

Workshop report

Broadening the user base of natural history collections

An EDIT and SYNTHESYS initiative

hosted by the Royal Belgian Institute of Natural Sciences, Brussels

November 4-5, 2008



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Executive summary

In the light of their common work on access and use of natural history collections EDIT and SYNTHESYS held the workshop “Broadening the user base of natural history collections” on November 4 and 5, 2008, in Brussels. The rationale of the workshop was to develop further insights in the opportunities and barriers for uses of collections by different user communities. Within this context EDIT and SYNTHESYS brought together users, managers and other stakeholders of natural history collections. The following subjects and questions were on the agenda: 1) trends and current uses of collections; 2) managing collections; 3) mechanisms to broaden the use of natural history collections.

The workshop itself and as well as the outcomes that are written down in this report, want to be informative and inspirational for institutional decision making and for the launch of future activities on the user base of natural history collections within in EDIT, SYNTHESYS and beyond. The diagram (Table 1) lists the most important uses, user needs, needs of collection management, barriers to broaden the use, the proposed mechanisms to broaden the use of collections – as they were discussed during the workshop.

Next to an investigation of the uses, the needs and the mechanisms to increase the use of collections, recommendations were drafted on how the proposed mechanisms could be implemented and by whom they should be implemented. These recommendations are:

To EDIT Board of Directors:

- Create and advertise a contact point within your institutions that deals with enquiries and communication to the broader user community looking for collection information or access to collections. In parallel, support a European or EDIT contact point that has an overview of collections services, access regulations and the institutional contacts in Europe.
- Develop mechanisms to offer facilities and charge fees for the accommodation of commercial collections
- Build partnerships with the user community at institutional and EDIT level by encouraging scientific staff to participate in user meetings and conferences.
- Assign your PR/communication department to target the broader user community. Preferably this should be based on a joint-communication strategy develop/stirred by an umbrella body like e.i. CETAF.
- Create optimal conditions for staff to interact with users and user demands (e.g more flexibility to employ temporary staff to match needs, include dealing with users in job grading)
- Base institutional priorities on a cost-benefits analysis before heading off (impact versus effort)

To SYNTHESYS/SYNTHESYS II:

- Develop criteria for accessions and distribution of collections
- Develop competencies/performance indicators for hosting users

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Table 1. Diagram of outcomes workshop Broadening the user base of natural history collections

USES OF COLLECTIONS	NEEDS OF USERS	MANAGEMENT NEEDS TO RESPOND TO USER DEMAND	BARRIERS TO BROADEN USE:	PROPOSED MECHANISM TO BROADEN USER BASE
Environmental specimen banking for environmental monitoring	Reliable databased records	Institutional support to make broad user base a priority	Little incentive (job grading) for collection managers and research staff to work with non-conventional users	Develop mechanism to keep track of use of collections
DNA samples for: archaeology, wildlife forensics, customs, other	Geo-referenced records	Make non-conventional users additional to conventional users, not instead	Lack of staff to reply to all user requests	Train staff to deal with user requests
Long term studies in population genetics	Appropriate, flexible institutional conditions to responds to user demands (all users)	Infrastructure to charge users for certain services, under certain conditions	Lack of coordination at international level e.g. collection standards	Create funding mechanism to support uses by users from countries of origin
Environmental impact assessments e.g. for landscape planning	Web-accessible electronic keys for determination by non taxonomists, hard to develop (all users)	Additional staff to look after user requests	Lack of long term preservation of (database) technology	Have clear communication strategy towards users on website of institutions and proactively in newsletters/ meetings.
Natural history art exhibitions, books	Access to specimen collections, also to rare specimens (photographers, other)	Training for staff to be able to better respond to request	Scattered collections in several countries no person of contact, hard to find what is where	Global networks of collections e.g. GBRC's and the XXX will make it easier for users to communicate with natural history collections
Long term biodiversity modelling	Access to 'paper' achieves, like books, maps, drawings personal correspondents (arts, humanities, ethnologists, historians).	Infrastructural facilities adjusted to different users e.g communication work desks and equipment on hand	The specimens themselves, e.g doing DNA extractions from classical collections control the amount of material used in the process or no more specimens available	Collections should operate, participate in user networks like e.g. EPSO
In agriculture the identification of biological control agents for weeds and diseases	Electronic access to digital imagery of specimen collections and paper achieves, 3D scans (a.o. environmental modelling, other)	Organisational and technical mechanisms to avoid destructive sampling	For vertebrate's collections which rarely grow in specimens anymore, it is mandatory to be able to renew the specimens lost during research activities/ other use and this is no easy or possible at all.	
Laboratories for social sciences and museum studies	Clear contact-point for user enquiries on website	More taxidermy expertise available	No overview of current state of collection use. Difficult to keep track of use of collections e.g. in publications, no systematic coordinated way of referencing to the loan institutions.	
Public health, specimens as reference collections for disease factors in human and animal health	Understanding of the costs induced by pests and consequently high value and profit to do it	Flexible storage space, enough freezers		
Identification of wood used in e.g. furniture - antique, also illegal logging	Acknowledge phytoprotection is similar to conservation an important task and that results may have huge consequences on conservation of habitats	Platform to regularly consult users on their needs		
Inspiration for engineering products (biomimicry)	Accurate records (coordinates, never provinces or ecological regions)	Solve legal issues regarding copy rights, specimen loans to "non-members", liability insurance for visitors etc that hamper use and access		
Educating the general public on natural history and evolution	A funding mechanism for users from outside the taxonomic community to visit collections			

Workshop participants

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Acknowledgements

The workshop came into being with help of a number of people. We would like to thank Bob Allkin who was the initiator of the original workshop idea in EDIT, also our kind hosts from the Royal Belgian Institute of Natural Sciences, in particular Isabella Van de Velde for her help with the logistical organisation, and many other who provided us with constructive input and feedback along the road and above we would like to thank all the participants who came to Brussels to share their views with us.

Introduction

The European Distributed Institute of Taxonomy (EDIT) and SYNTHESYS are both networks of leading European natural history institutions. EDIT's main focus is on work done within these institutions in the area of research on the taxonomy¹ of living or extinct organisms. Its general objectives are to overcome the taxonomic impediment² by building a distributed infrastructure for taxonomic research in Europe, which will increase the scientific basis and the capacity for biodiversity conservation. Natural history collections are an essential part of this infrastructure. The objectives of the SYNTHESYS network are setting standards for natural history collection management and databases, and aim to raise scientists' awareness of best practice by offering improved training and workshop opportunities, and to draft guidelines for the care, storage and conservation of collections.

It was in the light of their common work on access and use of natural history collections that EDIT and SYNTHESYS held the workshop "Broadening the user base of natural history collections" on November 4 and 5, 2008, in Brussels. The rationale of the workshop was to develop further insights in the opportunities and barriers for uses of collections. Natural history collections (cf. Winker, 2004) are libraries of natural objects such as plants, animals and fossils. These objects are collected and preserved because they form a rich source to study the natural world. By storing the physical object and not only an image or description of the natural organism, natural history collections aim to maximise the possibilities for new scientific discoveries. Within biodiversity research, taxonomists and evolutionary biologists are the traditional users of natural history collections. But their work is only one part of these collections' value. For environmental research, agriculture, genomics, climate studies, epidemiology, and other societal and management related areas, collections have become indispensable. Crucially, collections have in the past and will continue in the future to answer questions that are unrelated to the reasons for their establishment.

Today, natural history collections are already used in many of the domains mentioned, but they can play a much more important role. Non-conventional uses of natural history collections and specimens have been described in the literature (cf. Winker, 2004; Chapman, 2005). The aim of the workshop was not to replicate what these authors have described, but to discuss uses of collections directly with those concerned: the collection managers, users and other stakeholders to receive their input, to listen to their experiences and to generate their support for implementation measures on how to broaden the user base of collections

The following subjects and questions were on the agenda:

The current uses of collections. Collection users from different areas talked about their work while

¹ 'Taxonomy' to be understood in a very broad sense, cf. Enghoff, H. & Seberg, O. 2006: A taxonomy of taxonomy and taxonomists. – *The Systematist*, Newsletter of the Systematics Association 27: 13-15. – <http://www.systass.org/newsletter/TheSystematist27.pdf>

² <http://www.cbd.int/gti/>

focusing on:

- What they want and how they use collection data
- Which potential and what barriers they encounter when using collections

Managing collections. Collection managers discussed:

- Background of collection organisation and access
- The rationale behind usage protocols, loan and destructive sampling policies

Mechanisms to broaden user base of collections while focussing on:

- Future trends in collection use
- How collections managers and natural history institutions can prepare themselves for future demands

The workshop used a division of presentations and discussion and addressed a range of questions in a certain order. This report however, will not sum-up the events in a chronological way but summarises the headings which follow a rational order. Successively the format and outcomes of the workshop will be discussed while looking into the management and different uses of natural history collections, and finally the recommendations are listed.

First, in the paragraph below, a short introduction of the practical setting of the workshop is given.

1 Format of the workshop

The workshop brought together 37 participants from 10 different European countries. The venue of the workshop was the Royal Belgian Institute of Natural Sciences in Brussels. The workshop programme covered two days of presentations and discussion³. During the first day there were talks from collection managers working in natural history institutions about challenges and future trends in collection management. Successively, there were talks on the uses of collections from speakers from different professional fields (ecological niche modelling for conservation, agriculture, for public health, and for environmental monitoring). The second day of the workshop had a similar structure of presentations and discussion. In the morning there were talks on again the use (population genetics, humanities) and on existing and envisioned mechanisms to broaden the user base of collections. In this context two OECD mechanisms were discussed, the Global Biological Resource Centre Networks (GBRCs) and a XXX intited by the Global Science Forum and the European Plant Science Organisation (EPSO). The afternoon sessions of both days were dedicated to plenary discussions and work in break-out groups. The participants worked in 4 groups, each group had a moderator who would report on the group discussion afterwards. Each break-out groups listed what they thought were the most important barriers to uses of collections that needed to be tackled (from the perspective of users and collection management). Additionally, they made a list of best practices on how to overcome barriers to

³ Agenda and breakout group discussion in Annex 3

the uses of collections. During a plenary setting, participants and organisers drafted recommendations on how to broaden the user base of collections. Different recommendations for EDIT, SYNTHESYS, directors of natural history institutions and for individual staff working in collections – were summarised.

The outcomes of the workshop are in this report. The report wants to be an informative and inspirational document for institutional decision making and for the launch of future activities on the user base of natural history collections. The report will be disseminated among the member institutions of SYNTHESYS and EDIT, within the different hierarchal levels of the two networks and among all the workshop participants. Finally, the organisers will make an effort to bring the report to the attention of their broader stakeholder communities.

The three central themes that were addressed in the workshop are: 1) the current uses of collections; 2) the management of collections; 3) the mechanisms to broaden the user base of collections. These themes will be subsequently discussed in the following paragraphs.

2 Management and uses of natural history collections

Because there is management of collections, collections can be used. Today, users of collections work within regulatory framework set by collections management and their institutions. Some uses of collections are not possible or difficult due to institutional or national rules. The aim of the workshop was to investigate if and how the needs of collection management and user can be bridged. During the workshop different aspects of collection management in relation to users, and new trends in uses were discussed.

All speakers stressed that collections are an important research facility for numerous scientific and professional groups in society and that their current use can be further expanded. This idea emphasise the view that collections are valuable for society as a whole, and not only for taxonomists and evolutionary biologists. At the same time it was addressed that broadening the user base posses challenges on the organisation and priorities of collection management.

Next to new opportunities and barriers in collections management, the talks addressed the perspective of the users of collections. The workshop discussed what parts of the collections they are using, what further possibilities they see and what are barriers to the uses.

On a first glimpse it may look like collection management and broadening the use of collections are at odds. Management is responsible to look after the collections, to prevent damage and loss. Yet, during the talks and the workshop discussion there was a general consensus among collection managers and users that a broader user base of collections is very relevant for science and other domains in society. However at the same time is was emphasised that for collections management broadening the user base would mean that first at an institutional level things have to change.

In the following paragraphs, based on the talks and discussion, the opportunities and barriers for collection management to contribute to a broader use as brought up by the users (current and envisioned) of collections are listed. We will start with the opportunities.

2.1 Opportunities and barriers for collection uses

Several examples on the use of collections were mentioned in the presentations. There were examples on how collection management is and can contribute to a broader use of the collections and there were examples from the users about their experiences when using collections. These uses can be listed under what was described as “non-conventional” use. In short this term refers to the use of collections for different purposes than for which they were collected in the first place (Stoffelen, 2008). Some of the non-conventional uses of collections that were discussed:

2.1.1 *Population genetics*

Natural history collections are a very valuable source for studying populations of natural organisms. Collections are useful when one wants to study long time series in evolutionary change and anthropogenic influences. Collections hold a wealth of data for doing population genetics but molecular studies based on historical samples are challenging. Because collections were not assembled to carry out genetic studies and biased towards morphological varieties. One has to deal with incomplete sample sizes. Furthermore, genotype and sequence data obtained by PCR are often error prone. Consequently, precautions are needed to guarantee reliable genetic data, use isolated laboratories and be strict on the application of appropriate standards (for further reading: Wandeler et al, 2007).

Needs for populations genetics:

- Complete specimen records
- Access to/ permission to use DNA (tissue, bones) for molecular research
- Non-destructive (DNA) conservation of specimens

2.1.2 *Agriculture and public health*

[opportunities] Natural history collections are underexploited in terms of plant protection. They are potential sources of information for pests of agriculture and forestry, but also for vectors of veterinary and human diseases. The potential natural enemies, parasitoids and predators of pests (most parasitoid species have been described by European taxonomists and material is still in our collections). Even so, pests and parasitoids for developing countries. Types of economically important pests are hosted by EC collections. Collections can be used to predict pest distribution, for the reconstruction of invasion history, to predict damage areas of invasion to make develop taxonomic key's for farmers.

Needs for agriculture and public health:

- An international network to exploit them on a world wide scale (global market, international exchanges)
- Better define the main objectives (accessibility on type information's, iconography, quarantine species etc.)
- Understanding of the huge costs induced by pests and consequently high value and

profit to do it

- Acknowledge phytoprotection is similar to conservation an important task and that results may have huge consequences on conservation of habitats
- Have reliable records
- Accurate determinations: need for specimens interchange and loans
- Accurate records (coordinates, never provinces or ecological regions)
- Cluster plants and their pests in collections

2.1.3 *Environmental monitoring*

[Opportunities] Natural history collections are used for monitoring changes in our natural environment, by analysing levels of contamination in a particular territory. They serve as an archive of anthropogenic impact on nature. One can use conventional collections for environmental monitoring but for a systematic monitoring programme an environmental specimen bank is better infrastructure. The Swedish Museum of Natural History (SMNH) facilitates the Swedish Environmental Specimen Bank (SESB) on behalf of the national government. The SESB studies among others: metabolites of organic pollutants (seals, guillemot, human milk); enantiomer fractions of organochlorine compounds in herring and seal; bone mineral density in seal and otter (bone material from SESB and the collections of SMNH); oxidative stress in Baltic salmon as a possible cause of fry mortality. The majority of the users of the SESB come from regional and national public administration.

Broadening the use of natural history collections by users in environmental monitoring will need among others:

- Specialised environmental specimens collections
- Expertise in preparing and sending samples
- Flexible storage space, lots of freezers
- Collection is limited by endangered specimen act. Sometimes depends road kill or when found death
- Users willing to pay for preparing and sending specimens
- Have institutional mechanism at place to charge users for sending and preparing specimens.

2.1.4 *Biodiversity distribution models*

[opportunity] Models (graphs and geographical maps) of geographical species distribution are excellent tools for planning and conservation activities. Specimen collections can be used to add to these models a species distribution over time. [barriers] One difficulty for using specimen collections is that only the recent collected items have georeferences. When using material collected in the past one need to use alternative information material to retrace approximate georeference coordinates by studying old maps, diaries and field note books. Mapping of specimens serves also a verification of tool to filter out important labelling errors. Yet, this is a very time consuming activity.

It was said that broadening the use of natural history collections for biodiversity

distributions needs among others:

- Databased specimens
- Georeferenced – accuracy assigned
- ‘Clean’ dataset i.e. error checked
- Digital availability of old maps (high resolution)
- Digital availability of travel diaries, field notes etc.

2.1.5 Arts & Humanities and social sciences

[opportunities] Natural history collections have a lot to offer to historical sciences, museums studies, social sciences and arts and design. Collections are much more than specimen collections. They hold travel diaries, field notebooks, antique maps that tell stories of exploratory expeditions, and on economic, social and family history. Secondly, collections have a long tradition in making exhibitions which are interesting for museum studies. In fact museums have always collaborated with artists and taxidermists when mounting exhibitions. ‘Thirdly, collections hold (scientific) drawings of plants and animals from dead and living naturalists who are potential material for art/science exhibitions. Also the specimens themselves are a great source of inspiration for artists and designers. Finally, natural history collections are beautiful laboratories for social sciences to study organisational work process, procedures, ethos, motivations and curatorial culture. Also the Museo Nacional de Ciencias Naturales (MNCN) frames on of the uses of its collections for arts. Regularly photographers are using the collections for photo shoots. Art historians and collections mount regularly exhibitions with drawings and paintings by natural historians which they made as part of their scientific work.

The Natural History Museum in London (NHML) has experience in working in close collaboration with art and humanities users of collections and acknowledges the potential of their collections for these user groups. [barriers] At the same time they see several barriers for collaboration. For example they encountered that natural history museums have a very low scientific profile within academia. Natural history institutions are said to be in not dynamic, conservative and inflexible. Collections tend to be difficult to contact, there is no clear contact point, and they have a closed image. Furthermore, the NHML were told that intellectual property right issues and other institutional and cultural barriers prevent artists, historians and social sciences to work more intensively with natural history collections and vice versa. The NHML tries to address these barriers in its New Perspectives programme. Broadening the collaboration with arts and humanities needs among others:

- Clear institutional access point for collection enquiries
- To be convinced about the interests of the collaboration
- Trained staff to work with these users
- Communication, education that natural history collections have a lot of aesthetics to offer, inspirational for artists but that the important part of the beauty of the collections is that the material is beautiful for the eye *and* format, colours, structure, materials) are scientific accurate.

- Infrastructure at place to charge for commercial use of collections (e.g. photo shoots)
- Solutions for specimen insurance issues (learn from art museums)
- More experts in taxidermy (in Spain family secret)

2.1.6 *Other uses*

[opportunities] Besides the uses mentioned above other uses were discussed during the workshop. One was the use of the DNA collection (MNCN) for archaeology and wildlife forensic bodies like CITES. The collections of RMCA by African users [plant and flies are linked] of government bodies and NGO's. The RMCA wood collections serve antique collectors and help identify wood samples from illegal logging. Furthermore, the discipline of biomimics was mentioned to attract a new user group to natural history collections. Biomimics studies the models of nature, systems, processes and elements and then takes creative inspiration from them to solve human problems in a sustainable way for example in the field of engineering and public health (e.g. studying a leaf to invent a better solar cell). It was said to be to stress that collections for science and collections for exhibitions are completely different type of collections as specimens are differently prepared and stored.

[Barriers] One of the speakers stressed that one reasons for the invisibility of natural history collections has to do with the fact that they do not automatically appear in the list of references of publications. A general problem is that collections do not know what they do not have. The difference in quality of online collection databases is a problem for users to compile information that have different quality and IT standards but use as if they were the same.

Broadening the use of natural history collections will need among others:

- Users need to know what is where and what are the access and loan restrictions.
- Agreement on mandatory reference of the name of natural history institutions in publication reference lists
- Develop institutional mechanisms to deal with destructive sampling. E.g. bring person in contact with the one who did the original extraction, to save the specimen from further destruction.
- Have funding mechanism at place to support uses from countries of origin.
- Continuation on the development on common collection standards,
- Flexible space for expansion of collections.
- Mechanism to deal appropriately with users requests like a FAQs or/and one institutional contact point, European contact point at place.

2.2 **Mechanisms to broaden the user base of collections**

A significant part of the workshop discussion addressed mechanisms to broaden the user base of collections. Several examples were presented on running initiatives to improve access and use of collections. They are all networks with idea that working together will increase the visibility, access and quality of services for users. In the break-out and plenary discussion mechanisms were suggested that could be implemented at different levels of natural history

collections.

Below follows first the running initiatives all based on integration, collaboration and common standards.

2.2.1 OECD networks for collections

Within the frame work of the Organisation of Economic Co-operation and Development (OECD) two initiatives have been launched who address broadening the user base of collections from the principle of global networking. The Global Biological Resource Centres aim to build a network of living collections. It was suggested that natural history collections may want to learn from the experiences that living collections have with providing services to a broad user community. Traditionally living collections have always been both service providers and repositories of the living cells, genomes of organism, and information relating to heredity and the functions of biological systems. Biological Resource Centres (BRCs) contain collections of culturable organisms (e.g. micro-organisms, plant, animal and human cells) replicable parts of these (e.g. genomes, plasmids, viruses, cDNAs), viable but not yet culturable organisms, cells and tissues, as well as databases containing molecular, physiological and structural information relevant to these collections and related bioinformatics. Collaboration and common standards between natural history collections and Biological Resource Centres can increase the use of biological collections in general.

Current barriers of use of BRC's are:

- Lack of digital documentation
- Lack of sustainability of financial support
- Equipment needs (analytical, sterile flow cabinets)
- Collections very often depend on individual specialists
- limited governmental support
- Inability to implement new technologies for material conservation and quality control
- Training needs
- Access to informatics tools, on-line access to the scientific data
- Lack of coordination at international level
- Lack of long-term preservation technology

The second network launched within the OECD is the International federation/consortium of scientific collections. This is an initiative of the OECD Global Science Forum and aims to:

- Identify science-driven opportunities, unique, forward- looking interdisciplinary research that relies on collections
- Explore knowledge that could emerge from integrating collections and metadata across disciplines, collections, countries
- Build a global research infrastructure capable of providing tangible benefits to society in the form of new and accessible knowledge
- Provide advice and guidance to stakeholders on the development of distributed collections as an integrated global research infrastructure

- Promote excellence in research on research collections and collection management
- Add emphasis on human aspects, training
- Ensure optimal use of orphaned collections
- Promote collaboration with global initiatives that are producing new collections and observational data (e.g., ILTER, ATBIs).

2.2.2 *EPSO, EDIT & SYNTHESYS*

The European Plant Science Organisation (EPSO) represents 185 research institutes, departments and universities from 27 countries in Europe and beyond. EPSO's mission is to improve the impact and visibility of plant science in Europe. EPSO's top priorities are to facilitate the understanding of plant science, to boost funding for basic research and to coordinate research activities at the national and European levels – and beyond. At the moment EPSO represents only few natural history collections but a wide diversity of (potential) users of collections in the fields of agriculture, landscape ecology, food research, biotechnology, environmental studies, just to name some. EPSO can offer a platform for natural history institutions to meet and collaborate with users of collections when they would join the EPSO network.

EDIT and SYNTHESYS, the organisers of this workshop, are two European networks representing natural history collections. Within this framework they have an agenda setting function on the improvement of access of collection services for users of collections and at the same time to promote the work of natural history institutions to the broader user community. During the workshop EDIT and SYNTHESYS received several recommendations on what their networks can do (more explicit) next to what they are already doing for example:

- Provide funding to visit collections for other than pure scientific uses (IT, other)
- Promote and facilitate high resolution 3D digitisation of collections
- Collaborate with living tissue banks
- Train staff to deal with specific user requests
- Use the demands of wider user community to prioritise collection identification

More general issues that were mentioned:

- Should collection direction and development be led by current user demand (see also remark above)?
- Should current trends in technology be use to predict future needs, and how?
- Funders have a great say but working together sharing the risk and engaging users and sharing the task of exploring the possibilities must be part of the plan

2.3 Summary discussion

The presentations and the discussion input that are discussed above have delivered new insights on trends in uses, and on current use and accessibility of natural history collections. Moreover, views were developed on the needs of users and on the context of collection

management. Additionally, several valuable recommendations were given on how collections can improve their services. The recommendations stress that internal institutional measures can help improve access and quality of collection services, as well that external mechanisms (e.g. the use of global networking) will facilitate regular user-provider interactions and the exchange of ideas. An important remark was that until today, most collection services are primarily supply driven. It was said this stems from institutional tradition but above all from the fact that a lot of institutions do not have the resources or the institutional/national flexibility to further adjust their services towards the demand of users.

The remark on institutional tradition relates to the observation that collections managers are asked to deal and look after collections for the sake of collections. Their training - and in most institutions - their job grading does not take into account that and how they handle user requests. Sometimes this results in a tension of interests between collection management and collection users. During the meeting the participants provided us with input on the current users services provided (and trends), on user needs, on the needs of collections management to deliver demand, and on the proposed mechanisms, an overview from the workshop discussion.

Below follows a summary diagram of the observations and recommendations made during the workshop.

Uses of natural history collections:

- Environmental specimen banking for environmental monitoring
- DNA samples for: archaeology, wildlife forensics, customs, other
- Long term studies in population genetics
- Environmental impact assessments e.g. for landscape planning
- Natural history art exhibitions, books
- Long term biodiversity modelling
- In agriculture the identification of biological control agents for weeds and diseases
- Public health, specimens as reference collections for disease factors in human and animal health
- Identification of wood used in e.g. furniture - antique, also illegal logging
- Inspiration for engineering products (biomimicry)
- Set and material for photo shoots
- Laboratories for social sciences and museum studies
- Educating the general public on natural history and evolution
- Characterize and enable identification and naming of pests, especially those belonging to species complexes (food, agriculture, human and veterinary health, policy makers).
- Predict changes in their distribution under global change, warming or land use (food, agriculture, human and veterinary health, environmental studies, policy makers)
- Predict the potential damages caused by new invading pests and vectors of plant diseases (food, agriculture, human and veterinary health, policy makers)
- Increase the global knowledge on quarantine organisms (custom services, food,

agriculture, human and veterinary health, policy makers)

Needs of users:

- Reliable databased records
- Georeferenced records
- Appropriate, flexible institutional conditions to responds to user demands (all users)
- Web-accessible electronic keys for determination by non taxonomists (all users)
- Access to specimen collections, also to rare specimens (all, photographers)
- Access to ‘paper’ achieves, like books, maps, drawings personal correspondents (arts, humanities, ethnologists, historians).
- Electronic access to digital imagery of specimen collections and paper achieves, 3D scans (a.o. environmental modelling, other)
- Clear contact-point for user enquiries on website
- Understanding of the costs induced by pests and consequently high value and profit to do it
- Acknowledge phytoprotection is similar to conservation an important task and that results may have huge consequences on conservation of habitats
- Accurate records (coordinates, never provinces or ecological regions)
- Cluster plants and their pests in collections
- A funding mechanism for users from outside the taxonomic community to visit collections

Management needs to respond to user demand

- Institutional support to make a broad user base a priority
- Non-conventional users additional to conventional users, not instead
- Infrastructure to charge users for certain services, under certain conditions
- Additional staff to look after user requests
- Training for staff to be able to better respond to request
- Infrastructural support in communication services and physical, have work desks and equipment on hand for different type of visitors
- Mechanisms to avoid destructive sampling
- More taxidermy expertise available
- Flexible storage space, enough freezers
- Platform to regularly consult users on their needs
- Solve legal issues regarding copy rights, specimen loans to “non-members”, liability insurance for visitors ect that hamper use and access

Barriers to broaden the use:

- Little incentive (job grading) for collection managers and research staff to work with non-conventional users
- Lack of staff to reply to all user requests
- Lack of coordination at international level e.g. collection standards
- Lack of long term preservation of (database) technology

- Scattered collections in several countries no person of contact, hard to find what is where
- The specimens themselves, e.g. doing DNA extractions from classical collections control the amount of material we use in the process or we will not have anymore specimens available.
- Vertebrate's collections which rarely grow in specimens anymore, it is mandatory to be able to renew the specimens lost during research activities (use) and this is no easy or possible at all.
- No overview of current state of collection use. Difficult to keep track of use of collections e.g. in publications, no systematic coordinated way of referencing to the loan institutions.

Proposed mechanisms to broaden user base:

- Develop mechanisms to keep track of use of collections
- Train staff to deal with user requests
- Create funding mechanism to support users from countries of origin
- Have clear communication strategy towards users on website of institutions and proactively in newsletters, meetings.
- Global networks of collections e.g. GBRC's and the International federation/consortium of scientific collections from the Global Science Forum will make it easier for users to communicate with natural history collections by creating
- Collections are invited to participate in user networks like EPSO

Non-conventional uses of natural history collections and specimens have been described in the literature (cf. Winker, 2004; Chapman, 2005). The aim of the workshop was to discuss these directly with those concerned: the collection managers, users and other stakeholders to receive input and create support for implementation measures on how to broaden the user base of collections. Specific recommendations were given to the organising networks EDIT and SYNTHESYS and their members on how they could contribute to this implementation process.

Recommendations

The workshop Broadening the user base of natural history institutions aimed to investigate: trends and current uses of natural history collections with emphasis on non-conventional uses; to investigate the needs for these users; the needs of collection management to respond to user requests; and to propose mechanisms for broadening the user base of collections. These outcomes are listed above in the Summary discussion. The final discussion point during the meeting was that - now we know all this, to clarify who will pull the proposed mechanisms and to put the uses and needs of users and collection managers on the agenda? and on which agenda should it be? The participants of the workshop have suggested the following to the directors of collections/institutions, individual staff, EDIT and SYNTHESYS(2):

To EDIT BoD:

- Create and advertise a contact point within your institutions that deals with enquiries and communication to the broader user community looking for collection information or access to collections. In parallel, support a European or EDIT contact point that has an overview of collections services, access regulations and the institutional contacts in Europe.
- Develop mechanisms to offer facilities and charge fees for the accommodation of commercial collections
- Build partnerships with the user community at institutional and EDIT level by encouraging scientific staff to participate in user meetings and conferences.
- Assign your PR/communication department to target the broader user community. Preferably this should be based on a joint-communication strategy develop/stirred by an umbrella body like e.i. CETAF.
- Create optimal conditions for staff to interact with users and user demands (e.g more flexibility to employ temporary staff to match needs, include dealing with users in job grading)
- Base institutional priorities on a cost-benefits analysis before heading off (impact versus effort)⁴

To SYNTHESYS/SYNTHESYS II:

- Develop criteria for accessions and distribution of collections
- Develop competencies/performance indicators for hosting users

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⁴ See Annex 2 for example of matrix

Annex 1 : List of Acronyms

BRC	Biological Resource Centre
CITES	Convention on International Trade in Endangered Species
EDIT	European Distributed Institute of Taxonomy
EPSO	European Plant Science Organisation
GBRCN	Global Biological Resource Centre Network
MNCN	Museo Nacional de Ciencias Naturales
NHML	Natural History Museum in London
OECD	Organisation of Economic Co-operation and Development
RMCA	Royal Museum for Central Africa
SYNTHESYS	Synthesis of systematic resources

Annex 2: Cost-benefit analysis

Broadening the user base of natural history collections. A cost-benefit analysis for collections. Matrix proposed by K. Metzloff (EPSO)			
Users	Impact for you	Effort from you	priority
Arts			
Agriculture			
Humanities			
etc			

Insert impact for you if you get users from these fields

What will this take from you?
Money? Staff?

Which is priority based on impact vs effort see who you should promote your collections

Annex 3 : Workshop agenda and abstracts

Broadening the user base of natural history collections

A SYNTHESYS-EDIT workshop at the Royal Belgian Institute of Natural Sciences

November 4-5, 2008

DAY 1	No.	Tuesday 4th November	
Time		Item	Speaker
9.00		Arrival - Tea & coffee available	
10.00	1	Welcome to RBINS	P.Grootaert
10.10	2	Introduction to meeting content and structure , Expected outcomes	S.Owens
10.25	3	Introduction to European Collections	S.Owens & L. Kriegsman
		Session 1: COLLECTIONS – MANAGEMENT	
10.50	4	Users of new natural history collections: Tissues and DNA collections of MNCN	I. Rey
11.05	5	Zoology Collections at MNCN	J.Barreiro
11.20		<i>TEA AND COFFEE BREAK</i>	
11.40	6	Collections management at RMCA	P.Mergen & G.Cael
		Session 2: COLLECTIONS – USERS AND USAGE	
11.55	7	Demands of African Users of collections	P.Mergen & G.Cael
12.10	8	Uses of preserved botanical collections	P.Stoffelen & A.Bogaerts
12.25	9	Specimen occurrence data for conservation	N.Brummitt
12.40		Group photo	All
12.50		<i>LUNCH</i>	
14.00	10	Collections, Bias & Species Distribution Models	N.Raes
14.15	11	The Swedish Environmental Specimen Bank and the use of collections as an archive of anthropogenic impact on nature.	Y. Lind
14.30	12	Collections for agriculture	YV. Rasplus
15.00	13	Mapping the distribution of vectors: the need for accurate records of disease transmitting arthropods.	A. Estrada-Pena
15.15		<i>TEA AND COFFEE BREAK</i>	
15.35	14	Breakout Groups - Discussions on barriers of use	
17.00	15	Group feedback	All
17.30		DAY ENDS	
19.00		DINNER FOR PARTICIPANTS - LOCATION In 't Spinnepopke, 1 Place Jardin Aux Fleurs	

DAY 2		Wednesday 5th November		
Time		Item		Speaker
9.00		Arrival - Tea & coffee available		
9.30	17	Outcomes from day 1		R.Huxley
		Session 3: Broadening user base and mechanisms for further		
10.00	18	Interesting examples		S.Owens
10.15	19	New Perspectives: exploring the arts and humanities potential of the		J.Harvey
10.30	20	Potential new collaborations with / among EPSO members for future		K.Metzalff
10.45	21	Digitisation of Natural History Collections...Search for a Strategy		P.Seltmann
11.00		<i>TEA AND COFFEE BREAK</i>		
11.20	22	Prospects and limits of NHC specimens in population genetics		P.Wandeler
11.35	23	Introduction to the "International federation/consortium of scientific		P.Grootaert
11.50	24	Global Biological Resource Centres		D.Smith
12.05	25	Break-out on mechanisms recommendations for EDIT and		
13.15		<i>LUNCH</i>		
14.45	27	Group feedback		
15.15	28	Outcomes from day 2 and next steps		S.Owens
16.30		MEETING CLOSES		
		<i>Tea & coffee available</i>		

Abstracts

Item 4: Users of new natural history collections: Tissues and DNA collections of MNCN - I. Rey

The tissue and DNA collection of the MNCN began its activity in 2002. Today it includes 26.213 specimens in its catalogue with over 50.000 samples already classified and available to the scientific community. Approximately 250.000 samples more are also deposited and are currently in the process of being classified. The popularity of this collection is growing and the number of users requiring tissues or extracted DNA is steadily increasing. Until the present 1.180 samples have been sent to 110 different researches, some of them with the required permits as they belong to species

included in annex I of CITES. The catalogue number of the samples in our collection is a voucher number, which appears in Genbank where currently 211 sequences belonging to our frozen samples, can be localized.

Item 6&7: Collections management at RMCA and collaboration with African Users

Michel Louette, Hein Vanbee, Garin Cael and Patricia Mergen

The Royal Museum for Central Africa (RMCA) is a multidisciplinary institution with a special focus on Sub-Saharan Africa. The Museum is a world centre in research and knowledge dissemination on past and present societies and natural environments of Africa, and in particular Central Africa, to foster a better understanding and interest in this area and, through partnerships, to substantially contribute to its sustainable development with target audience being both the public at large and the scientific community. The three sections 'Vertebrates', 'Entomology' and 'Invertebrates non-insects' in the Department of African Zoology and parts of the Sections 'Agricultural Economy' (for wood biology) manage collections of about 10million specimens of animals and 56,000 wood specimens of 13,600 different botanical species. The researchers carry out studies on animals and woody plants within their natural environment in Africa. Their aim is to gain more insight into biodiversity and to stimulate interest among the general public and the scientific community.

The geology and Mineralogy department hosts more than 350,000 rocks, minerals and fossils, plus an unique collection of 20,000 maps and 300,000 aerial Photographs. Its objectives are to act as an information and research centre for the study of geological processes in Africa and their influence on society, to distribute information about the physical environment and natural resources of Central Africa. They are realised in partnership with African researchers and institutions.

The aim of the Cultural Anthropology Department is to conduct a diachronic and synchronic study of African societies and the inherent meaning of their cultural products. The Department carries out its task through scientific research, including fieldwork, through the study and provision of documentation and by managing and developing its collections. In this way, the Department seeks to promote better understanding of Africa's sociocultural diversity, more specifically that of Central Africa, not only in the scientific community but also among the general public, through ongoing cooperation with African researchers. The department is composed of the following sections: Ethnography, Prehistory and Archaeology, Ethnosociology and Ethnohistory, including the Human Sciences Documentation Centre, Linguistics and Ethnomusicology and Collection Management including for example about 180,000 Ethnographic objects, 410,000 photographic archives, 6,000 hours of traditional music recordings and over 1km of archives including the famous Stanley Archives. The talk will briefly introduce the museum and the various collaboration programs with African partners focusing on collections and be followed by an overview of the collection management activities at RMCA.

Item 8: Herbarium uses of preserved botanical collections

Piet Stoffelen, Elmar Robbrecht and Ann Bogaerts

Initially preserved botanical collections were mainly intended to be used for the study and illustration of taxonomy, nomenclature, morphology and distribution of plant species.

Throughout the years collections grew steadily and herbaria became vast warehouses of raw data on plant diversity. The recent progress in sciences, analytical techniques and information technology increased the diversity of users and uses significantly. With the growing diversification of uses, exchange of information between users and collection managers, became more and more a problem. Today's practice fails in keeping track off and documenting these uses.

The presentation briefly summarizes the current uses of botanical collections based on experiences of collection managers and literature study. We also question how we can improve the exchange of information of the collections between collection managers and users.

Item 9: Specimen occurrence data for conservation*Neil Brummitt*

The talk will focus on species conservation assessments and the application of specimen data to the IUCN Categories and Criteria. This relies on having a database of georeferenced specimens and has associated issues (accuracy, precision, handling error etc.). We have automated GIS algorithms, but these automated preliminary assessments are not sufficient for a full IUCN assessment, so I will also talk about supplementing measures of EOO and AOO to satisfy the IUCN subcriteria, which we also do with GIS. We routinely use ecological niche modelling, including predicted range size under future climate scenarios, in carrying out full assessments; but there is a trade-off here - we want to know most information about species which have small ranges and few specimens, since these are more likely to be threatened, but there is often insufficient data to use some of the more recent techniques reliably. I will present some preliminary results from our project, looking at global patterns of plant diversity and conservation need.

Item 10: Collections, Bias & Species Distribution Models*Niels Raes*

Digitized natural history museum- and herbarium collections serve a wide range of applications, often related to geographic distributions of species. In order to use the collections for spatial analyses they need to be georeferenced. Although the coordinates of many collection localities are available in gazetteers, especially many localities from remote (tropical) regions are still not georeferenced. Fortunately, many institutions also harbour a large collection of maps that were made during the collection expeditions of which they store the specimens. To make the collections from these remote areas available for spatial analyses we introduced a technique known as georegistration, a process that allows the geographic positioning of digitized expedition maps (with their collection localities). This is achieved by matching the maps in a geographic information system (GIS) with SRTM digital elevation data and high-resolution satellite images. Once georegistered, the coordinates of the collection localities can easily be extracted. This process allowed us to reduce geographical collection bias of our study area to a minimum.

Few regions have been uniformly sampled, however, leaving large regions under-sampled or not sampled at all. To be able to predict the potential presence and absence of species even for these areas has resulted in the development of species distribution modelling techniques (i.e. GARP, Maxent, BioClim). I will briefly demonstrate the methodology of species distribution modelling and illustrate some of its applications with our work on the botanical diversity and phytogeography of Borneo.

Item 11: The Swedish Environmental Specimen Bank and the use of collections as an archive of anthropogenic impact on nature.*Ylva Lind*

The purpose of the Swedish Environmental Specimen Bank (SESB) has been to provide material for monitoring, screening and research. Today, the main use of the collections that is located at the Swedish Museum of Natural History (SMNH) is environmental monitoring of contaminants. An important user is the Environmental Monitoring Programme, initiated in 1980 by the Swedish Environmental Protection Agency (SEPA). This year is also the official start of SESB although a yearly collection of certain species (pike, starling) started already in the 1960s. The Department of Contaminant Research at SMNH is responsible for collecting, keeping and, together with SEPA to administer the SESB. The monitoring and screening studies financed by SEPA are performed by the department of Contaminant Research at SMNH together with different laboratories.

Another important user of SESB are researchers and SESB samples have been used in several retrospective studies both on earlier known chemicals and on chemicals that have been discovered to occur in biota since the start of SESB. Examples are studies on polybrominated flame retardants

and fluorinated substances where SESB provided samples that made it possible to study the levels in biota from the late 1960s up until the present time. SESB samples have also been used in studies on effects of contaminants. A delicate issue to consider concerning the use of SESB collections is that the material is mostly destroyed by usage. Some matrices such as guillemot egg that has been collected since the 1960s are very popular in retrospective studies on new substances because they are so well examined and this can be a problem as the material is limited. Other uses of SESB material besides for chemical analyses of contaminants are studies on bone material involving the measurement of bone density as a parameter in studying the effect of environmental contaminants. Material from SESB has also been used in DNA studies. As new methods develop such as analyses of stable isotopes there are new possibilities to use material from SESB and this ought to broaden the user base of the collections.

Item 13: Mapping the distribution of vectors: the need for accurate records of disease transmitting arthropods.

Agustín Estrada-Peña

Current concerns about the spread of some prominent arthropod-borne requirements, as to be useful in mapping potential areas of disease. Diseases are supported by the use of distribution models projecting the expected range of the vectors. These models commonly use the known (or realized) distribution of the vector, projecting its range by using climate and/or landscape-derived attributes. Leaving aside other limitations of these models, their robustness lies on a set of accurate and reliable records of the organism to be mapped. However, distributional records of parasites may have strong inaccuracies, like different collection pressures, local interest on a given species, or seasonal dynamics. Lack of adequate georeferencing and reference to large administrative divisions is also a serious limiting factor in the use of these datasets. The presentation provides some examples about the need to have adequate sets of data and their main requirements, as to be useful in mapping potential areas of disease.

Item 19: New Perspectives: exploring the arts and humanities potential of the Natural History Museum collections

Julie Harvey

Funded by the Arts and Humanities Research Council, the Natural History Museum has recently completed a project scoping the potential of using the specimen, library and archive collections as a resource for arts and humanities academic research.

The project called *New Perspectives* included input from 70 academics representing 20 UK universities. The presentation reviews the findings of the project and how the Museum intends to build on this initiative.

Item 20: Potential new collaborations with / among EPSO members for future research

Karin Metzloff

EPSO aims to advance plant science in Europe. In this context EPSO aims to encourage closer collaboration between the different plant science experts, such as for example ecologists, conservation biologists, cryologists and molecular biologists that are relevant to the discussion at this workshop. EPSO started a first survey among its members asking which developmental and molecular biologists etc. would be interested in natural history collections such as herbaria

A first summary of the responses will be presented together with an offer to hold a small brainstorm meeting of potential new users and representatives from the EDIT and SYNTHESIS consortia early 2009. EPSO has a solely academic membership of 185 research institutes, universities and research departments from 27 countries in Europe and beyond, representing over 24 000 plant researchers and staff. In addition, EPSO has 1 200 personal members.

The mission of EPSO is to promote plant science and plant scientists, to represent plant scientists

in discussions about future plant science programme priorities across Europe, to provide an authoritative source of independent information on plant science, and to promote training of plant scientists to meet 21st century challenges in breeding, agriculture, horticulture, forestry, plant ecology and sectors related to plant science. To achieve its mission, EPSO advises policy and decision makers at national and European level on science policy, in the Initiative for Science in Europe and the European Technology Platform ‘Plants for the Future’. EPSO supports plant scientists via the EPSO conferences including support grants for junior and eastern scientists, workshops, tutorships and as information broker via EPSO News and its website.

Item 21: Digitisation of Natural History Collections...Search for a Strategy

Peggy Seltmann

Natural history collections worldwide house an estimated 3.0 billion conserved specimens. This represents an immense knowledge base on global biodiversity. Currently, this knowledge base is largely under-utilised. To fully realise their potential, specimen information must be made accessible in an international network.

Currently, less than 60 million specimen-based records are accessible through the Global Biodiversity Information Facility (GBIF), but this is only a tiny fraction of the total wealth of information that could be put to use. Therefore, the goal is to develop a Global Strategy and Action Plan for the Digitisation of Natural History Collections (GSAP-NHC) that helps to prioritise digitization activities, and that helps to raise resources essential for industrializing the process of natural history data digitization and free and open data mobilisation.

Item 22: Prospects and limits of NHC specimens in population genetics

Peter Wandeler

Museums and other natural history collections house millions of specimens. With the advent of molecular genetic approaches these collections have become the source of many fascinating studies particularly when historical with present-day genetic diversity has been contrasted. However, because DNA extracted from NHC samples is degraded, analyses of such samples are technically demanding and many potential pitfalls exist. Here, I will present some of the central scientific question that can be addressed by using specimens from NHC in population genetics along a set of guidelines that outline the steps necessary to begin such investigations.

Item 23: Introduction to the “International federation/consortium of scientific collections”

Patrick Grootaert

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. 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. A meeting of the GSF in October 2008 held in Rome endorsed the reports of the both meetings, with the task to produce a detailed implementation plan for a future international coordinating mechanism for research collections.

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 fulfill 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

Item 24: The Global Biological Resource centre Network and the World Federation for Culture Collections

David Smith

Biologists require high quality living resources preserved well for continuity of processes as in most instances collecting materials as they are needed is generally labour intensive and often it is difficult to re-isolate a strain with identical properties. Culture collections or Biological Resource Collections (BRC) have a role to play using state-of-the-art preservation techniques to maintain such resources. The World Federation for Culture Collections, World Data Centre for Microorganisms lists 536 collections with over 1.8 million strains almost half of which are fungi (<http://www.wfcc.info>). It is essential that research is based on well preserved, representative materials and carried out in compliance with the Convention on Biological Diversity.

The OECD BRC initiative to establish the virtual infrastructure of the **Global Biological Resource Centre Network** (GBRCN) encourages collections to meet the high quality operational standards required. The Task Force established by the OECD member countries which included 10 observer countries reported in 2000 (<http://oecdpublications.gfi-nb.com/cgi-bin/oecdbookshop.storefront>). The report argued the need for biological resource centres, strengthened and modified to meet the requirements of the 21st century, and recommended the creation of the GBRCN. The subsequent years concentrated on developing operational guidance that would deliver high quality materials and associated data in a legal and operational framework that met national rules, regulations, legislation and conventions. In 2007 the results of this seven year activity were published, OECD Best Practice Guidelines for Biological Resource Centres (Online), <http://www.oecd.org/dataoecd/6/27/38778261.pdf>. It is intended that BRCs adopt these practices to ensure that users get legitimate and safe access to high quality biological materials and associated information.

Increasingly molecular techniques are being used to characterise strains to assure organism authenticity. Unfortunately some databases contain erroneous data that can undermine research. A recent study (Bridge et al., 2004) revealed that of 206 named sequences of the ribosomal RNA gene cluster in fungi up to 20% were considered unreliable. PCR fingerprinting techniques have been used to demonstrate that poor freeze-drying and cryopreservation technique can induce polymorphisms in preserved fungi (Ryan et al. 2001). Users are faced with the problems of different access controls, uncertainty of product quality and gaps in coverage, where can they get exactly what they need? The German Government sponsored GBRCN demonstration project will show how synergies between collections will underpin the developing bioeconomy and better meet customer needs. A concerted effort is needed to support the development and long-term sustainability of culture collections so that they may support global research and development.

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