas, L. G. L. Gomes, T. G. Prins, and R. Vonk	2008	Conservation status of Caribbean Coot <i>Fulica caribea</i> in the Netherlands Antilles and other parts of the Caribbean	Endangered Species Research 4:241-246	1.323
Page, R. D. M.	2008	LSID Tester, a tool for testing Life Science Identifier resolution services	Source Code for Biology and Medicine 3:2.	0.000
Peterson, A. T.	2008	Uses and requirements of ecological niche models and related distributional models	Biodiversity Informatics 3:59-72.	10.680
Peterson, A. T.	2008	Biogeography of diseases: a framework for analysis	Naturwissenschaften 95:483-491	2.126
Second, G., and G. Rouhan	2008	Human-mediated emergence as a weed and invasive radiation in the wild of the CD genome allotetraploid rice species (<i>Oryza</i> , Poaceae) in the Neotropics	PLoS ONE 3:e2613	0.000
Stephenson, S., M. Schnittler, and Y. Novozhilov	2008	Myxomycete diversity and distribution from the fossil record to the present	Biodiversity and Conservation 17:285-301	1.473
Svenning, J.-C., and R. Condit	2008	Biodiversity in a warmer world	Science 322:206-207	28.070
Timdal, E.	2008	Studies on <i>Phyllopsora</i> (Ramalinaceae) in Peru	The Lichenologist 40:337-362	1.279
Vieira, C. M., D. Blamires, J. A. F. Diniz-Filho, L. M. Bini, and T. Rangel	2008	Autoregressive modelling of species richness in the Brazilian Cerrado	Brazilian Journal of Biology 68:233-240	0.000

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von Konrat, M., M. Renner, L. Söderström, A. Hagborg, and J. Mutke	2008	Early land plants today: Liverwort species diversity and the relationship with higher taxonomy and higher plants	Fieldiana Botany 47:91-104	1.403
Wang, L.-S.	2008	Taxonomic revision of the <i>Pternopetalum delavayi</i> complex (Apiaceae)	Annals Botanica Fennici 45:105-112	0.000
Yetişir, H., M. Şakar, and S. Serçe.	2008	Collection and morphological characterization of <i>Lagenaria siceraria</i> germplasm from the Mediterranean region of Turkey	Genetic Resources and Crop Evolution 55:1257-1266	0.967
			TOTAL 2008 (36 papers)	126.322
			AVERAGE	6.649
Alsos, I.G., T. Alm, S. Normand & C. Brochmann	2009	Past and future range shifts and loss of diversity in dwarf willow (<i>Salix herbacea</i> L.) inferred from genetics, fossils and modelling	Global Ecology and Biogeography 18: 223-239	5.304
Argote Cortes, A.	2009	Nueva localidad para el trepatroncos gigante (<i>Xiphocolaptes promeroporhynchus</i>) en el estado de Guerrero, Mexico	Acta Zoologica Mexicana (ns) 25: 207-209	0.000
Beaumont, L.J., R.V. Gallagher, W. Thuiller, P.O. Downey, M.R. Leishman & L. Hughes	2009	Different climatic envelopes of invasive populations may lead to underestimations of of current and future biological invasions	Diversity and Distributions 15: 409-420	3.446
Beaumont, L.J., R.V. Gallagher, P.O. Downey, W. Thuiller, M.R. Leishman & L. Hughes	2009	Modelling the impact of <i>Hieracium</i> spp. on protected areas in Australia under future climates	Ecography 32: 757-764	4.099
Bertzky, M. & Stoll-Kleeman, M.	2009	Multi-level discrepancies with sharing data on protected areas: what we have and what we need for the global village	Journal of Environmental Management 90: 8-24	1.794
Byrne, A. & U. Fitzpatrick	2009	Bee conservation policy at the global, local and national levels	Apidologie 40: 194-210	1.603

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Cayueta, L, Golicher, D., Newton, A., Kolb, H, de Albuquerque, F. S., Arets, E. J. M. M, Alkemade, J. R. M. and Pérez, A. M.	2009	Species distribution modeling in the tropics: problems, potentialities, and the role of biological data for effective species conservation	Tropical Conservation Science 2: 319-352	0.000
Cunningham, H.D., L.D. Rissler & J.J. Apodaca	2009	Comeptition at the range boundary in the slimy salamander: using reciprocal transplants for studies on the role of biotic interactions in spatial distributions	Journal of Animal Ecology 78: 52-62.	4.220
Davis, A.P., R. Goveaerts, D.M. Birdson, M. Ruhsam, J. Moat & N.A. Brummitt	2009	A global assessment of distribution, diversity, endemism, and taxonomic effort in the Rubiaceae	Annals of the Missouri Botanical Garden 96(1):68-78	1.246
Feeley, K.J., and M.S. Silman	2009	Extinction risks of Amazonian plant species	Proceedings of the National Academy of Sciences USA 106: 12382–12387	9.380
Feeley, K.J., and M.S. Silman	2009	Biotic attribution from tropical forests correcting for truncated temperature niches	Global Change Biology, 10.1111/j.1365- 2486.2009.02085.x (on-line 29 Sep 2009)	5.876
Gavin, D.G.	2009	The coastal-disjunct mesic flora in the inland Pacific Northwest of USA and Canada: refugia, dispersal and disequilibrium	Diversity and Distributions 15: 972-982	3.446
Gonzalez-Christen, A., C.A. Delfin-Alfonso & A. Gonzalez-Romero	2009	New record and southern range extension for the Mearn's grasshopper mouse (<i>Onychomys arenicola</i> Mearns, 1896) in Veracruz, Mexico	Western North American Naturalist 69: 391- 395	0.381
Guralnick, R., and A. Hill	2009	Biodiversity informatics: automated approaches for documenting global biodiversity patterns and processes	Bioinformatics 25:421-428	4.627
Hauton, C., T. Tyrrell & J. Williams	2009	The subtle effects of sea water acidification on the amphipod <i>Gammarus locusta</i>	Biogeosciences 6: 1479-1489	2.810
Hengl, T., H. Sierdsma, A. Radovic & A. Dilo	2009	Spatial prediction of species' distributions from occurrence-only records: combining point patterns analysis, ENFA and regression-kriging	Ecological Modelling, in press corrected proof on-line 11 November 2009 (doi:10.1016/j.ecolmodel.2009.06.038)	0.000

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Hsu, R. & J.H.S. Wolf	2009	Diversity and phytogeography of vascular epiphytes in a tropical-subtropical transition island, Taiwan	Flora 204: 612-627	1.031
Israili Z.H. & B. Lyoussi	2009	Ethnopharmacology of the plants of genus <i>Ajuga</i>	Pakistan Journal of Pharmacological Science 22: 425-462	0.000
Koehler, J.	2009	The identity of <i>Hylambates rufus aubryioides</i> Andersson, 1907 (Anura: Arthroleptidae) from Cameroon	Copeia 2009(1): 57-61	1.100
Koenemann, S., A. Bloechl, A. Martinez, T.M. Iliffe, M. Hoenemann & P. Oromi	2009	A new, disjunct species of <i>Speleonectes</i> (Remipedia, Crustacea) from the Canary Islands	Marine Biodiversity 39:215-225	0.000
Luxbacher, A.M. & Knouft, J.H.	2009	Assessing concurrent patterns of environmental niche and morphological evolution among species of horned lizards (<i>Phrynosoma</i>)	Journal of Evolutionary Biology 22: 1669-1678	3.471
Masgood Javed, S.M., S. Saravanan, F. Tampil & C. Srinivasulu	2009	Occurrence and comparison of Jerdon's Gecko <i>Hemidactylus subtridrus</i> Jerdon 1853 with Termite Hill Gecko <i>Hemidactylus tridrus</i> (Daudin 1802) from Ananthagiri Hills, northern Eastern Ghats, India	Journal of Threatened Taxa 1: 366-369	0.000
Meimberg, H., K.J. Rice, N.F. Milan, C.C. Njoku & J.K. MacKay	2009	Multiple origins promote the ecological amplitude of allopolyploid <i>Aegilops</i> (Poaceae)	American Journal of Botany 96: 1262-1273	2.512
Miller, R.J., A.D. Carroll, T.P. Wilson & J. Shaw	2009	Spatiotemporal analysis of three common wetland invasive plant species using herbarium specimens and geographic information systems	Castanea 74(2):133-145	0.388
Nativi, S., P. Mazzetti, H. Saarenmaa, J. Kerr, and É. Ó. Tuama	2009	Biodiversity and climate change use scenarios framework for the GEOSS interoperability pilot process	Ecological Informatics 4:23-33	1.100
Nourouzi, A., A.A. Talebi, Y. Fathipour & A.I. Lozan	2009	<i>Apanteles laspeyresiellus</i> (Hymenoptera: Braconidae), a new record for Iran insect fauna	Journal of Entomological Society of Iran 28: 79-8079	0.000
Obermayer, W., K. Kalb, H.J.M. Sipman & T.H. Nash	2009	New reports of <i>Culbersonia nubila</i> (Moberg) Essl. from the Tibetan region, Bolivia, Argentina, Lesotho and South Africa	The Lichenologist 41: 683-687	1.279

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O'Dor, R.K. & M.J.W. Stokesbury	2009	The Ocean tracking network - adding marine animal movements to the global ocean observing system	in Nielsen, J.L. et al. Tagging and tracking of marine mammals with electronic devices. Springer Verlag, The Netherlands, pp. 91-100.	0.000
Otto, E.M., T. Janssen, H-P. Kreier & H. Schneider	2009	New insights into the phylogeny of <i>Pleopeltis</i> and related Neotropical genera (Polypodiaceae, Polypodiopsida)	Molecular Phylogenetics and Evolution 53: 190-201	4.448
Palero, F., Crandall, K.A., P. Abello, E. Macpherson & M. Pascual	2009	Phylogenetic relationships between spiny, slipper and coral lobsters (Crustacea, Decapoda, Achelata)	Molecular Phylogenetics and Evolution 50: 152-162	4.448
Peterson, A. T.	2009	Shifting malaria transmission risk across Africa with warming climates.	BMC Infectious Diseases 9: 59	2.540
Pineda, E. & J.M.Lobo	2009	Assessing the accuracy of species distribution models to predict amphibian species richness patterns	Journal of Animal Ecology 78: 182-190	4.220
Provan, J., G. E. Beatty, S. L. Keating, C. A. Maggs, and G. Savidge	2009	High dispersal potential has maintained long-term population stability in the North Atlantic copepod <i>Calanus finmarchicus</i>	Proceedings of the Royal Society B 276:301-307	4.248
Randle, A.M., J.B. Snyder & S. Kalisz	2009	Can differences in autonomous selfing ability explain differences in range size among sister-taxa pairs of <i>Collinsia</i> (Plantaginaceae)? An extension of Baker's law	New Phytologist 183: 618-629	5.178
Renner, S. C., and J. H. Rappole	2009	Bird species richness pattern in the Greater Himalayan Mountains - a general introduction	in Biogeography of birds in the southeastern and sub-Himalayan Mountains - center of endemism or many species in marginal habitats? Ornithological Monographs. American Ornithologists' Union, Washington, D. C.	0.000
Roedder, D.	2009	Sleepless in Hawaii' - does anthropogenic climate change enhance ecological and socioeconomic impacts of alien invasive <i>Eleutherodactylus coqui</i> Thomas 1966 (Anura: Eleutherodactylidae)	North-Western Journal of Zoology 5: 16-25	0.000
Sardari, S., M.A. Shokrgozar & G. Chavanni	2009	Cheminformatics based selection and cytotoxic effects of herbal extracts	Toxicology In Vitro 23: 1412-1421	2.473

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Smith, S.A. & J.M. Beaulieu	2009	Life history influences rates of climatic niche evolution in flowering plants	Proceedings of the Royal Society B; Published online before print September 23, 2009, doi: 10.1098/rspb.2009.1176	4.248
Soberón, J. and A. T. Peterson	2009	Monitoring biodiversity loss with primary species-occurrence data: toward national-level indicators for the 2010 Target of the Convention on Biological Diversity	AMBIO 38:29-34	2.092
Tallent-Halsell, N.G. & M.S. Watt	2009	The invasive <i>Buddleja davidii</i> (Butterfly Bush)	The Botanical Review 75: 292-325	2.900
van Wilgen, N.J., N. Roura-Pascual & D.M. Richardson	2009	A quantitative climate-match score for risk-assessment screening of reptile and amphibian introductions	Environmental Management 44: 590-607	2.286
van Zonneveld, M., J. Koskela, B. Vinceti and A. Jarvis	2009	Impact of climate change on the distribution of tropical pines in South East Asia	Unasylva 231/232, 60: 24-29	0.000
			TOTAL 2009 (42 papers)	98.194
			AVERAGE	4.567