OECD Global Science Forum
Second Activity on Policy Issues Related to Scientific Research Collections
Washington DC, July 17-19, 2008
Chair: Dr. Phyllis Johnson, Smithsonian Institution

Final Report on Findings and Recommendations
Submitted to the 19th Meeting of the OECD Global Science Forum
by the Delegation of the United States

EXECUTIVE SUMMARY

Scientific collections are essential parts of the research infrastructure of all countries with scientific enterprises, and they are critical to many areas of science, from microbiology to space science. National governments share an interest in finding answers to basic research questions and many applied research challenges, and no one nation has all the assets to pursue major research challenges independently. Furthermore, natural phenomena are unaffected by national frontiers. For these reasons, in 2006, the OECD Global Science Forum authorized a workshop on Policy Issues Related to Scientific Research Collections, which was held in Leiden, the Netherlands, in 2007. A second, follow-up workshop was held in Washington, DC, in July 2008. This final report presents the findings and recommendations from these two workshops regarding the optimal maintenance, utilization, and international coordination of scientific research collections.

Participants of the Leiden meeting identified a series of unmet needs regarding scientific collections. These include the problem of "orphaned" collections that may contain irreplaceable specimens but nonetheless be proposed for disposal by the holding institution because of changes in mission, budget priorities, or other compelling reasons. Workforce development and training are increasingly becoming problematic, and there is no clear career path for technicians and curators, nor is there much mobility among institutions. There is a general need for development of common standards and best practices for managing scientific collections. There is also a need for improved electronic cataloging and accessibility of collections. There are some research questions that can only be answered by combining information across multiple collections. Finally, although collections comprise fundamental infrastructures for the scientific research enterprise, they are generally not managed as such. There is a particular lack of coordination of this distributed infrastructure at the international level.

The conclusions of the Leiden Workshop (see annexe 1) contain a series of recommendations addressing three main topics:

- Scientific research collections as research infrastructures,
- Functional operation,
- International organisation

Among these recommendations, the proposal to set up a new international coordinating mechanism for scientific research collections was underlined as a possible way to address the other issues. The Washington meeting developed some specific ideas about the potential activities and organization of such an international mechanism. The term "mechanism" was selected to avoid pre-judging whether a permanent, temporary, centralized, distributed, real, or virtual organizational structure would be most appropriate.

The **Mission of an International Coordinating Mechanism for Scientific Collections** would include the following:

- Enable global-scale research activities
- Promote an international culture of collections as large-scale distributed infrastructure

- Improve access to and mobility of collection objects and associated data, and the people associated with them; foster capacity-building
- Identify and integrate existing standards of community practice, and develop additional standards deemed necessary

In order to fulfil this mission, this coordinating mechanism should undertake the following actions:

- Create a research roadmap in coordination with the user community
- Create self-assessment tools for collections
- Set standards of practice
- Promote research on scientific collections and collections management
- Provide opportunities for the global collections workforce
- Provide a clearinghouse mechanism/interface between collection-based science and broader societal concerns/policies

The mechanism should promote highly integrative research enabled by collections as well as excellence in collection management. It should be highly responsive to the needs of institutions and governments that maintain collections. Accordingly, the scale and duration of the international coordinating mechanism's activities should reflect their impact on and value to the research community. Participants agreed that the coordination mechanism should have financial sustainability during its lifetime without relying on binding financial contributions to a new inter-governmental structure. The activity should be science-driven, to involve the research community of collection users including those in both OECD and non-OECD countries.

The delegates considered a number of organizational models as a starting point for discussion of how the international coordination of collections could best be served. It was felt that no single existing organizational model was appropriate, but that several models have useful aspects that could be adapted and used

Several recommendations are presented for moving forward with the creation of an international coordinating mechanism for scientific collections. A general work plan for a "Year Zero" planning and development phase was also developed by the steering committee; it is presented in the annexe 2.

SUMMARY OF RECOMMENDATIONS

- An international coordinating mechanism for scientific collections should be created.

- A follow-on activity should be authorized by the Global Science Forum, with a mandate to produce an implementation plan leading to a design for and creation of such an international coordinating mechanism.

- GSF delegations should be invited to initiate home government consultations to discuss the findings and recommendations in this report and to identify relevant national contact points or persons to participate in the follow-on activity.

- GSF delegations should engage their respective research communities and other stakeholders and investigate the feasibility of engaging such dialogue, possibly through the European Science Foundation.

- GSF delegations are invited to raise support for a "Year Zero" planning and development phase of the future coordinating mechanism

Background

In 2006, the Global Science Forum (GSF) of the Organisation for Economic Cooperation and Development (OECD) agreed, following a proposal by the delegation of the Netherlands, to convene a workshop on Policy Issues Related to Scientific Research Collections. This workshop was held at the National Museum of Natural History Naturalis in Leiden (ND) on 12-13 June 2007, attended by 32 participants from 15 countries and international organizations. The focus was on the optimal maintenance, utilisation and international coordination of large scientific research collections. One of the main recommendations resulting from this workshop was the creation of an international organisation of scientific collections, which could:

- establish the criteria to define scientific collections as research infrastructures;
- define general standards for the operation of scientific collections and corresponding performance indicators;
- promote public and governmental awareness of scientific collections and their importance as part of the infrastructure needed for scientific research;
- develop strategies for international, large-scale scientific undertakings which depend on the collections; and
- develop policies, guidelines and conditions that would ensure accessibility to collections.

The GSF endorsed at its 17th Meeting the proposal of the delegation of the United States to organize a second workshop dedicated to move this initiative forward and help consider the mechanisms required to implement such an international body.

This workshop was held at the Smithsonian National Museum of Natural History in Washington DC, the United States, on July 17-19, 2008, and co-hosted by the Smithsonian Institution and the US Department of Agriculture. It was attended by 36 participants from 19 countries and international organisations (see list in the annexe 3). The findings and recommendation of the first workshop held in Leiden, The Netherlands, on June 12-13, 2007, served as a basis for this second workshop. The focus was on the potential need and value of a new mechanism for international coordination of scientific research collections, and its potential mission, activities and organizational model. A discussion paper had been prepared by the International Steering Committee and distributed beforehand as a basis for discussion at this workshop.

1. Scientific Collections and the International Infrastructure of Research

Scientific collections are integral, essential parts of the infrastructure of all countries with strong research enterprises. As agreed at the initial Leiden workshop, scientific collections are understood as those which have been accumulated and stored primarily for research purposes rather than for historical or artistic reasons. These include collections and repositories of plants, animals, microbes, biomedical samples, rocks, minerals, ice cores, fossils, human artefacts, and diverse other objects of scientific study, but exclude collections of data only, libraries, or art objects. Scientific progress requires the curation, retention and maintenance of these collections for a variety of reasons, including but not limited to:

- Keeping voucher and reference material for verifying past results;
- Providing study material for emerging and new analytical techniques,
- Offering rapid access to representative samples from around the world, including remote locations,
- Keeping material that has value related to the specific point in time that it was collected (especially environmental samples);
- Keeping material from sites, organisms, or ecosystems that may no longer exist;
- Avoiding the cost of re-collecting samples when urgently needed in the future;
- Calibrating processes and instruments in different laboratories
- Contributing to an understanding of the shared culture of science around the world, including the history and development of science.

New technologies, such as molecular analysis, DNA sequencing, small-scale chemical, spectroscopic and isotopic analysis, and digitization, have expanded the use of specimens in scientific collections considerably. They also allow the generation of large and statistically relevant data sets from different collections for various scientific purposes. Furthermore, because of new scientific questions that invariably arise, and new techniques that allow new information to be obtained from a specimen, there is strong scientific consensus about the importance of keeping the objects themselves for future study. This necessity to retain, curate and manage the world's vast scientific collections produces significant challenges.

Natural history collections alone are estimated to contain two billion objects[1]. A US survey of scientific collections held by its Federal government alone reported hundreds of millions of objects, and the survey is known to have not received responses from some large collections. A report from the United Kingdom noted that there were 104 million specimens of organisms in the 22 largest collections in the United Kingdom[2]. Thus, the scale of the entire scientific collections enterprise is extremely large. It is important to note that the large number of specimens in many collections is directly related to the scientific importance of documenting variability in nature and over time.

Research is an international, collaborative enterprise for three reasons, each of which is highly relevant to scientific collections.

- National governments share an interest in finding answers to basic research questions and many applied research challenges. The elements and results of most research can be considered "global public goods" that benefit all people. Scientific collections are critical to meeting many of these research challenges;
- Natural phenomena such as plate tectonics, evolution, and climate processes are unaffected by national frontiers. Studying these aspects of nature require the free international flow of people, data, and the objects and specimens in scientific collections; and
- No one nation has all the assets to pursue major research challenges independently. The human talent, facilities, budget, and scientific specimens needed for many research initiatives are distributed around the world. Sharing these samples, specimens and data makes many research initiatives possible and affordable.

Scientific collections may also have additional, more political, values. At a time when differences between the world's major cultures are of increasing political and social concern, the value of science as a common thread connecting us all becomes increasingly valuable.
Scientific collections reveal our common approach to understanding the world around us and how historically we have come to the current state of knowledge and application of science. As such, they are an important means of bridging gaps between nations and cultures.

Although the value and importance of scientific collections are increasingly recognized, they face common problems linked to their historical structure and increasing demand for access. Traditional policies and procedures may not be adequate to meet their emerging role as part of the global research infrastructure, and many collections are seeking ways to improve their operations. Current political, technological and financial restrictions faced by these scientific collections also have international implications.

For these reasons and others described below, countries share an interest in improving international coordination in the area of scientific collections.

[1] Global Biodiversity Information Facility (GBIF) 2008. http://www.gbif.org/GBIF_org/bf1#whyneed.
[2] House of Lords, Select Committee on Science and Technology, 2002. "What on Earth? The Threat to the Science Underpinning Conservation," Session 2001-02, 3rd Report. HL Paper 118(i).

2. Unmet needs for international coordination of collections

Governments may be interested in increased coordination of research collections for two reasons: better efficiency at the national level (value for money) and the opportunity for cultural diplomacy, an issue that should probably be further discussed by the collections community. But collections themselves face a large number of issues that need to be addressed. Among those cited were the problem of orphan collections, access policies, training and career development of personnel, capacity building etc. Hence the drive for increased collaboration at the international level is very strong.

Orphaned Collections

It is becoming increasingly common, as collection managers face a steady increase in the size of collections at the same time as constant or even reduced resources, that difficult decisions must be made regarding what material to keep. Even if resources are not an issue, the mission of an institution may change, and this may result in changes in priorities for maintaining certain collections. However, the judgement of a particular collection manager not to keep a collection does not necessarily mean that the collection has no value to science and should be disposed of as rubbish. An international mechanism for coordination among collections would provide notice of collections potentially to be "orphaned," and opportunities for other institutions to undertake their custody and curation to the benefit of the global research enterprise. A recent report on systematics from the United Kingdom[3] noted that of 602 herbaria present in Britain in 1945, 97 have been destroyed or cannot be traced, and the whereabouts of 106 are currently unknown; thus the specimens in 203 collections have been lost to science. It also expressed concern regarding the future of the CAB International (CABI) fungal reference collection, stating that "its loss would deepen the crisis in fungal taxonomy."[4] Losses or potential losses of collections in other countries have also generated concern in fields as diverse as microbiology, mineralogy or archaeology.[5][6][7]

Workforce development and training

Institutions around the world report that curation and management of collections is often not regarded as a distinct career with clear opportunities for advancement. There is little formal training available for professional support staff outside of what is provided by individual institutions. This makes it more difficult for staff to move from one institution to another, particularly at the international level. Decreases in numbers of technicians and curators and inflexible employment hierarchies within institutions have reduced movement between these roles and research positions as individuals gain skills and maturity.[8] The scientific collections community would benefit from working together to create better training and clearer career paths for collection management. Greater clarity in this area would also be beneficial for countries or institutions that need to build capacity in collections science.

Best Practices and Common Standards

The conduct of scientific research in a globalized, hyperlinked society requires standards of quality, precision, openness, repeatability, and ethical behavior. These standards allow researchers to be trained in one country but pursue their careers elsewhere, and for scholarly findings to be published anywhere and be taken seriously everywhere. Participants in the Leiden workshop and in the subsequent Washington workshop identified three levels at which international standards and agreements are needed for the successful operation of scientific collections:

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[3] House of Lords, Select Committee on Science and Technology, 2008. "Systematics and Taxonomy Follow-Up," HL paper 162, page 31.
[4] House of Lords, 2008, page 42
[5] Amato I, 2006. Chemical and Engineering News 84(26):36-37.
[6] Bawaya M, 2007. "Curation in Crisis." Science 317:1025-1026.
[7] Snydman DR et al, 2008. Destruction of Isolates from the Pittsburgh Veterans Affairs Laboratory. Clinical Infectious Diseases 46:1053-9.
[8] House of Lords, 2008, page 112.

1. The level of the individual collections, at which the quality of specimen and data curation are assured. Standards at this level will be to a large degree discipline-specific. Without internationally accepted technical standards at this technical level, collections have uneven scientific credibility and impact;
2. The level of a scientific community, at which priorities and initiatives are determined for increasing collections and increasing their use. International standards for documenting and sharing information on collections enable researchers everywhere to know which specimens are already available for study in a collection somewhere and which specimens must be collected for the first time; and
3. The level of international research infrastructures, at which policies of access, cost-sharing, and service to the global scientific community are set. Agreements at this level increase the overall impact of the global scientific community while providing each participating country with clearer information on the impact of its investments in collections.

Collections as Research Infrastructure

The concept and definition of collections as research infrastructures were discussed at length. Although research infrastructure can be defined in many ways, it is usually considered to be facilities, resources, or services of a unique nature that allow scientists to conduct high-quality research. While in the past, this definition was restricted to single-site facilities, research infrastructures are increasingly viewed as distributed resources. They often require structured information systems related to data management, enabling information and communication. The extreme heterogeneity of scientific collections, their age, their structure, their funding, and their frequent association with non-governmental institutions or non-scientific ministries have usually prevented them from being considered as research infrastructure. However, in recent years, increasing demand for using scientific collections to address various major scientific and policy issues has called into question the way that they are currently organized and managed, and led to calls for greater international coordination.

The current ESFRI definition for distributed infrastructure does not fit scientific collections, as that definition requires a central management and legal entity, so the collections community needs to develop a new concept or model, which may be useful for other domains of science as well. In order to develop recommendations regarding a model for organizing and coordinating collections at an international level, the workshop first considered what the goals and objectives of such an activity might be.

3. Potential goals, objectives, and activities for an international coordinating mechanism

The Washington workshop revisited the general goals for an international coordinating mechanism that had been set out at the Leiden workshop, and also heard presentations illustrating possible models for collaborative organizations. The presentations were on the Australian experience of national collaboration among herbaria to provide integrated access to data on distributed collections; on the Integrated Ocean Drilling Program (IODP), an example of a centralized intergovernmental initiative; and on the International Society of Biological and Environment Repositories, (ISBER) an example of a distributed bottom-up initiative; and on cross-cutting activities under international organizations. The cross-cutting activities described were ICSU joint initiatives and the European Science Foundation's Foresight Exercises. It had been agreed by a number of governments following the Leiden workshop that there was not a desire to create a new intergovernmental infrastructure such as that represented by GBIF, so that model was not directly considered.

The discussion confirmed the original objectives set in Leiden, to create an international coordination mechanism in order to develop standards, performance indicators, awareness, strategy development,

guidelines, and reinforce the research infrastructure basis of scientific collections Several additional important issues were stressed:

- the need to find a bottom-up system to define standards for collections, to avoid a "fear factor" (the Biological Research Centres top-down accreditation system for cell cultures and microorganisms appears to have its limits);
- the need to include an education component regarding standards and best practice, and a grace period before standards are actually enforced;
- the need for an electronic portal to link the different collections, and in the future, some additional work on interoperability.

The coordination has in particular to take into account the need for financial sustainability (and the desire of governments to avoid a binding new inter-governmental structure), that of attracting the whole scientific community beside OECD countries, and be science-driven, to involve the research community of collection users.

Structure:

Workshop participants expressed the feeling that the need for an international coordination mechanism for collections was a key issue, and that no current model and benchmark is yet available. Participants also felt that none of the mechanisms examined during the meeting was exactly suited to the needs, but that each has some interesting features that could be included in the proposed model. For instance, structures like the Integrated Ocean Drilling Program (IODP) have a strong coordination mechanism and influence but a heavy architecture and high running cost. Affiliating structure to the International Council of Science (ICSU), such as CODATA, have a greater flexibility and lower cost, but uneven participation from key stakeholders and erratic funding which hinders the sustainability of their operation. Similarly, very light membership organisations such as ISBER are very reactive to the need of their community but have reduced influence for policy development.

Following discussion, the current proposal is for a federation/consortium of collections using a membership structure. Such structure (see Figure) would represent the lightest organisation able to carry out the various objectives proposed. It would include, at the beginning, some initial financial support from governments, which would gradually be phased out as membership from collection institutions grows from a small number of major institutions to a broader community. However, an advisory board representing interested governments or their representative institutions would still be present to strengthen the links with funding bodies and increase the credibility of the organisation. The user community would be integrated at the working group level, which should be largely self-sustained.

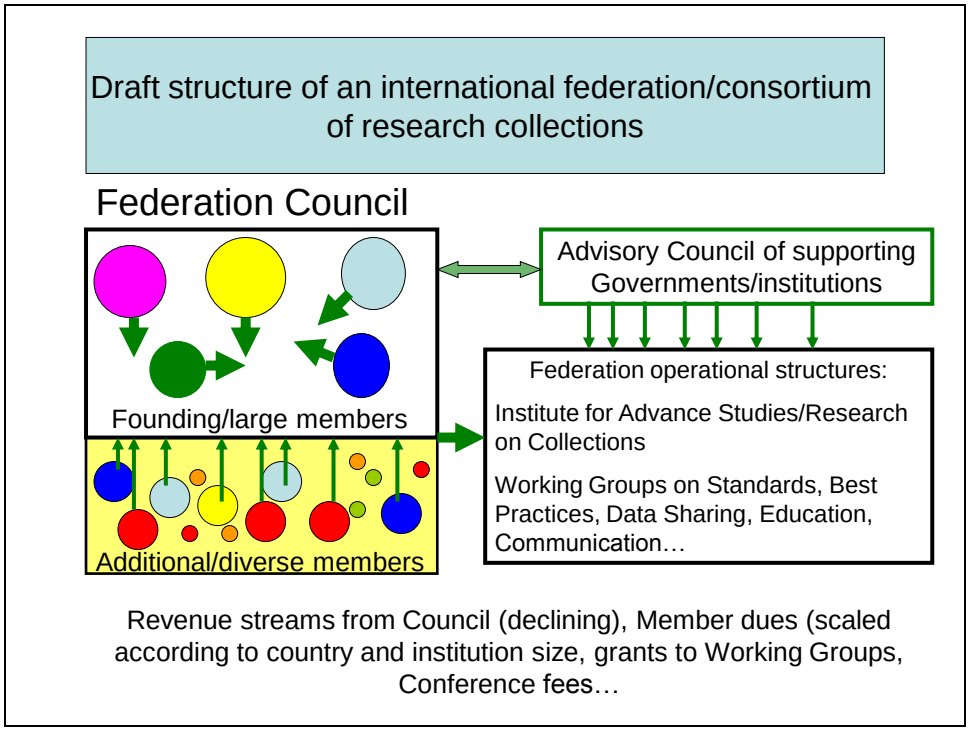
A number of ***overarching principles*** were then expressed for the future coordination mechanism:

1. The coordinating mechanism is interdisciplinary and science-driven
2. It should be inclusive (in terms of geography, disciplines and institutions)
3. Collections and their associated data should be openly accessible
4. The coordinating mechanism should implement a plan for its own sustainability/continuity, without reliance on long-term governmental revenue streams
5. It should add value to existing initiatives without duplicating efforts
6. Scientific collections in their role of research infrastructures, are integral to basic research; realizing their full scientific value will require global interdisciplinary integration.

In addition, a series of activities for such coordination mechanism was proposed:

1. Identify science-driven opportunities, unique, forward-looking interdisciplinary research that relies on collections
2. Explore knowledge that could emerge from integrating collections and metadata across disciplines, collections, countries

3. Build a global research infrastructure capable of providing tangible benefits to society in the form of new and accessible knowledge
4. Provide advice and guidance to stakeholders on the development of distributed collections as an integrated global research infrastructure;
5. Promote excellence in research on research collections and collection management
6. Add emphasis on human aspects, training
7. Ensure optimal use of orphaned collections
8. Promote collaboration with global initiatives that are producing new collections and observational data (e.g., ILTER, ATBIs)



4. Mission of an International Coordinating Mechanism for Scientific Collections

A. Enable global-scale research activities

The justification for creating any global research infrastructure rests on the importance of the research it would enable. The major costs of creating, maintaining and operating scientific collections are borne by national, state, and local governments and by private universities, museums, and other research organisations. Unlike telescopes and synchrotrons, building a globally-integrated research collection would require a relatively small investment dedicated to coordination and collaborative activities. In return for this small incremental investment, an enormous new source of data would be created for integrative research on areas such as:

- global change (climate, biodiversity),
- linkages among the atmosphere, geosphere, hydrosphere, cryosphere and biosphere,
- earth history in all its dimensions, and
- human impact on the natural environment and vice versa (e.g., human migration patterns).

An international coordinating mechanism devoted to scientific collections could convene conferences, symposia and workshops that explore the potential impact of research collections on these and other research areas, and design and facilitate research initiatives to pursue this potential.

The international coordinating mechanism would be in a position to identify science-driven opportunities and unique, forward-looking interdisciplinary research that relies on collections. It

could also promote collaboration with global initiatives that are producing new collections, such as ILTER, ATBIs or GEO BON. In addition, it should also act as an interface (and clearinghouse mechanism) between collection-based sciences and politics/society.

B. Promote an international culture of collections as large-scale distributed research infrastructure

Scientific collections have always been viewed as distributed resources for the researchers in a particular field, created for the specific research questions in that field. An emerging viewpoint is that the global integration of data from these collections would create a major research infrastructure capable of opening new research opportunities far beyond those that were envisioned when they were amassed. The creation of an international coordinating mechanism would foster integration of collections and their metadata across scientific disciplines, collections, and countries to create new knowledge beyond that embodied in any single collection, thus yielding tangible benefits to society.

This emergence of a major collections-based research infrastructure platform would parallel the history of research infrastructure in other fields of science. Following World War II, a growing component of research in the physical sciences has relied on large-scale infrastructure platforms such as astronomical observatories, satellites, and particle accelerators. Over the past 20 years, biological sciences have also come to rely on large shared infrastructure resources such as synchrotrons for resolving protein structures and public databases of structures, gene sequences, and gene expression data. Social sciences are following this model by considering research questions that can only yield to large international social survey databases. An international coordinating mechanism would provide advice and guidance to stakeholders of this large-scale collection infrastructure.

A culture of viewing scientific collections as a distributed infrastructure for research by the entire global community will also ensure optimal use of orphaned collections.

C. Improve access to and mobility of collection objects and associated data, and the people associated with them.

The current impediments for internationally sharing collection-based objects in support of research activities and the lack of data sharing are the most compelling testimony to the independent evolution of many scientific collections and the need for a culture of collections as a shared research infrastructure. Lack of data interchange results from multiple causes, including technical, operational, organizational, financial, ethical and legal barriers. A global organisation could be a driving force and the agent for change leading to greater sharing of data, integration, and research utilization.

As an example, the research community devoted to biodiversity is making great progress in overcoming these obstacles and in putting their more integrated data to use in new research areas. The Global Biodiversity Information Facility (GBIF) that grew out of a Global Science Forum initiative has developed protocols, software systems and data sharing agreements that have made millions of data records available on the web. The Taxonomic Database Working Group (TDWG, now the Biodiversity Informatics Standards) is an informatics specialist group that develops technical standards and has contributed to GBIF's progress. Further extension is now being explored through the possible construction of a Biodiversity Collections Index (BCI), which would contain 'metadata' that describe the overall contents of each collection, rather than its individual component specimens. A similar approach could be used to promote an index of all scientific collections.

D. Create Standards of Community Practice

As scientific collections grew within different research fields and countries, they developed different norms of practice. Their systems of legal ownership, management, professional training and development, specimen preservation and curation, user access, and data sharing have often

evolved in isolation. Creating more harmonized standards of community practice would enable greater access to inter-connection and use of scientific collections and their associated data, thereby promoting more ambitious and collaborative programs of research.

5. Practical actions to be undertaken by an International Coordinating Mechanism for Scientific Collections

A. Create a Research Roadmap in coordination with the user community

Large-scale research initiatives such as Global Change and the Millenium Ecosystem Assessment are examples of areas that could benefit greatly from the global integration of scientific collection data. An international coordinating mechanism could draw up a research roadmap, outlining the infrastructure needed to address the challenges which are linked to the numerous uses of research collections. Such a roadmap would parallel the Astronomy and Astrophysics Decadal Survey that sets priorities for the construction of new observatories and infrastructure. Furthermore, such mechanism may act as an interface between collection-based science and broader societal issues.

B. Create self-assessment tools for collections

Biological Research Centres (BRCs, including type culture centres and living stock resources) have been discussing standards and accreditation systems for quality assurance under the auspices of the OECD's Biotechnology Working Group. The number of scientific collections far exceeds the number of BRCs, making it unwieldy and probably cost-prohibitive to rely on an external system of inspection and accreditation. Alternatively, an international coordinating mechanism could develop tools for self-assessment that scientific collections could use to judge themselves relative to standards of community practice. The results of these self-assessments could be posted by individual collections and compiled for periodic analysis by the international organisation. They could be useful in the process of allocating resources between projects and infrastructures at the national level.

C. Set standards of practice

Scientific collections have diverse stakeholders, including the organizations that own them and fund them, the scientists who curate and manage them, the research communities that rely on them, the students who learn from them, and the general public that visits, appreciates, and supports them. The standards of practice used to create, preserve and manage collections within a discipline must meet the demands of all these stakeholders. If collections are to be integrated intellectually in the pursuit of new research questions, standards of practice across disciplinary and national boundaries will need to mesh and interoperate.

An international coordinating mechanism could create a clearinghouse for the exchange of best practices in all areas related to scientific collections, as well as a forum for establishing and harmonizing standards of good community practice.

D. Promote research on scientific collections and collections management

The science of scientific collections and their management is in its infancy. Management of collections as a sub-field of management generally has been little addressed. There are opportunities to examine other aspects of the science of scientific collections, such as the sociology and culture of how collections are managed, and the efficacy of various approaches. An international coordinating mechanism will provide a focal point for dialogue on these subjects and help to move the science of scientific collections forward.

E. Provide opportunities for the global collections workforce

Workshops for training of collections personnel could provide developmental opportunities, enhance career paths and mobility, and aid in capacity building. Human resources are every bit as critical as financial resources for effective curation and management of collections. Many disciplines are experiencing shortages of trained personnel to carry out critical curation activities. Paying more attention to the workforce will benefit both collections and the people who work

with them. In addition, it is crucial that academic staff are credited with appropriate academic merit for their work with collections, in line with the Council of Europe´s Recommendation Rec(2005)13 on the governance and management of university heritage.

Next Steps

The International Steering Committee met on July 19, the day following the workshop, to discuss a plan of work for implementation of the workshop recommendations. This work plan is attached (annexe 2) to this report. It is envisioned that the International Steering Committee could meet in December 2008 or January 2009 to begin working on implementation, if the recommendations below are adopted.

Since the project for an International Co-ordination mechanism for research collections is clearly not limited to OECD countries, non-OECD countries and organizations (such as Brazil, India, Russia, Costa Rica, Egypt, Indonesia, Argentina, Thailand, Singapore, Malaysia, ICOM, ICSU, SCBD and UNESCO for instance) that could be directly interested will be invited to participate to the implementation discussions.

RECOMMENDATIONS TO THE GLOBAL SCIENCE FORUM

- **An international coordinating mechanism for scientific collections should be created.** Several potential names are proposed:
    - International Federation/Consortium of Scientific Collections
    - Global Scientific Collections: A Coordinating Mechanism
    - Scientific Collections International: A Coordinating Mechanism
    - Federation/Consortium of Scientific Collections: An International Coordinating Mechanism

- **A follow-on activity should be authorized by the Global Science Forum, with a mandate to produce an implementation plan.** It is envisioned that the International Steering Committee could meet in December 2008 or January 2009 to begin working on implementation (as described in annexe 2).

- **GSF delegations should be invited to initiate home government consultations to**:
    - Discuss the findings and recommendations presented in the present report
    - Identify relevant national contact points or persons
    - Provide guidance to national contact points for gathering information, opinions, and priorities for the future international coordinating mechanism
    - Request that national contact points provide feedback to the Steering Committee

- **GSF delegations should engage their respective research communities and other stakeholders and investigate the feasibility of engaging such dialogue, possibly through the European Science Foundation**

- **GSF delegations are invited to raise support for a "Year Zero" planning and development phase of the future coordinating mechanism.** A work plan for "Year Zero" is found in the annexe 2.

Annexe 1

OECD Global Science Forum
Workshop on Policy Issues Related to Scientific Research Collections
Chairman: Dr. Wouter Los, University of Amsterdam

Preliminary report on findings and recommendations
Submitted to the Seventeenth Meeting of the OECD Global Science Forum
by the Delegation of The Netherlands

Background

A proposal to organise an activity on scientific research collections was made by the delegation of the Netherlands at the Fourteenth Meeting of the Global Science Forum. Following recommendations from GSF delegates, a Steering Committee was set up, comprising thirteen members from nine delegations (Australia, Belgium, European Commission, France, Germany, Netherlands, Norway, United Kingdom and the US) and chaired by Dr. Wouter Los, to refine the scope and content of the workshop. As a result of this work, the Steering Committee proposed that the Global Science Forum convenes a workshop to explore the key bottlenecks that prevent effective use of science collections and to propose appropriate in-country and cross-border policies and programme recommendations related to four main issues:

- International standards and performance indicators
- Definition of the missions and common priorities for collection institutes
- Regional and international networking policies for small and large-scale collections
- Access to research collections

This workshop was held at the National Museum of Natural History Naturalis in Leiden, The Netherlands, on June 12-13, 2006. It was attended by 32 participants from 15 countries and international organisations (see list in the appendix). The focus was on the optimal maintenance, utilisation and international coordination of large scientific research collections.

Introduction

Scientific Research Collections are structured ensembles of physical objects collected to answer scientific questions, providing high quality information based on original, primary scientific resources. Biological collections are probably the best-known, but there are many other types, for example, collections of fossils, minerals and other geological specimens, soils, ice cores, atmospheric samples, anthropological objects. Often, collections are the result of hundreds of years of exploration, compilation, documentation and investigation, thus allowing the study of both the spatial variability of related objects and of the temporal evolution of physical or biological phenomena. Some physical research data may also be regarded as collections, for example, archives of photographic plates, sound recordings, and laboratory notebooks.

Collections have multiple uses in basic and applied research. They are invaluable for reconstructing the Earth's history, for analysing the present and for forecasting the future. Collections are used to understand issues in human health and well-being, including emerging diseases of humans, animals and plants, biotechnology, climate change, the sustainability of agricultural systems and the exploitation of natural resources, historic patterns of change and evolution and, finally, the shared cultural, biological, and geological heritage. Expertise in identifying and understanding any organism, living or extinct, any geological or anthropological artefact, is linked, more or less closely, to the scientific collections.

The digitization of collections and the dissemination of the digitized data are recognised priorities on the science policy domain, presenting important technological and policy challenges. Different from digitization, the policy issues in this report concern the physical collections themselves, and how to optimize their utility for science and for society. No matter how much digitization of collections is achieved, the integrity of the original specimens must be maintained, because it is impossible to predict the needs and capabilities of future generations of scientists. This has been demonstrated many times during the past century in the case of geological, soil, plant, zoological, chemical, and anthropological, collections. For instance, contemporary techniques of molecular sequencing, CT scanning, isotope analysis, and new information technologies (such as data mining) are uncovering new uses for the biological collections and their associated data. Because they hold actual physical material (which is a voucher of the past) collections can be regarded as "laboratories" for studying the physical and cultural world. Scientific collections are a public good: ideally, they should be available to all sectors of society who need them to extract information and knowledge.

Although the value and importance of such large collection facilities are increasingly recognised, they face common problems linked to their historical structure, increasing demand for access, and needs for changes to their operation as internationally cooperating research infrastructures. Current political, organisational, technological and financial issues and bottlenecks faced by these scientific collections also have international implications.

Scientific Research Collections as Research Infrastructures

Although there is no single definition of what constitute a Research Infrastructure, these are generally considered as facilities, resources or services of a unique nature that allow scientists to conduct high-quality research. As opposed to the old view of single-site facilities, research infrastructures are increasingly distributed, or even virtual (the service being provided electronically). They often require structured information systems related to data management, enabling information and communication. Research infrastructures are usually opened to interested researchers, based on open competition and selection of the proposals evaluated on their scientific excellence, although some restrictions may apply, depending on the type and ownership of the infrastructure.

The extreme heterogeneity of scientific collections, their age, their structure, their funding and their association with non-scientific ministries or institutions have usually prevented them to be considered as research infrastructure, and be managed or funded as such. In recent years however, the increasing demand for using scientific collections to address various issues have led to question the current organization and role of these collections.

<u>Findings</u>

- Scientific collections have very often grown from older collections and may still reflect outdated structures and practices. They operate in diverse ways, they are often hosted in old buildings, they are financed with diverging mandates from different ministries, agencies, foundations, universities etc. Furthermore, because collection objects are scattered among many different structures around the world, the information available in collections is often unknown, or poorly accessible to the scientists themselves. A consequence is that the value of the combined collections resources in a specific area is not always obvious to governments and science administrators, and therefore the value of individual collections is not easily recognized or acknowledged.

- Despite their heterogeneity, almost all collections report basic research as their primary purpose. Whatever their content, they share some basic missions, such as foster the understanding of the planet and of our society, monitor our environment and human activities, and maintain specimens for scientific studies. New technologies provide totally new

opportunities to utilize the total wealth of scientific collections and they open up new avenues for original research. In addition, the user community for research collections has grown exponentially in recent years, particularly to address issues of global concern (biodiversity, climate change etc.).

- In response to their evolving nature, scientific collections have to be regarded as (distributed) international research infrastructures. Such evolution has direct consequences on the mandate, and practical organisation of scientific collections.

Recommendations

- The international community of scientific collections and their superior funding bodies should agree on a set of criteria or mission statements that will more clearly define scientific collections as Research Infrastructures.
- Recognition of scientific collections as research infrastructures has implications for common standards and performance indicators. These may be defined in 3 layers of mission (mandate) statements and corresponding operational standards with respect to:
    1. The level of the individual collections objects and associated information (collected and maintained for scientific purposes; Curatorial standards)
    2. The combination of objects in scientific collections (Series of objects as 'representation' of reality; Scientific standards)
    3. Collections research infrastructures (Emphasis on utilization; Service standards, access and training policies)
- Governments are recommended to agree on the role of scientific collections as international research infrastructures and encourage collection organisations and funding agencies to adopt these missions and update accordingly their mandates. Such a new organisational approach will result in economy of scale through networking of scientific collections with common missions, by sharing methods and data, and with common priorities for large-scale projects.

Functional operation

The evolution of the role of scientific collections, of the technologies used, of the user community, has an important impact on the way scientific collections are managed and organised. The diversity of collections prevents any uniformed system to be developed, but calls for increased harmonisation of standards and procedures.

Findings

- The need to protect and curate specimens and to offer a greater access to them creates a basic requirement to digitise of scientific collections. Digitisation is not restricted to the construction of databases but requires the development of nomenclature codes and standardised curation information.
- Existing systems such as proposed by Biological Resources Centres or ISO standards provide interesting models to develop certified collections or to ensure the quality of use and care of collections, but are based on lengthy accreditation processes which may be difficult to translate for all scientific collections. Similarly, existing performance indicators for (mostly art) museums are not adapted for scientific collections.
- Disaster planning (including immediate crisis management, asset maintenance security and long-term business continuity) is insufficiently developed. Training plays a crucial role for long-term maintenance.
- Performance indicators are rarely ever used to determine funding for scientific collections. These may include maintenance, conservation strategies, quality of the material collected, access policies etc… Curation performance indicators are often lacking, although important

for knowledge perpetuation. Access records are good indicators of the interest for and quality of scientific collections.
- Users are rarely consulted by scientific collection managers. Needs and expectations of the user community should be better known to collection managers and curators.

Recommendations

- International consultations should be carried out between interested stakeholders (collections, funding and user communities) to define a set of common standards, benchmarks, data accreditation systems, access guidelines and performance indicators. National and regional (European) efforts currently in process could serve as a basis for discussion.
- To foster a greater use of scientific collections, a global online index (indicating where specimens are available and who to contact), or a more developed scientific collection information facility (where information on orphan collections, up-to-date databases etc. could be displayed), should be set up.
- Research collection databases should be recognised as scientific publications, with review procedures and proper credits for the authors.
- Governments and funding agencies are invited to support scientific collections at least partially on the basis of quality criteria.

International organisation

For historical and cultural reasons, scientific collections are highly fragmented. This has prevented until now an efficient use and development of these research infrastructures.

Findings

- In some disciplines, several efforts are currently being undertaken, at national or regional level and through networks, to help structure and run more efficiently scientific collections. However, these efforts are not yet coordinated at a global level, and all scientific fields are often not included in those processes.
- There is currently no obvious existing body to take responsibility for establishing a global harmonisation effort. Scientific collections are hosted by various types of institutions (museums, universities, foundations, ministrial departments, and others) that each has its own organisation with little connections with each other, and often restricted interest towards scientific collections as research infrastructures.

Recommendations

- National networking should be promoted, resulting in national focal points as a basis to define general missions and global standards for scientific collections.
- A framework for developing a consulting platform between the scientific collection community and the user groups should be set up. This process should focus on needs assessment, benchmarking, research perspectives and priorities (and implications for new collection development).
- A global body for scientific collections infrastructures is proposed for:
    - ✓ establishing the criteria to define collection research infrastructures;
    - ✓ defining common (and collection-specific) standards and corresponding performance indicators;
    - ✓ promoting public and governmental awareness for the collection infrastructures;
    - ✓ strategy development for large-scale scientific undertakings which depend on the collections;

- ✓ developing accessibility policies, guidelines and conditions.

Action item

Several key questions regarding the proposal to create an international organisation dedicated to scientific collections remain to be addressed: defining an organisational model, its activities and goals, a business plan, solutions for long-term funding of the platform etc.

The proposal to the GSF is to endorse such follow-on activity, and agree to the organisation of a second workshop or conference (including representatives from non-OECD country organisations) to move this initiative forward. This second workshop should also be the opportunity to consider the mechanisms required to implement the other recommendations described above.

The United States would be prepared to host this follow-on meeting during 2008 in the Washington DC area.

Annexe 2

Work plan for the follow on activity (development phase)

The steering committee met following the Washington meeting and devised a list of tasks that should be undertaken during the follow on activity. The overall goal would be to develop a plan for the organizational structure and sustainability plan for the international coordinating mechanism, assemble core stakeholder institutions in each of the relevant scientific disciplines, and develop a Program of Work that could then be considered by potential funders.

The work plan for the development phase would be carried out by the following working groups:

- Strategic planning: This WG would define the mission and scope of the international coordinating mechanism, types of participating collections and organizations, and the range of activities that the mechanism should undertake;
- Program of work and outreach to research communities: This WG, possibly in collaboration with the European Science Foundation, will develop outreach material on this initiative and disseminate it to key institutions and "umbrella organizations" (e.g., international unions). WG members would then contact and recruit key institutions as participants. Representatives of these key institutions would develop a preliminary Program of Work, including a few pilot projects that could be completed within 1-2 years, to demonstrate the potential value and impact on global research and research collections. The Steering Committee discussed one such possible pilot project on the potential role of collections and collection data in climate change research.
- Governance, staffing, business planning and budget: This WG would develop the organizational and financial plan that would be proposed to potential funders at the end of the development phase. They would obtain any legal advice needed to create an organizational and business plan, including a draft membership fee structure that would be needed for sustainability.
- Launch event and fund-raising: This WG would be responsible for developing the plan for activities that follow the development/planning process described above. These would include a Launch Event and associated fund-raising efforts.

It is envisioned that the development phase could begin with another meeting of the steering committee in December 2008 or January 2009, with a second meeting of the needed around June of 2009. Staffing for the development phase could be done through secondments or by volunteers.

At the end of the development phase, the following deliverables could be expected:

- A Strategic Plan with Mission/Vision Statement
- An inventory of relevant stakeholders, stakeholder networks and organizations, activities (national, regional, global)
- A higher awareness and name recognition for the initiative
- A Program of Work for years 1-3 following launch, including timeline and deliverables
- A Research Forward Look (similar/in collaboration with ESF)
- A Terms of Reference with Membership Declaration
- A Governance structure and possible relation to an international umbrella organization
- An Operational structure, including a Committee and Working Group structure
- An Outreach plan for inclusivity of disciplines and countries
- A Communications plan for stakeholders and the general public
- A Financial/Sustainability plan (including budget)
- A Draft proposal for funding of the programme of work, including letters of commitment from stakeholders
- A Launch Event (50K)

Annexe 3

Participants at the Workshops

Leiden Workshop

* Members of the Steering Committee; ** Chairman

Australia	Judy WEST	Commonwealth Scientific and Industrial Research Organisation (CSIRO)
Belgium	Patrick GROOTAERT	Entomology Department RBINS
Canada	Roger BAIRD	Canadian Museum of Nature
	Larry SPEERS	Agriculture and AgriFood Canada
European Commission	Anna Maria JOHANSSON	Research DG RTD-B3 Research Infrastructures
European Science Foundation	Ruediger KLEIN	Humanities Department
Finland	Eeva IKONEN	The Research Council for Natural Sciences and Engineering Academy of Finland
France	Michel GUIRAUD*	Museum National d'Histoire Naturelle
	Myriam NECHAD*	Museum National d'Histoire Naturelle
Germany	Christoph HAEUSER*	Chair, GBIF Governing Board Staatliches Museum für Naturkunde
	Reinhold LEINFELDER*	Museum of Natural History Berlin
Japan	Keiichi MATSUURA*	National Museum of Nature and Science Collection Center
Italy	Luca BARTOLOZZI*	Natural History Museum, Zoological Section "La Specola"
Netherlands	Jeannette RIDDER-NUMAN	Ministry of Education, Culture and Science
	Leo KRIEGSMAN	Naturalis Geology Department
	Leo LE DUC*	Ministry of Education, Culture and Science
	Wouter LOS**	University of Amsterdam Faculty of Science
	Daniel MOURAD	Ministry of Education, Culture and Science
	Robert VAN AKKER	Delegation of the Netherlands for GBIF
	Cornelis VAN BOCHOVE	Ministry of Education, Culture and Science

Norway	Kaare AAGAARD	Museum of Natural History and Archaeology The Norwegian University of Science and Technology
	Bernt-Erik HEID	The Research Council of Norway
	Einar TIMDAL	The National History Museums and Botanical Garden University of Oslo
	Anders TRODAL	Ministry of Education and Research
Portugal	Paolo GAMA MOTA*	Coimbra University Museu da Ciência
South Africa	Paul BARTELS	Wildlife Biological Resource Centre National Zoological Gardens
	Michelle HAMER	South African Biosystematics Initiative University of KwaZulu-Natal
United Kingdom	Richard LANE*	Natural History Museum
	Simon OWENS	Royal Botanical Gardens Herbarium Department Kew Garden
United States	Phyllis JOHNSON*	US Department of Agriculture Agricultural Research Service
OECD	Frédéric SGARD*	Global Science Forum
	Takuya OKAMOTO	Global Science Forum

Washington D.C. Workshop

* Members of the Steering Committee; ** Chairman

Australia	Jim CROFT	Australian National Herbarium CSIRO Plant Industry
Belgium	Patrick GROOTAERT*	Depatment of Entomology Belgian Royal Institute of Natural Sciences
Canada	Roger BAIRD	Collections Services Canadian Museum of Nature
European Commission	Astrid-Christina KOCH	Science, Technology and Education Delegation of the European Commission to the United States
European Science Foundation	Rüdiger KLEIN	Research and Foresight
Finland	Eeva IKONEN	The Research Council for Natural Sciences and Engineering Academy of Finland
France	Michel GUIRAUD*	Musée National d'Histoire Naturelle
	Delphine TESSIER	Office of Science and Technology Embassy of France in the United States
	Dany VANDROMME	Direction générale de la Recherche et de l'Innovation, Direction de la Stratégie, Cellule des Très Grandes Infrastructures Ministère de l'Education Nationale, de l'Enseignement Supérieur et de la recherche
Germany	Christoph L. HÄUSER*	GBIF Governing Board Staatliches Museum für Naturkunde
	Reinhold LEINFELDER*	Museum of Natural History at Humboldt-University Berlin Museum of Natural History
ICSU	Carol CORILLON	Committee on Freedom and Responsibilities in Science
Israel	Tamar DAYAN	Dept. of Zoology Tel-Aviv University
Japan	Keiichi MATSUURA*	National Museum of Nature and Science
Netherlands	Leo KRIEGSMAN	
	Wouter LOS*	University of Amsterdam
	Joost TAVERNE	Royal Netherlands Embassy, Washington, D.C.
Norway	Axel CHRISTOPHERSEN*	NTNU Museum of Natural History and Archaeology
	Fridtjof MEHLUM	Natural History Museum, University of Oslo

Portugal	Paulo GAMA MOTA*	Museu e Ciência of the University of Coimbra
South Africa	Paul BARTELS	Wildlife Biological Resource Centre National Zoological Gardens
United Kingdom	Richard LANE*	The Natural History Museum
United States	Irma ARISPE	Office of Science and Technology Policy (OSTP) Executive Office of the President
	Rodey BATIZA	Division of Ocean Sciences National Science Foundation
	Antoinette BETSCHART	USDA Agricultural Research Service
	Phyllis JOHNSON**	Smithsonian Institution
	Scott E. MILLER	Office of the Under Secretary for Science Smithsonian Institution
	Kathie L. OLSEN	National Science Foundation
	Karen PITT	Division of Cancer Epidemiology and Genetics National Cancer Institute
	Joan ROLF	Office of Science and Technology Policy (OSTP) Executive Office of the President
	Joann ROSKOSKI	Office of the Assistant Director for Biological Sciences National Science Foundation
	David SCHINDEL	Consortium for the Barcode of Life Smithsonian Institution
	Judith SKOG	Division of Biological Infrastructure National Science Foundation
	Paul F. UHLIR	International STI Programs Board on International Scientific Onganizations National Research Council
OECD	Frédéric SGARD*	Global Science Forum